STUDIA DEMOGRAFICZNE

2(174) 2018

Krzysztof Tymicki
Institute of Statistics and Demography
SGH Warsaw School of Economics
ktymic@sgh.waw.pl

Krystof Zeman
Vienna Institute of Demography,
Österreichische Akademie der Wissenschaften

Dorota Holzer-Żelażewska
Institute of Statistics and Demography
SGH Warsaw School of Economics

Cohort fertility of Polish women, 1945–2015: the context of postponement and recuperation

Introduction

This article is a follow-up to the analysis published by Holzer-Żelażewska & Holzer in 1997 and Holzer-Żelażewska & Tymicki in 2009, which focused on changes in fertility of women who were born in 1930–1990 and who gave births in the years 1945–2008. Individual data from the birth registration obtained from Statistics Poland (SP) in Warsaw made it possible to expand the scope of the analysis by including women who gave birth in the years 2009–2015. Moreover, there are major changes to the paper by Holzer-Żelażewska & Tymicki (2009): the period perspective has been cancelled, instead, the analysis of postponement and recuperation has been added. The analysis of postponement (i.e. a decline in fertility at younger ages) and recuperation (i.e. a compensatory increase in fertility at higher ages) was prepared using the methodology originally proposed by Frejka (2011) and Lesthaeghe (2001) and further developed by Sobotka and colleagues (Sobotka et al., 2011).

This paper, therefore, not only updates and extends the previous analyses but also contributes extensively to the existing research on cohort fertility both on the national and international levels. In the Polish literature of the topic one may find substantial contributions on the examination of cohort fertility by Frątczak et al. (2011a, 2011b), Bolesławski (1974, 1993) and Paradysz (1992). On the international level, the recent paper by Frejka & Gietel-Basten (2016) might be considered as an excellent example of a comprehensive cohort analysis with an in-depth reference to public policy issues.

The main advantage of the presented cohort analyses is the application of unified entry data (from registration of births) and use of the methodology which allows us to analyse occurring changes on comparable rates. This is an important contribution since the calculation of cohort fertility rates for the whole period after the Second World War was not easy, due to the fact that not all of the detailed data was available and also because the live birth definition changed over time. Firstly, the data used and the methods applied are described. In the next sections outcomes of the cohort fertility analysis are provided. Finally, the paper presents some remarks on data quality issues, mostly related to the possible impact of migration on the underestimation of both cohort and period fertility rates in Poland, followed by a discussion of changes in the cohort fertility trends before and after 1989 in the context of the tempo, quantum and recuperation effects.

Data and methods

In the analysis of the cohort fertility two sets of data have been used. The first dataset is the same as used by Holzer-Żelażewska & Holzer (1997). The second database is created by an essential expansion of the database used by Holzer-Żelażewska & Tymicki (2009), including births registered in the years 2009–2015.

As reported by Holzer-Żelażewska & Tymicki (2009), the authors of the original contribution from 1997 adopted certain assumptions and estimates in order to calculate rates comparable across time using the first dataset obtained from SP at that time. The adopted approach, dealing with the changes in the live birth definition over time, division of births into first and second category according to the Lexis diagram and estimation of women by single year age groups for some years was presented by Holzer-Żelażewska & Holzer (1997).

The birth registration data obtained from SP for the purpose of this follow-up analysis, constitutes the second dataset and covers the period between 1985 and 2015. The way to organise and analyse this data is identical to the approach applied in the previous publication (Holzer-Żelażewska & Tymicki, 2009). The recent individual data file obtained from SP in Warsaw includes births registered up to 2015, therefore, it was possible to calculate the completed fertility up to the age of 49 for women born in 1965 and up to the age of 45 for women born in 1969. For younger cohorts, taking into account five-year intervals, it was possible to calculate the completed fertility by the age of 25 for the cohort born in 1989.

Additionally, the paper focuses on the analysis of cohort fertility in the context of postponement and recuperation. As noted above, we use the methodological approach proposed by Sobotka and colleagues (Sobotka et al., 2011) that is essentially an elaboration of the analytical approaches proposed by Frejka et al. (2001, 2004, 2011) and Lesthaeghe (2001). This approach accounts for the process of fertility ageing characterised by postponement (a fertility decline at younger ages) and recuperation (an increase in fertility at older ages). This process has been predominantly responsible for the observed fertility decline in most developed countries along with shifts in age-specific fertility schedules resulting in increasing the age at first birth. Unlike the period approach in demography, the cohort perspective seems to be more appropriate in demography for studying events which occur sequentially over lifetime and in a selected cohort. Hence, using the cohort approach for studying the interconnected process of postponement and recuperation seems to be by far the best solution.

In this paper, we adopt a basic benchmark model originally proposed by Frejka and Calot (2001) and Frejka and Sardon (2004) and further elaborated by Sobotka et al. (Sobotka et al., 2011). In this model, postponement and recuperation are measured for selected cohorts with the use of a reference cohort to what is called a benchmark cohort. In this perspective, postponement has been labelled as a fertility deficit and recuperation as a fertility surplus. As noted in the main reference paper (Sobotka et al., 2011: 425), the choice of a benchmark cohort is critical with respect to outcomes of the analysis. As suggested, the benchmark cohort should be the one that first experienced an onset of the increase in the mean age at first birth (MAFB) that spanned over at least five consecutive cohorts. In the case of Poland, the first cohort to exhibit a permanent increase in MAFB is the 1968 cohort, but since for practical purposes the benchmark cohort should end in 0 or 5, we suggest using the 1965 cohort as a benchmark of our analyses.

The presented analysis of postponement and recuperation focuses on the order-specific analysis, since changes to timing and quantum of fertility resulting from the second demographic transition impacts the postponement and recuperation of the first and second births and the permanent decline in the third and higher order births (Sobotka et al., 2011: 425; Kohler et al., 2002).

The main advantage of the applied analytical framework is that it can be characterised by a simple set of indicators also allowing for its graphical presentation (Sobotka et al., 2011: 426). The analysis starts with the calculation of cumulated fertility rate up to age 40 – in our case the last analysed cohort is the 1974 one. An important concept of a *through age* is introduced in the applied analytical framework. This is the age at which the gap between the cumulated fertility rate of the benchmark cohort and the observed cohort reaches a maximum. The importance of this concept relies on the fact that both measures of postponement and recuperation are calculated with respect to this value.

A postponement measure (P) for a given cohort is defined as the maximum difference in cumulated fertility between the benchmark and the observed cohort that is usually negative (equation 1 in Sobotka et al., 2011: 426). Therefore, the larger is the difference between the two, the stronger is the postponement. On the other hand, a recuperation measure (R) is defined as an absolute increase in cohort fertility as compared to the benchmark cohort between the *through age* and the end of the reproductive period (equation 2 in Sobotka et al., 2011: 426). Last but not least, the final difference (FD) is defined as the decline in fertility between the benchmark cohort and the cohort of interest computed as a sum of the postponement measure and the recuperation measure. From the variety of proposed methods we use the basic benchmark model which allows for the reconstruction of recuperation and postponement measures, as well as the recuperation index (RI) and measure of the permanent decline (Sobotka et al., 2011: 426). These measures have been calculated for all births and separately by birth order (up to the third birth).

Another important issue related to the data we need to address is the impact of migration on the estimated rates. This issue is directly related to data quality and completeness, which might be greatly endangered as a result of migration flows from Poland. These migration flows contribute to the underestimation of fertility rates caused by differences in the size between the *de jure* and the *de facto* populations (Fihel & Jasilionis, 2016; Tymicki & Zeman, 2017) as well as due to the under-registration of births (Gołata, 2016). A more detailed perspective on the potential impact of migration flows on estimated fertility rates is presented in the discussion part of the paper.

Cohort age-specific fertility rates

Table 1 presents age-specific fertility rates for selected cohorts in Poland. Significant changes in the fertility pattern during the time period under consideration can be noticed. One may observe a distinct decrease in the age-specific fertility rates with each consecutive cohort. Furthermore, the cohorts born in the mid-1970s are characterized by a visible shift of childbearing from young to older ages. In the subsequent cohorts, the age group of the highest fertility has moved from 20–24 to 25–29 years (see Graph 1). This is especially apparent when the 1975, 1980 and 1985 cohorts are compared (Table 1). Clearly, the 1985 cohort is moving beyond the age of 28 in terms of intensity of childbearing. The youngest observed 1989 cohort has an even lower fertility up to the age of 25 than cohorts born in the 1980s. The analysis of the cohort age-specific fertility rates over time confirms trends noticed already (Figure 1). From the analysis of the age-specific cohort fertility we can draw an important conclusion related to the relative importance of the quantum and tempo effects in changes of fertility patterns in Poland. Up to the 1970 birth cohort, the overall drop in fertility had been caused mainly by the quantum effect, with almost no changes in the tempo of reproduction. Then from the 1975 cohort onward we can observe slight shifts in age schedules of childbearing related to the tempo effect.

Noticeably, the cohort born in 1976 is the first for which we observe a significant shift of the highest age-specific cohort fertility rate from the age group 20–24 to the age group 25–29. From then on, there has been a significant decrease in the age-specific cohort fertility rates in the age group 20–24. These age shifts (the tempo effect) were accompanied by the already mentioned overall decrease in age-specific fertility rates (the quantum effect). For instance, the fertility rate in the age group 20–24 for the 1976 cohort was only about 50% of the fertility rate for this same age group among the cohort born in 1956. The respective value for the age group 25–29 for these two cohorts was 65%. These observations prove that fertility patterns for the cohorts which have entered the reproductive age after 1989, were driven by initial changes in the quantum of fertility followed by a strong tempo effect. For the cohorts reproducing around the year 2000 we have observed a sharp drop in fertility rates as a result of interactions between the quantum and tempo effects.

It seems that higher age-specific fertility has permanently moved to the older age group. However, in the 25–34 age group we can also notice a major fall in the level of age specific fertility rates after 1984.

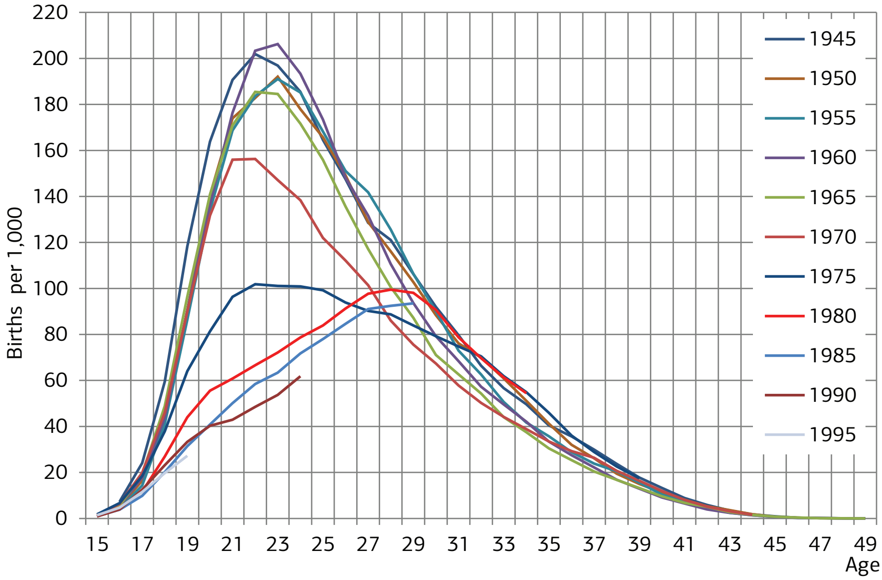
Table 1. Cohort age-specific fertility rates (births per 1,000) for selected cohorts

Age	Cohort born in:										
	1945	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995
15		1.3	1.1	1.3	1.4	1.5	1.8	1.3	1.0	0.9	1.39
16	7.3	4.9	4.1	5.4	5.5	6.4	6.7	4.7	3.9	3.5	4.67
17	24.1	16.4	14.4	17.8	19.5	19.9	18.5	11.6	9.8	11.0	11.49
18	59.5	43.5	41.1	43.8	48.8	46.1	37.9	26.9	20.2	23.1	19.70
19	118.3	90.3	86.4	90.3	96.4	90.0	64.0	44.0	31.4	35.3	27.22
20	163.8	140.6	133.8	136.5	140.8	131.7	81.3	55.5	40.8	43.4	
21	190.7	174.0	168.7	176.4	170.8	156.0	96.4	60.8	50.1	46.7	
22	201.9	182.8	183.6	203.3	185.5	156.3	101.8	66.6	58.4	49.2	
23	196.9	192.1	191.0	206.2	184.5	147.1	101.1	72.1	63.4	57.3	
24	185.5	177.9	185.2	193.4	171.6	138.4	100.9	78.7	71.7	62.8	
25	164.5	165.7	168.2	173.4	155.9	122.0	99.2	83.9	78.0	73.1	
26	147.6	149.2	151.1	148.1	135.7	112.1	93.9	91.3	84.6		
27	128.6	128.9	141.8	131.7	117.2	101.4	90.2	97.7	91.0		
28	121.1	116.1	125.7	110.6	100.6	86.0	88.7	99.5	92.5		
29	106.3	102.7	106.4	93.6	87.2	75.6	83.9	98.1	93.5		
30	91.9	88.3	90.0	79.3	71.1	67.4	79.2	90.7			
31	79.7	76.1	72.9	68.4	62.6	57.8	74.7	78.7			
32	66.4	69.9	62.6	57.2	54.3	50.2	70.5	69.7			
33	56.6	60.9	50.7	49.6	44.1	44.2	61.9	61.4			
34	49.6	51.1	41.7	42.0	37.5	38.8	54.9	54.4			
35	40.5	41.2	35.7	33.4	30.5	33.5	45.9				
36	35.7	32.0	28.9	27.5	25.4	29.3	36.1				
37	29.9	26.2	23.8	22.2	20.4	26.4	28.9				
38	23.7	19.5	20.5	16.8	16.8	20.7	22.6				
39	17.8	15.0	15.6	13.0	13.2	16.4	17.5				
40	13.3	11.3	10.4	9.1	9.6	12.0					
41	8.9	8.1	7.2	6.5	6.8	8.1					
42	5.8	5.3	4.8	3.9	5.1	5.2					
43	3.5	3.6	2.5	2.4	2.8	3.1					
44	1.8	1.8	1.4	1.4	1.6	1.6					
45	0.9	0.7	0.7	0.7	0.8						
46	0.4	0.3	0.3	0.3	0.4						
47	0.2	0.1	0.1	0.2	0.1						
48	0.1	0.0	0.1	0.1	0.1						
49	0.0	0.0	0.0	0.0	0.0						

Source: own calculations based on the Statistics Poland data.

Thus, we can conclude that the strong postponement effect might not be fully compensated by the recuperation effect, since the quantum of fertility in higher age groups does not compensate for fertility "lost" in younger age groups. This situation was observed in many countries which underwent similar changes in fertility patterns (Sobotka et al., 2011).

Figure 1. Age-specific cohort fertility rates (cohorts born in 1945–1995)

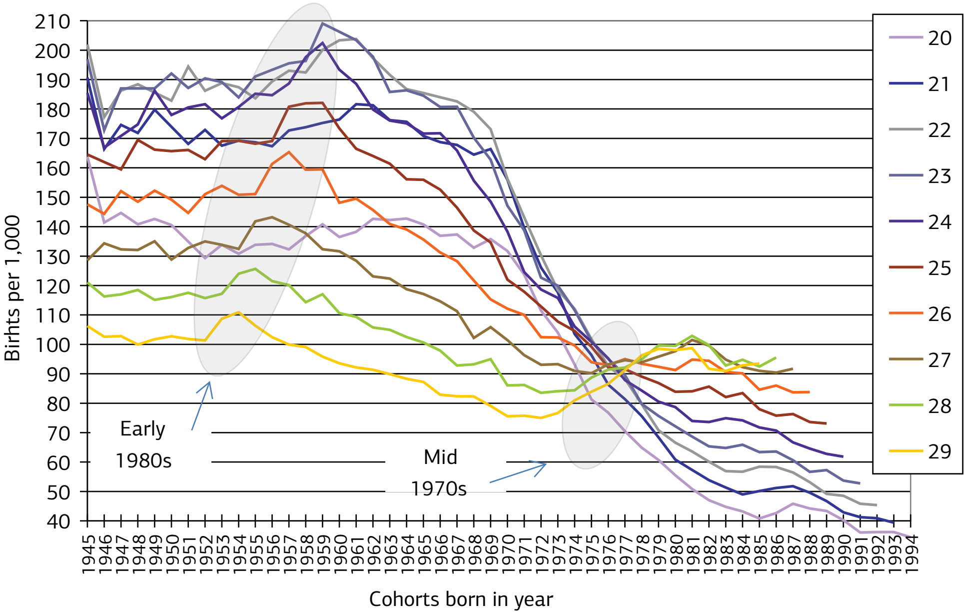


Source: own calculations based on the Statistics Poland data.

An important issue related to the considerations of the quantum/tempo interplay is the recuperation effect. This effect could be characterized as the compensatory fertility increase at higher reproductive ages seen as a response to the postponement expressed by the fertility decline at younger ages (Sobotka et al., 2011). The aforementioned quantum/tempo interaction that leads to the drop in fertility rates may be clearly seen when one looks at cohort age-specific fertility rates arranged by age groups (Figure 2 and Figure 3).

In Figure 2 we can observe a postponement pattern due to declining fertility rates for age groups 20–24 (cohorts born in the early 70s) followed by an increase in fertility rates for age groups 25–29 (cohorts born in 1975 and later). Overall, the traditionally most fertile 20–24 age group noted a 65–70% decrease in the level of fertility rates starting from the 1984 cohort. This was accompanied by a shift in fertility schedules to the 25–29 age group, which is clear if we look at the area marked in Figure 2 showing changes in fertility patterns around the year 2005 for the cohorts born in the mid 1970s. This transition area marks the time with the lowest observed period total fertility rates after the Second World War in Poland.

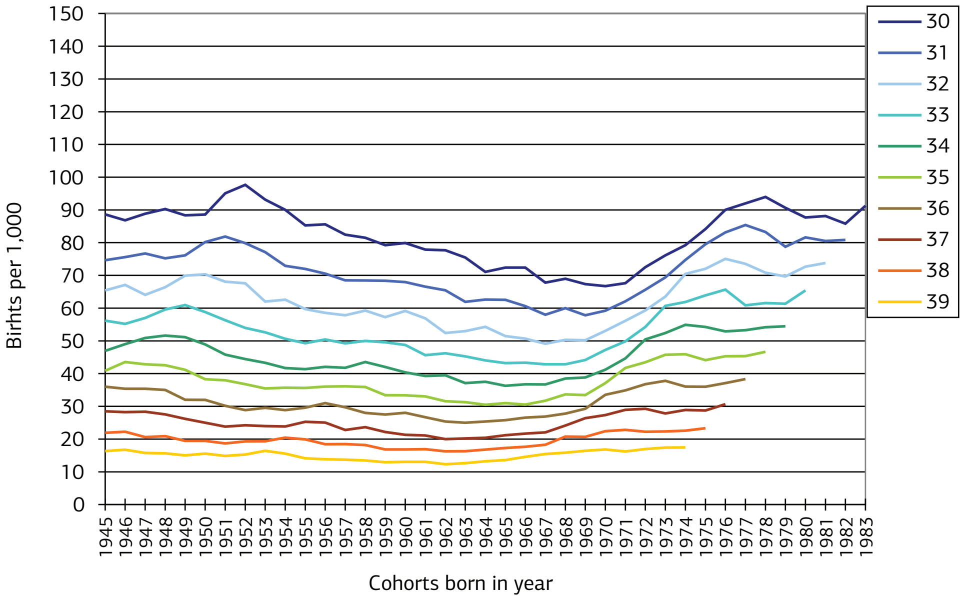
Figure 2. Age-specific cohort fertility rates for the 20–29 age group



Source: own calculations based on the Statistics Poland data.

The analysis of cohort fertility rates for groups above 29 years of age, presented in Figure 3, seems to confirm that the recuperation might not fully compensate for the drop in fertility rates observed among younger age groups. We can notice that there has been a fertility increase at the age of 30 up to the age of 37, especially for cohorts born after 1974. Firstly, the data suggests that there was a moderate recuperation effect especially among age groups 30–34. This recuperation is clear if we look at the combined information concerning the number of registered births and its parity structure. After the year 2003 with the lowest registered number of births in the post-war period around, there was an increase till the year 2009 and recently for the years 2014–2017 (GUS, 2018). However, according to data from Statistics Poland (GUS, 2017), this increase in the number of registered births could be mostly attributed to the increase in the number of second and third births among women aged 25–29, 30–34, and 35–39 (Kotowska, 2018).

Figure 3. Age-specific cohort fertility rates for the 30–39 age group



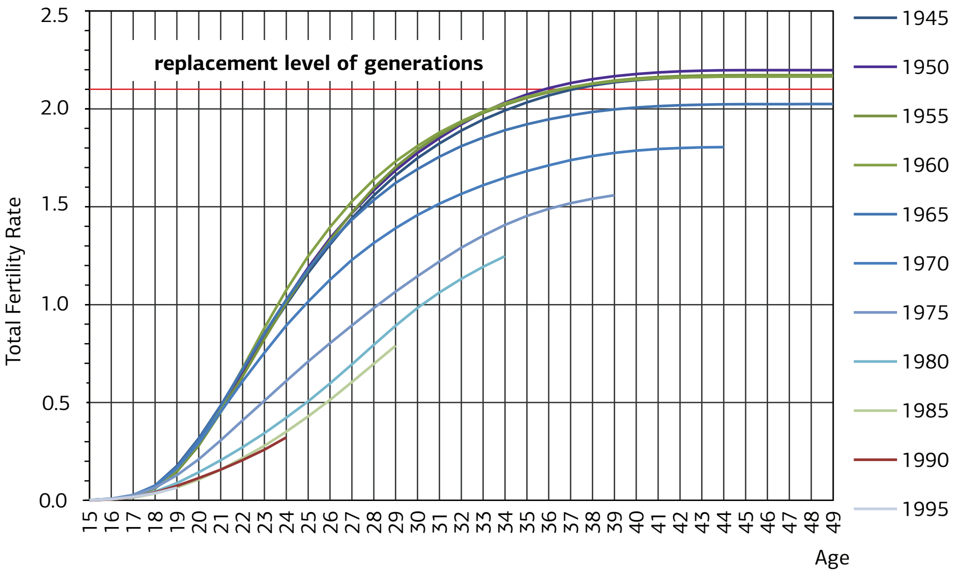
Source: own calculations based on the Statistics Poland data.

Cohort total fertility rates

The cohort total fertility rate (CTFR) represents the average number of children born to one woman from a single generation. Many generations under observation have not reached the end of their reproductive age, but it is possible to calculate the CTFR that has been actually completed (achieved) up to a certain age (CCFR). The extended data on births made it possible to calculate the CTFR for generations of women born in 1946–1965. For the cohorts born earlier the data on births was missing and so we could not calculate the CTFR, while for those born later we could only calculate the CCFRs for younger ages, since these women have not reached the age of 49.

The CCFRs show that the first generation of women that had not given birth to even one child by age 25, was the generation born in 1971. Furthermore, the cohort born in 1980 was the first one that had not given birth to even one child by the age of 30. As shown in Figure 4 with a red curve, the 1964 cohort was the first one to attain the below replacement level for the completed cohort fertility. Moreover, younger cohorts are marked with a steady decline in cohort fertility rates.

Figure 4. Cohort total fertility rates for selected cohorts



Source: own calculations based on the Statistics Poland data.

On the other hand, it is worth mentioning that at the age of 35 the generation of women born in 1946 had on average 1.99 children per woman, and yet at the age of 45 the cohort TFR was equal to 2.17, which guaranteed the replacement of generations. However, to achieve fertility at the replacement level with the contemporary low cohort fertility of women aged 20–24, the fertility of older women would have to be even higher than those prevailing in the 1980s in the most fertile age group. As Table 2 shows, the completed fertility of the 1985 and 1994 cohort at the age of 20 is only around 30% of the completed fertility for the 1946 cohort at the same age. The completed fertility for older age groups are not that dramatically lower than the referenced 1946 cohort, due to the so-called recuperation process. However, the completed fertility by the age of 39 of the 1975 cohort, for example, constitutes only around 73% of the 1946 cohort for the same age. Therefore, it can be argued that it will be very difficult for today's generations to achieve high enough fertility levels, especially in older age groups, to guarantee the replacement of generations.

Table 2. Cohort completed fertility rate for selected cohorts

Age	Cohorts born in:										
	1945	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995
15		0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001
16	0.006	0.006	0.005	0.007	0.007	0.008	0.008	0.006	0.005	0.005	0.006
17	0.026	0.023	0.020	0.024	0.026	0.028	0.027	0.018	0.015	0.017	0.018
18	0.076	0.066	0.061	0.068	0.075	0.074	0.065	0.044	0.035	0.041	0.037
19	0.176	0.157	0.147	0.159	0.172	0.164	0.129	0.088	0.066	0.074	0.064
20	0.317	0.297	0.281	0.295	0.312	0.295	0.210	0.144	0.107	0.114	
21	0.484	0.471	0.450	0.471	0.483	0.451	0.307	0.205	0.157	0.157	
22	0.661	0.654	0.633	0.675	0.669	0.608	0.408	0.271	0.216	0.206	
23	0.834	0.846	0.824	0.881	0.853	0.755	0.509	0.343	0.279	0.259	
24	1.001	1.024	1.009	1.074	1.025	0.893	0.610	0.422	0.351	0.321	
25	1.163	1.189	1.178	1.248	1.181	1.015	0.709	0.506	0.429		
26	1.307	1.339	1.329	1.396	1.316	1.127	0.803	0.597	0.513		
27	1.441	1.468	1.471	1.528	1.434	1.229	0.894	0.695	0.604		
28	1.557	1.584	1.596	1.638	1.534	1.315	0.982	0.795	0.697		
29	1.660	1.686	1.703	1.732	1.621	1.390	1.066	0.893	0.790		
30	1.749	1.775	1.793	1.811	1.693	1.458	1.145	0.983			
31	1.823	1.851	1.866	1.879	1.755	1.516	1.220	1.062			
32	1.889	1.921	1.928	1.937	1.809	1.566	1.291	1.132			
33	1.945	1.982	1.979	1.986	1.854	1.610	1.353	1.193			
34	1.992	2.033	2.020	2.028	1.891	1.649	1.407	1.248			
35	2.033	2.074	2.056	2.062	1.922	1.682	1.453				
36	2.069	2.106	2.085	2.089	1.947	1.711	1.489				
37	2.097	2.132	2.109	2.111	1.967	1.738	1.518				
38	2.119	2.152	2.129	2.128	1.984	1.759	1.541				
39	2.135	2.167	2.145	2.141	1.997	1.775	1.558				
40	2.147	2.178	2.155	2.150	2.007	1.787					
41	2.155	2.186	2.162	2.157	2.014	1.795					
42	2.160	2.191	2.167	2.161	2.019	1.800					
43	2.163	2.195	2.170	2.163	2.021	1.803					
44	2.165	2.197	2.171	2.165	2.023	1.805					
45	2.166	2.198	2.172	2.165	2.024						
46	2,166	2.198	2.172	2.165	2.024						
47	2,166	2.198	2.172	2.166	2.024						
48	2,166	2.198	2.172	2.166	2.024						
49	2,166	2.198	2.172	2.166	2.024						

Source: own calculations based on the Statistics Poland data.

Postponment and recuperation of cohort fertility

The graphical presentation of the postponement and recuperation measures obtained from the basic benchmark model are shown in Figure 5. As noticed in the earlier section, we use the 1965 cohort as a benchmark with the cutting line on the 1974 cohort.

The upper left panel provides the graphical representation for all birth orders. From that figure we can notice the constant postponement, which is manifested in falling fertility at younger ages for all the observed cohorts after 1965. It also has to be noted that for cohorts born after 1980 the decline in fertility at younger ages seems to level off. Although looking at all the birth orders might be difficult for interpretation, we can notice that there is a clear permanent decline in fertility even when taking all the birth orders together into account.

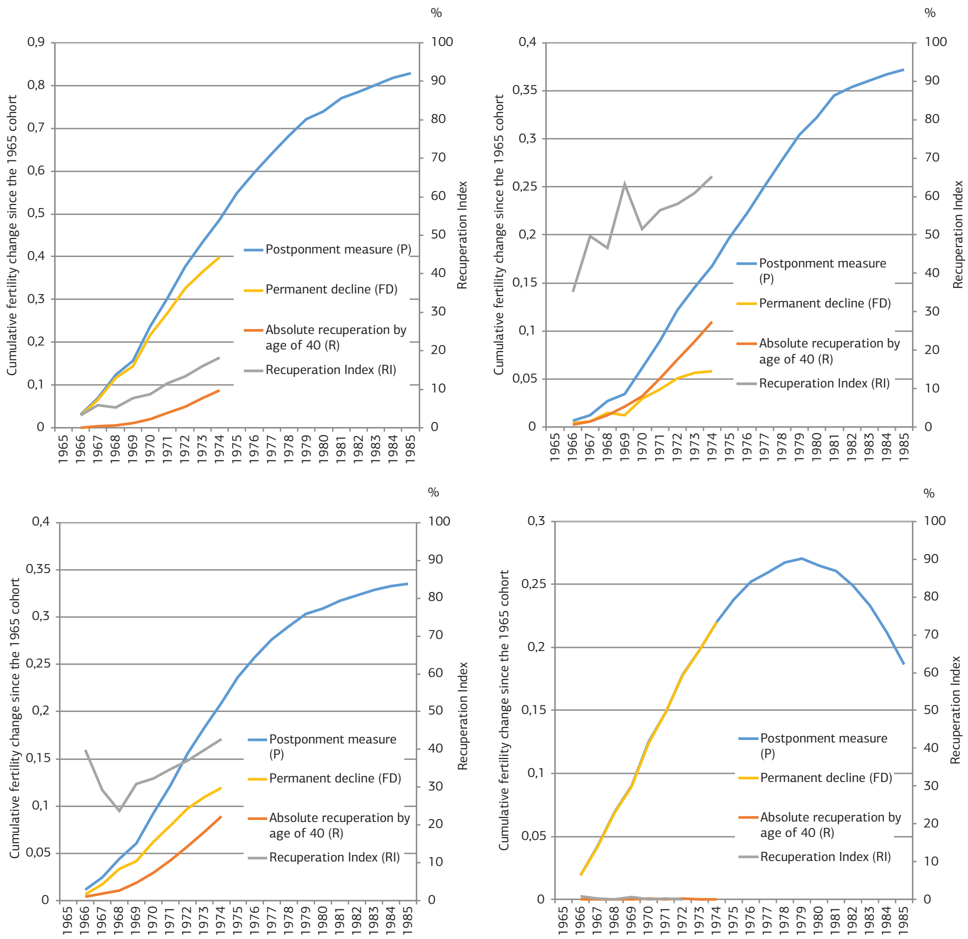
The interpretation of the results is much easier and intuitive in case of parity specific calculations. The upper right panel provides information on measures calculated for first births. The picture that emerges from that panel shows the significant permanent decline in first births (FD) along with continuous postponement (P) that seems to level off for the cohorts born after 1980. It has to be noticed that in the case of first births recuperation can be considered as moderate that resulted in quite a significant permanent decline in first births. It also has to be noted that in the case of first births the low values of the permanent decline measure prove that the fertility change that occurred in Poland mostly reflects postponement and afterwards recuperation of first births. Although the recuperation index reflects only moderate recovery of first births as compared to the benchmark cohort of 1965 (in the case of first births it shows around 65% recuperation for the 1974 cohort), however, we might speculate that it will keep its inclining upward trend for consecutive cohorts.

The different situation can be noticed by analysing second births (the bottom left panel of Figure 5). As a result of the shifts in the age at first birth, we observe postponement of second births with the maximum value of recuperation index around 43% for the 1974 cohort. It is noteworthy that for second births there has been a greater permanent decline as compared to first births, which also manifests in lower values of the absolute recuperation measure.

The pattern observed for the first and second births characterised by postponement, decreasing recuperation and an increasing permanent decline manifests itself distinctively for third births (the bottom right panel of Figure 5). Third births for cohorts of Polish women seem to be permanently postponed with almost no recuperation.

It seems that, as compared to the 1965 cohort, there was almost a complete retreat from having third births for younger cohorts.

Figure 5. Postponement and recuperation in cohort fertility among Polish women: the basic benchmark model for all births and by parity



Source: own calculations based on the Statistics Poland data

Discussion

We believe that the presented analyses contribute to a better understanding of fertility changes in Poland. So far, the above-mentioned studies based on registration of births constitute the only regularly updated source of cohort fertility rates. Now this data is available to a wider scientific community via Human Fertility Database[1] (HFD, 2018; Jasilioniene et al., 2009; Tymicki & Zeman, 2017). Thanks to the Human Fertility Database, users have an opportunity to compare not only main fertility indicators but also get insights into the cohort fertility. Therefore, all the fertility data will be easily accessible without a necessity of browsing through scattered research papers.

During the analysed years 1945–2015, the cohort fertility pattern in Poland changed significantly. Age-specific fertility rates decreased and the highest fertility shifted towards the 30+ year age group. As compared with our previous analyses, the shift of the age schedule seems to be most remarkable for cohorts born at the beginning of the 1970s. Therefore, the recuperation of postponed fertility could be observed especially from 27 to 34 years of age. These descriptive findings have found support in more detailed analyses performed with the use of the basic benchmark model (with the 1965 cohort as the reference). The analysis of postponement and recuperation shows continuous postponement in case of first births with a relatively high recuperation (with the recuperation index yielding 65% for the cohort 1974) and a modest permanent decline. A consequence of the increase in the age of first birth is postponement in second births with a more pronounced permanent decline and lower values of the recuperation index (the value of 42% for the 1974 cohort). Even more striking is the pattern for third births with almost permanent postponement (the permanent decline equals postponement) and no recuperation. These findings support the results of other parity specific studies with the use of the applied model that show recuperation of first births, a partial decline of second births and permanent postponement of third births (Zeman et al., 2017).

The analysis of completed cohort fertility by age shows that there are no signs of any increase in the observed levels. The 1964 cohort was the first one which has not achieved the completed cohort fertility rate at the replacement level and the completed fertility continues to decrease for all younger cohorts. The 1980 cohort was the first one to experience fertility below the value of 1 by the age of 30 (0.98). For the 1984 cohort, the same value yielded 0.9, which is around 50% lower value as compared to the 1946 cohort. It seems that the younger the cohort, the lower the values of cohort fertility rates are observed. The developments of cohort fertility rates for the youngest observed cohorts point to the undeniable fact that the declining of the completed cohort fertility rates will continue in the nearest future. However, we may speculate that the pace of the decrease in cohort fertility rates may slow down and most likely the cohort TFR will level off at the value around 1.4–1.5.

[1] As of 10.10.2016 the HFD data collection for Poland includes the period data 1971–2014 and the cohort data 1956–1974.

These patterns are coherent with more general studies that provide an overview of fertility trends in the CEE countries (Frejka & Gietel-Basten, 2016). However, it has to be noted that in terms of the cohort total fertility rates at the age of 40, Poland has witnessed the most significant drop among Central and East European countries. According to forecasts of cohort fertility prepared for 37 developed countries (Myrskyla et al., 2013), Poland is about to experience a further drop in fertility rates. This further decrease in cohort fertility rates will be caused mostly by the insufficient recuperation which cannot compensate for fertility lost at younger age groups (Frejka & Gietel-Basten, 2016: 16). As noted by Frejka and Gietel-Basten (2016: 16) "(in Poland) by the age of 35 the 1975 birth cohort has recuperated only 35% of the postponed births compared to the 1970 cohort, it is almost certain that women born in 1975 will not recuperate 100% of postponed births by the time they reach the end of their reproductive period".

These observations of changes in cohort fertility rates in Poland have to be confronted with the recent studies related to impacts of migration on registered births and fertility rates (Kaczmarczyk, 2014; Gołata, 2016; Tymicki & Zeman, 2017). The outmigration wave that occurred in Poland as a result of accession to the EU has been directly connected to previously observed migration streams (Kaczmarczyk, 2014). The general observation is that, due to migration, period fertility indicators for the period starting in 2000 can be underestimated by as much as 10% (Tymicki & Zeman, 2017). According to Statistics Poland in Warsaw, the projections of fertility rates might be underestimated by around 3% due to migration flows (GUS, 2016a).

Therefore, fertility indicators for the cohorts born after 1965 (especially cohort childlessness) should be used only with special caution (Tymicki & Zeman, 2017). Fertility estimates may differ from those discussed already, due to differences between the size of the *de jure* and *de facto* populations (Fihel & Jasilionis, 2016) and under-registration of births due to a large number of births by Polish citizens registered abroad (Gołata, 2016).

It has to be noted that in the period 1958–2014 there were four different definitions of the population used for official population statistics (Fihel & Jasilionis, 2016). As noted by Tymicki and Zeman: "In 1958–1982, population statistics referred to the currently resident (*de facto*) population. In 1983–2005, population statistics covered the population registered as permanent or temporary (residing for at least 2 months) residents. In 2006–2010, the definition was modified so that temporary residence referred to those staying in the country for at least 3 months. Finally, a more recent change was introduced with the 2011 census, when a new concept of *usual residence* was introduced in population statistics. The new official definition includes as usual residents all the individuals who are living in Poland (immigrants holding

EU citizenship or temporary residence permits) and those declaring their intention to live in Poland for at least one year. This definition excludes people who officially declared to the authorities their departure abroad for a period of more than one year." (Tymicki & Zeman, 2017: 5–6). According to Statistics Poland (GUS, 2016b) the number of Polish citizens who are included in the official resident population but are in fact living abroad increased from 0.4 million in 2002 to one million in 2004 (just after the accession of Poland to the European Union) and further to 1.95 million in 2006 and to 2.4 million in 2015 (GUS, 2016b). Moreover, this population is predominantly concentrated in the peak productive and reproductive ages 25–34 (Kaczmarczyk, 2014; Gołata, 2016), so the underrepresentation at these ages among women is around 12%. That leads to the second issue related to the registration of births.

To avoid births/exposures bias, the births statistics would also have to cover childbirths to Polish citizens living abroad and registered as *usual residents* in Poland. This is, however, not the case – statistical reporting includes all births registered by register offices in the current year that have taken place in Poland (excluding births to mothers staying temporarily in Poland, but permanently residing abroad). The number of births to Polish citizens living *de facto* abroad is difficult to estimate – in 2014, the number of births to Polish citizens in England and Wales was 22.1 thousand (ONS, 2016), while in Germany it was 10.0 thousand (DESTATIS, 2016). It is also not known how many of these mothers were excluded from or included into the Polish population exposure.

The fertility indicators for periods after 2000 are thus underestimated. In 2011 the number of women at the age of 15–49 living abroad was 760 thousand. If we exclude this exposure from the calculation of TFR, instead of the official number 1.30 in 2011 we get 1.46 (11% higher). We estimate that during 2004–2014, the births/exposures bias underestimated TFR increasingly by 5–10%. Our estimations are confirmed by Gołata (2016), who estimates TFR for 2011 at 1.45–1.46 (Dormon, 2014). In a similar way the cohort summary indicators can be underestimated as well. For example, the cumulated cohort fertility of first birth is suspiciously low in recent cohorts, which means that the cohort childlessness is overestimated – childlessness at the age of 40 increases from 10–14% in the 1956–1967 cohorts towards 20% in the 1974 cohort.

As already noted, the described changes in cohort fertility patterns are marked by an initial decrease in the quantum of reproduction (for cohorts born up to the early 70s) followed by a remarkable tempo effect, which shifted reproduction to higher age groups. The recent recuperation observed, both from the cohort and period perspectives, is mostly related to the increase in the number of second and third births. This might be partly a consequence of the developments in public policy in Poland, which focuses on boosting second births. The aforementioned underestimation of both cohort and period fertility rates due to migration flows might attenuate the fertility decline observed in Poland however it is unlikely to reverse the observed negative trends. Nevertheless, it is important to take into account the impact of migration on the analysis and interpretation of changes in fertility patterns in Poland before and after 1989.

References

Bolesławski, L., 1974, *Tablice płodności kobiet według generacji* [Fertility Tables by Generation], Statystyka Polski [Polish Statistics], Warszawa: Główny Urząd Statystyczny.

Bolesławski, L., 1993, *Polskie tablice dzietności kobiet 1971–1992* [Polish fertility tables 1971–1992], Warszawa: Główny Urząd Statystyczny.

DESTATIS, 2016, *Live births: Germany, years, citizenship*. GENESIS-Online Datenbank, retrieved on 3.4.2017 from: https://www-genesis.destatis.de/genesis/online

Dormon, O., 2014, *Childbearing of UK and non-UK born women living in the UK: 2011 Census data. Office for National Statistics*, retrieved on 3.4.2017 from: http://webarchive.nationalarchives.gov.uk/20160105160709/http://ons.gov.uk/ons/rel/fertility-analysis/childbearing-of-uk-and-non-uk-born-women-living-in-the-uk/2011-census-data/index.html

Fihel, A., Jasilionis, D., 2016, *About mortality data for Poland. Human Mortality Database country documentation file*, retrieved from: http://www.mortality.org/

Frątczak, E., Ptak-Chmielewska, A., Pęczkowski, M., 2011a, *Płodność w Polsce – analiza kohortowa: kohorty urodzeniowe 1911–1986*, Tom I, Warszawa: OW SGH.

Frątczak, E., Ptak-Chmielewska, A., Pęczkowski, M., 2011b, *Płodność w Polsce – analiza kohortowa: kohorty urodzeniowe 1911–1986*, Tom II, Warszawa: OW SGH.

Frejka, T., Calot, G., 2001, *Cohort Reproductive Patterns in Low-Fertility Countries*, "Population and Development Review" 27(1), 103–132.

Frejka, T., Sardon, J.P., 2004, Childbearing trends and prospects in low-fertility countries, [in:] *European Studies of Population 13*, Dordrecht: Kluwer Academic Publishers.

Frejka, T., 2011, *The Role of Contemporary Childbearing Postponement and Recuperation in Shaping Period Fertility Trends*, "Comparative Population Studies" 36(4), 927–958.

Frejka, T., Gietel-Basten, S., 2016, *Fertility and Family Policies in Central and Eastern Europe after 1990*, "Comparative Population Studies" 41(1), 3–56.

Gołata, E., 2016, *Estimation of fertility in Poland and of Polish born women in the United Kingdom*, "Studia Demograficzne" 1(169), 13–38.

GUS, 2015, *Informacja o rozmiarach i kierunkach czasowej emigracji z Polski w latach 2004–2014. Notatka informacyjna 5.10.2015 r.*, Warszawa: Główny Urząd Statystyczny.

GUS, 2016a, *Prognoza ludności rezydującej dla Polski na lata 2015–2050*, Główny Urząd Statystyczny, Warszawa.

GUS 2016b, *Informacja o rozmiarach i kierunkach czasowej emigracji z Polski w latach 2004–2015. Notatka informacyjna 5.10.2015 r*., Warszawa: Główny Urząd Statystyczny.

GUS, 2017, *Ludność i ruch naturalny w 2016*, Warszawa: Główny Urząd Statystyczny.

GUS, 2018, *Sytuacja demograficzna Polski do 2017 r. Urodzenia i dzietność* [Demographic situation in Poland up to 2017. Births and fertility], Warszawa: Główny Urząd Statystyczny.

HFD – Human Fertility Database, 2018, Max Planck Institute for Demographic Research (Germany) and Vienna Institute of Demography (Austria), retrieved from: www.humanfertility.org

Holzer, J.Z., Holzer-Żelażewska, D., 1997, *Płodność kohortowa kobiet w Polsce w latach 1945–1994*, "Studia Demograficzne" no. 2, 3–23.

Holzer-Żelażewska, D., Tymicki, K., 2009, *Cohort and period fertility of Polish women, 1945–2008*, "Studia Demograficzne" no. 1, 48–69.

Jasilioniene, A., Jdanov, D.A., Sobotka, T., Andreev, E.M., Zeman, K., Shkolnikov, V.M., Goldstein, J.R., Philipov, D., Rodrígues, G., 2009, *Methods protocol for the Human Fertility Database*, retrieved from: www.humanfertility.org/Docs/methods.pdf

Kaczmarczyk, P., 2014, *Recent Trends in International Migration in Poland. The 2012 SOPEMI Report*, CMR Working Papers 71/129, Centre of Migration Research, University of Warsaw.

Kohler, H.-P. et al., 2002, *The Emergence of Lowest-Low Fertility in Europe During the 1990s*, "Population and Development Review" 28(4), 641–680.

Kotowska, I.E., 2018, *Czy Program Rodzina 500 Plus umożliwi trwałe odwrócenie spadku urodzeń w Polsce?*, unpublished manuscript.

Lesthaeghe, R., 2001, *Postponement and recuperation: Recent fertility trends and forecasts in six Western European countries*, the paper presented at the IUSSP Seminar "International perspectives on low fertility: Trends, theories and policies", Tokyo, 21–23 March 2001.

Paradysz, J., 1992, *Dzietność kobiet w Polsce*, Warszawa: Główny Urząd Statystyczny.

Myrskylä, M., Goldstein, J.R., Cheng, Y.A., 2013, *New Cohort Fertility Forecasts for the Developed World*, "Population and Development Review" 39(1), 31–56.

ONS, 2016, *Parents' country of birth 2015*, Office for National Statistics, retrieved on 3.4.2017 from: https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/livebirths/datasets/parentscountryofbirth

Sobotka, T., Zeman, K., Leshaeghe, R., Frejka, T., Neels, K., 2011, *Postponement and Recuperation in Cohort Fertility: Austria, Germany, Switzerland in a European Context*, "Comparative Population Studies" 36 (2–3), 417–452.

Tymicki, K., Zeman, K., 2017, *Human Fertility Database documentation: Poland*, retrieved from: http://www.humanfertility.org

Waller L., Berrington A. and Raymer J., 2014, *New insights into the fertility patterns of recent Polish migrants in the United Kingdom*, "Journal of Population Research" 2(31), 131–150.

Zeman, K., Beaujouan, E., Brzozowska, Z., Sobotka, T., 2017, *Cohort fertility decline in low fertility countries: Decomposition using parity progression ratios*, "Demographic Research" 36(25), 651–690.

Cohort fertility of Polish women, 1945–2015: the context of postponment and recuperation

Abstract

The article is a follow-up and an extension to previously published papers by Holzer-Żelażewska & Holzer (1997) and Holzer-Żelażewska & Tymicki (2009). Fristly, we have added new cohorts to the cohort analysis based on the individual data from births registration for the years 2009–2015. Secondly, we have extended the scope of the study by taking into account the context of postponement and recuperation to analyses of cohort fertility of Polish women.

The approach applied to the fertility postponement and recuperation on the cohort data refers to the method which was originally proposed by Frejka (2011) and Lesthaeghe (2001) and further developed by Sobotka et al. (Sobotka et al., 2011). This method allows for calculation of fertility postponement and recuperation measures with respect to a benchmark cohort chosen as the one that first experiences an onset of the increase in the mean age of motherhood at first birth.

The results show the remarkable changes in the fertility patterns in Poland. The main driving forces behind the change in fertility patterns in Poland are related to the postponement of first births along with a relatively good recuperation. The magnitude of recuperation for Polish cohorts dropped significantly for second births and was almost non-existent for third and higher births. Therefore, the pattern of fertility in Poland observed till 2015 could be characterized by postponement and recuperation of first births along with a significant decrease in second births with perpetual postponement of third and higher births.

Keywords: cohort and period fertility measures, postponement, recuperation