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COHORT PATTERNS OF FERTILITY IN POLAND BASED ON STAGING PROCESS – GENERATIONS 1930-1980

Wioletta Grzenda[1], **Ewa Frątczak**[2]

ABSTRACT

As a transition country in the region of Central and Eastern Europe, Poland has experienced unprecedented changes in the fertility. Currently, the total fertility rate level is very low, ca. 1.3 children per woman, which is below the replacement level. Many studies have described changes in fertility based on the cross-sectional approach. However, the changes of cohort fertility have been described not quite sufficiently. Our paper complements this gap by the assessment of stochastic fertility tables, calculated for five-year generations of women born in the period 1930-1980. The main goal of this study is to analyse changes in the cohort patterns of female fertility in Poland.

Key words: cohort fertility, stochastic process, stage probabilities.

1. Introduction

Fertility behaviour of women is influenced by numerous factors and is constantly changing over time, therefore fertility tables are the best tool for their analysis. Fertility tables are derived from life tables, which are one of the oldest tools of demographic analysis. The contemporary methodology of constructing life tables, based on the probability theory, was introduced by C.L. Chiang in 1968 (Chiang, 1968). He was also one of the first authors of stochastic fertility tables (Chiang, 1984). There are also numerous publications on this subject in Polish (Frątczak and Ptak-Chmielewska, 2011a; 2011b; Frątczak, 1996; Bolesławski, 1974) and foreign literature (Cigno, 1994; Namboodiri, 1991; Chiang and Van Den Berg, 1982; Namboodiri and Suchindran, 1987). The bases for constructing such tables are stochastic processes, because the events from a life course of a given individual, such as for example births, can be treated as the implementation of these processes. Therefore, often tables constructed in this manner are called stochastic tables. The events considered are localized in time, therefore the stochastic fertility tables can be used for analysing the changes of the level and pace of this phenomenon.

[1] Warsaw School of Economics, Collegium of Economic Analysis, Institute of Statistics and Demography. E-mail: wgrzend@sgh.waw.pl.
[2] Warsaw School of Economics, Collegium of Economic Analysis, Institute of Statistics and Demography. E-mail: ewaf@sgh.waw.pl.

The main aim of this paper is the analysis of cohort patterns changes of female fertility in Poland using stochastic fertility tables. There are various methods of constructing such stochastic fertility tables. The most popular and the least complicated approach is to treat the birth of each child as a single event and investigate single episode model. In this paper stochastic fertility tables have been constructed based on staging process (Willekens, 1991) using multi episode models. The construction of such tables necessitates taking into account the time of waiting for an event, which is the birth of a child. This requires the use of event history analysis methods (Graunt, 1962; Liu, 2012) in the modelling. This approach made it possible to comprehensively analyse successive births as sequences of events. The cohort approach is very common in fertility behaviour studies, because it allows the researchers to compare the fertility of each generation of women in a particular moment of their lives. One publication (Frejka and Calot, 2001), describing the fertility patterns in low fertility countries, studied women born in the years 1930-1970. In the majority of the 27 countries analysed, the total fertility rate decreased for each subsequent birth cohorts. In order to reverse this trend, women who are at the beginning of their fertility period should adopt vastly different fertility patterns than women born in 1960s and 1970s. The analysis of fertility patterns for groups of women born in the same year can be also found in many other publications (Frejka and Sardon, 2004; Sobotka, 2003).

Properly constructed fertility tables provide important information regarding women's fertility behaviour. They allow us to answer questions such as: when did a given woman give birth, at what age, and how many children does she have. A complementary character of such information is very important; therefore studies offer various methods of supplementing the missing information for cohort fertility schedules (Cheng and Lin, 2010).

This paper aims to analyse the fertility behaviour of women in Poland, based on the stochastic fertility tables constructed for five-year generations, from 1931-1935 to 1976-1980. Five-year age groups are widely used in the studies of female fertility (for example: Lee, 1974), which makes our results comparable with the results of other similar works. The data used for constructing the fertility tables come from "Fertility of Women" study conducted along with the National Census of Population and Housing in Poland in 2002. The basis for this study, received from the Central Statistical Office, was created for the "Epidemiology of fertility dangers in Poland – multi-centre, prospective cohort study" research project by pairing the information from Form D "Women's fertility" with selected results from Form A "National Census of Population and Housing 2002" [3]. The results of

[3] Research project: Epidemiology of fertility dangers in Poland – multi-centre, prospective cohort study / Ministry of Science and Higher Education ordered grant, decision K 140/P01/2007, Repro_PL, project director: Professor Wojciech Hanke, MD, PH.D., J. Nofer Occupational Medicine Institute in Łódź. Project implementation: 2007 – 2011.

Within the abovementioned project framework, the Event History and Multilevel Analysis Unit of the Institute of Statistics and Demography conducted two research assignments:

Research Assignment 1.1.1 *Demographic and socio-economic reasons for low fertility and total fertility rate in Poland (postponing the childbearing decisions – descriptive and modelling analyses). Past, present, perspectives.*

Research assignment 1.1.2 Late fertility and childbearing diagnosis (postponing the childbearing decisions; plans and preferences – cohort prospective study (quantitative and qualitative) of demographic, socio-economic and health factors. For the purpose of research assignment 1.1.1, the research team received the relevant National Census of 2002 data from the Central Statistical Office.

descriptive fertility tables for single cohorts 1911-1986, where the birth of each child is treated as a single-episode process and not a staging process, based on the results of "Women's Fertility" study conducted along the Census of 2002, are included in the work (Frątczak and Ptak-Chmielewska, 2011a, 2011b). Moreover, the results of the preliminary analysis of this data set are contained in (Frątczak and Grzenda, 2011). This text is a continuation of the latter research on the subject of cohort fertility based on the "Women's Fertility" data.

The scope of the analysis conducted allows us to verify numerous research hypotheses regarding the changes of fertility behaviour of Polish women after World War II. The reasons for these changes can be linked to the Second Demographic Transition (Van de Kaa, 1987), which relates to the demographic changes from the beginning of 1990s in Central-Eastern Europe. Regarding fertility, these changes are characterized mostly by a decrease in fertility rate and postponing the decision of first birth.

Analysing births in Poland (Bolesławski, 1974; 1975; Paradysz, 1992) we can conclude that the baby boom in 1970s and 1980s is an echo of the post-war baby boom of 1950s. Taking into consideration other publications dealing with the issue of fertility analysis we have posed two research hypotheses. The oldest birth cohorts: 1931-1935 and 1936-1940 are characterized by the largest probability of forth and subsequent births. The 1951-1955 and 1956-1960 birth cohorts exhibit a high staging probability of second and third births. At the end of the 20th century we saw the lowest level of fertility in virtually every European country (Frejka and Sardon, 2004). In this study we will verify the hypothesis that the youngest birth cohorts: 1971-1975 and 1976-1980, are characterized by the greatest probability of remaining childless and the lowest rate of successive births. The calculations of stochastic fertility tables for investigated cohorts not only allow verifying these hypotheses but also allow determining the exact differences in the fertility for these cohorts.

2. Research Method

The majority of methods used for population research are based on the probability theory because births, migrations or mortality for each individual can be considered an event. Each event is a transition from one state into another, and each individual at risk of each event has a certain positive probability of experiencing the transition between states (Namboodiri, 1991). We are interested not only in the time of occurrence of a given event, but also how often this event occurred during an individual's life and what the probability of such event occurring in a given timeframe is. The analysis of random events is based on the analysis of random variables. These variables are indexed with a certain parameter, interpreted as time; therefore the result is a stochastic process (Chiang, 1980).

The staging process is a sequence of certain events, generated by a random mechanism, bearing in mind that a multiple occurrence of the same event at the same time is impossible. It differs from the Markov process in that it has a certain sequence and is irreversible, while in Markov process there are recurring stages. Examples of staging processes in survivability analysis can be found in (Chiang, 1985), in medical applications and in fields related to fertility. Therefore, an example of a staging process is the fertility process:

0 *children*→ 1 *child* → 2 *child* → 3 *child* → … → *n–th child*.

An elementary process is a process which generates one event – the occurrence of the event in a given time is the end of the elementary process. A chain of independent elementary processes defines a staging process: the first elementary process generates the first event and triggers the second elementary process, which in turn generates the second event, etc.

In order to describe the staging process we assume the following notation:

μ_n – intensity of the n-th event,

X_n – the time of occurrence of the *n*-th event; the times are ordered increasingly: $X_0 < X_1 < X_2 < \ldots$,

U_n – the period of waiting for the occurrence of the *n*-th event: $U_n = X_n - X_{n-1}$,

N_x – the number of events.

The schema of staging process with 5 events can be defined as follows:

The process intensity:

$$0 \xrightarrow{\mu_1} 1 \xrightarrow{\mu_2} 2 \xrightarrow{\mu_3} 3 \xrightarrow{\mu_4} 4 \xrightarrow{\mu_5} 5$$

Waiting time:

$$X_0 \xrightarrow{U_1} X_1 \xrightarrow{U_2} X_2 \xrightarrow{U_3} X_3 \xrightarrow{U_4} X_4 \xrightarrow{U_5} X_5$$

Please note that the waiting period for the first event, which is the birth of the first child, is a random variable with no memory parameter. This parameter, also known as the Markov's parameter, is characteristic of an exponential distribution. After the first event has occurred everything starts again. Therefore, we assume that successive periods of waiting for childbirth are independent random variables with exponential distribution.

The theoretical basis for constructing fertility table is the Poisson process, where the times between two successive events (waiting periods) U_n are independent random variables with exponential distributions, but with different parameters.

In the analysed process, the measure that has been found is the intensity (hazard) function. For the *n*-th event it is expressed by the formula:

$$\mu_n = \lim_{\Delta x \to 0} \frac{P(x < X_n \le x + \Delta x \mid X_n \ge x)}{\Delta x}.$$

It is the probability of the occurrence of the *n*-th event within the time interval, assuming that the event with the number *n*-1 had occurred before the process reached time *x*.

Distribution function of the waiting period for *n*+1 event is not dependant on the occurrence of the n-th event:

$$F_{n+1}(u) = P(U_{n+1} \leq u) = 1 - \exp(-\mu_{n+1}u) = 1 - \exp(-\mu_{n+1}u).$$

The density function for the time period between *n* and *n+1* event is given as:

$$f_{n+1}(u) = P(U_{n+1} = u) = \frac{\partial P(U_{n+1} \leq u)}{\partial u} = \mu_{n+1}\exp(-\mu_{n+1}u).$$

The probability that the event does not occur before the time *x,* i.e. survival function, is: $P(N_x = 0) = P(X_1 > x) = \exp(-\mu_1 x)$.

The probability that the process being at the first stage at the time *x* is exposed to the risk of experiencing the first event is called stage probability and labelled as: $S_1(x)$.

The probability that the event occurs exactly once in the interval $(0, x)$ is denoted by $P(N_x = 1)$. It is stage probability $S_2(x)$, which means that the process at the time *x* is at the stage 2. If the dependant events process $\mu_1 \neq \mu_2$, then the probability is determined as follows:

$$S_2(x) = P(N_x = 1) = \frac{\mu_1}{\mu_1 - \mu_2}\left(\exp(-\mu_2 x) - \exp(-\mu_1 x)\right).$$

The probability that the event occurs exactly *n*-1 times within the $(0, x)$ interval is calculated as:

$$S_n(x) = P(N_x = n-1) = (-1)^{n-1}\left[\prod_{j=1}^{n-1}\mu_j\right]\sum_{j=1}^{n}\frac{\exp(-\mu_j x)}{\prod_{\substack{k=1 \\ k\neq j}}^{n}(\mu_j - \mu_k)}.$$

While constructing the fertility tables we calculate such staging probabilities for successive births. In the staging process analysis, we quite often identify the moment from which we start measuring the duration of a given process – this study assumes a period of 15 years, and the time axis covers the following age of women: 15 – 49 years.

Based on the formulas presented, using the exponential distribution, we have calculated the hazard value for each event μ_n, $n = 1, 2, \ldots, 5$ and then the staging probability values for successive births. This study presents the staging probabilities for five-year age groups: 15-19, 20-24,…, 45-49.

3. Estimation Results

Based on the formulas presented in the previous section we have created an original program for calculating the characteristics of fertility tables. The estimation of all models was conducted in SAS systems. The estimation of fertility tables was conducted taking into consideration weights, therefore the results may be generalized for the entire population of women. In this chapter we present and interpret the resulting parameters of stochastic fertility tables.

In tables 1-7 we include the staging probabilities of successive births for five-year age groups of women: 15-19, 20-24,…, 45-49, determined for five-year generations, from 1931-1936 to 1976-1980.

Table 1. The stage probabilities of successive births – women aged 15-19

Birth cohorts	0 children	1 child	2 children	3 children
1931-1935	0.8696	0.0941	0.0307	0.0051
1936-1940	0.8536	0.1080	0.0349	0.0031
1941-1945	0.8471	0.1161	0.0306	0.0057
1946-1950	0.8757	0.0972	0.0239	0.0030
1951-1955	0.8921	0.0844	0.0210	0.0024
1956-1960	0.8836	0.0869	0.0259	0.0033
1961-1965	0.8685	0.0969	0.0288	0.0039
1966-1970	0.8625	0.0998	0.0323	0.0052
1971-1975	0.8681	0.1005	0.0274	0.0034
1976-1980	0.8994	0.0817	0.0171	0.0016

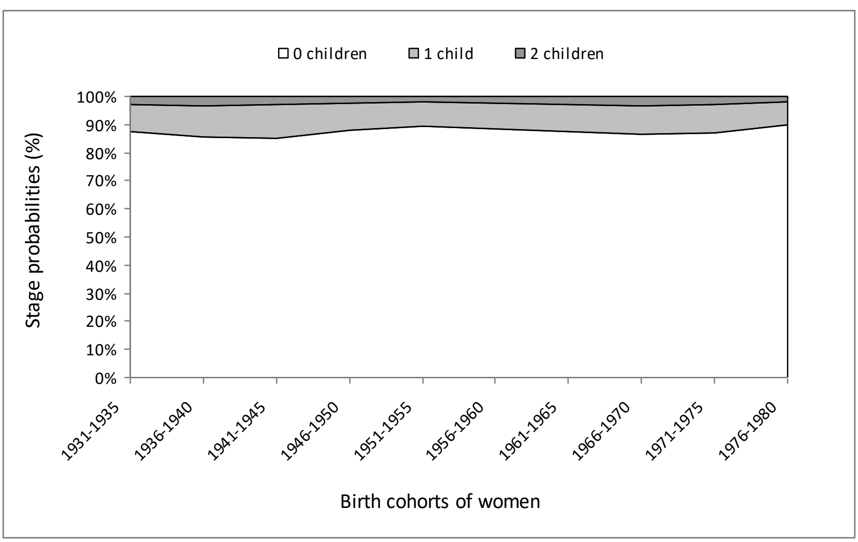

Figure 1. Distribution of stage probabilities of births – women aged 15-19

In Table 1, we present the stage probabilities for women aged 15-19. The stage probabilities of successive births for all generations are similar (Figure 1). In the case of first births, the highest probability is observed for 1936-1940, 1941-1945 and 1971-1975 cohorts.

Table 2 includes the values of stage probabilities for women aged 20-24. The youngest cohorts: 1971-1975 and 1976-1980 are the cohorts with the highest percentage of childless women, which is clearly visible in Figure 2. The stage probability values for first births for all generations are similar, peaking for generation 1946-1950 and 1971-1975. The stage probabilities of second births for generations from 1931-1940 to 1966-1970 are similar, reaching the highest value for 1961-1965 cohort, while the probability value is lowest for the two youngest cohorts. It is important to note a steady drop in higher-order births for each subsequent birth cohort.

Table 2. The stage probabilities of successive births – women aged 20-24

Birth cohorts	0 children	1 child	2 children	3 children	4 children	5+ child.
1931-1935	0.4462	0.1849	0.2033	0.1061	0.0412	0.0183
1936-1940	0.4284	0.2077	0.2264	0.0956	0.0319	0.0100
1941-1945	0.4252	0.2380	0.2199	0.0835	0.0252	0.0082
1946-1950	0.4471	0.2477	0.2086	0.0703	0.0201	0.0062
1951-1955	0.4478	0.2363	0.2221	0.0709	0.0173	0.0056
1956-1960	0.4320	0.2194	0.2355	0.0855	0.0209	0.0067
1961-1965	0.4137	0.2154	0.2485	0.0895	0.0266	0.0063
1966-1970	0.4299	0.2289	0.2341	0.0788	0.0214	0.0069
1971-1975	0.5029	0.2511	0.1818	0.0502	0.0114	0.0026
1976-1980	0.6680	0.2247	0.0887	0.0163	0.0021	0.0002

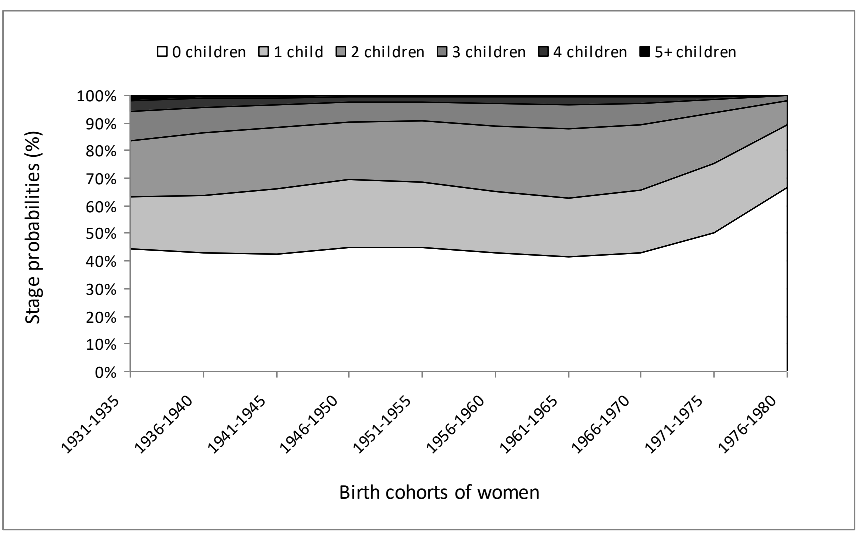

Figure 2. Distribution of stage probabilities of births – women aged 20-24

Table 3 presents the values of stage probability for women aged 25-29. The highest probability of remaining childless is observed for the youngest birth cohort: 1971-1975, but at the same time this cohort is characterized by the highest probability of first births. A higher probability of first births is also visible for generations 1941-1945, 1946-1950 and 1966-1970. When it comes to second births, they are at a similar level, bearing in mind that they are the lowest for the youngest and oldest cohorts, and the highest for 1956-1960 and 1961-1965 cohorts. We can also see that the oldest cohort has the highest value of third births, while this probability is lowest for the youngest cohort (Figure 3).

Table 3. The stage probabilities of successive births – women aged 25-29

Birth cohorts	0 children	1 child	2 children	3 children	4 children	5+ child.
1931-1935	0.2584	0.1560	0.2694	0.1831	0.0838	0.0493
1936-1940	0.2468	0.1791	0.3070	0.1662	0.0639	0.0370
1941-1945	0.2453	0.2133	0.3085	0.1487	0.0569	0.0273
1946-1950	0.2536	0.2123	0.3229	0.1409	0.0487	0.0216
1951-1955	0.2496	0.1976	0.3357	0.1455	0.0495	0.0221
1956-1960	0.2374	0.1734	0.3515	0.1616	0.0519	0.0242
1961-1965	0.2257	0.1778	0.3503	0.1655	0.0565	0.0242
1966-1970	0.2434	0.2123	0.3404	0.1443	0.0427	0.0169
1971-1975	0.3270	0.2828	0.2841	0.0812	0.0192	0.0057

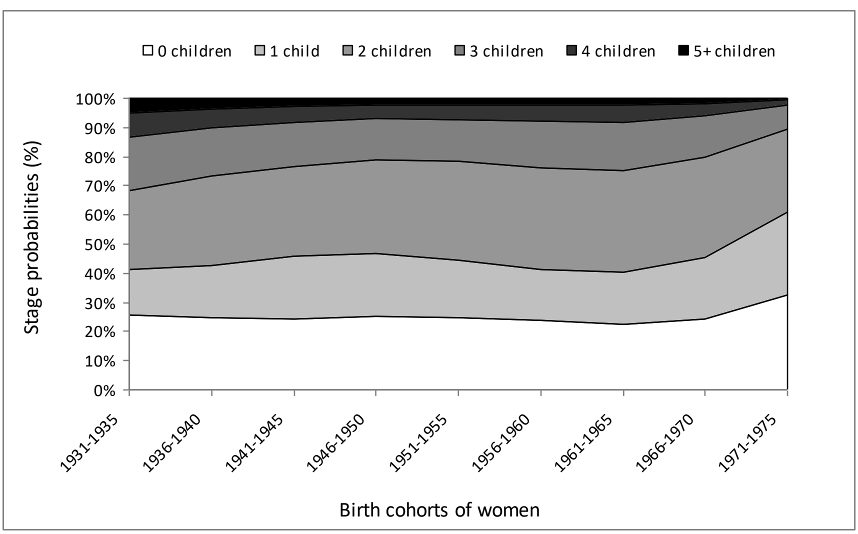

Figure 3. Distribution of stage probabilities of births – women aged 25-29

Analysing Table 4 and Figure 4 we can see that for women aged 30-34 the values of each probability are similar for “middle” cohorts. It is worth noting that the highest value of fourth births is observed for the oldest cohort. There is also a significantly lower probability of first births in favour of second births for generations 1956-1960 and 1961-1965, as well as a higher value of first births probability for cohorts 1941-1945, 1946-1950 and 1966-1970.

Table 4. The stage probabilities of successive births – women aged 30-34

Birth cohorts	0 children	1 child	2 children	3 children	4 children	5+ child.
1931-1935	0.1718	0.1289	0.3027	0.2230	0.1080	0.0656
1936-1940	0.1624	0.1501	0.3485	0.2025	0.0872	0.0493
1941-1945	0.1576	0.1803	0.3559	0.1925	0.0741	0.0396
1946-1950	0.1631	0.1788	0.3744	0.1858	0.0654	0.0325
1951-1955	0.1588	0.1601	0.3900	0.1930	0.0657	0.0324
1956-1960	0.1499	0.1409	0.4021	0.2053	0.0691	0.0327
1961-1965	0.1403	0.1450	0.4045	0.2075	0.0713	0.0314
1966-1970	0.1575	0.1942	0.4078	0.1754	0.0482	0.0169

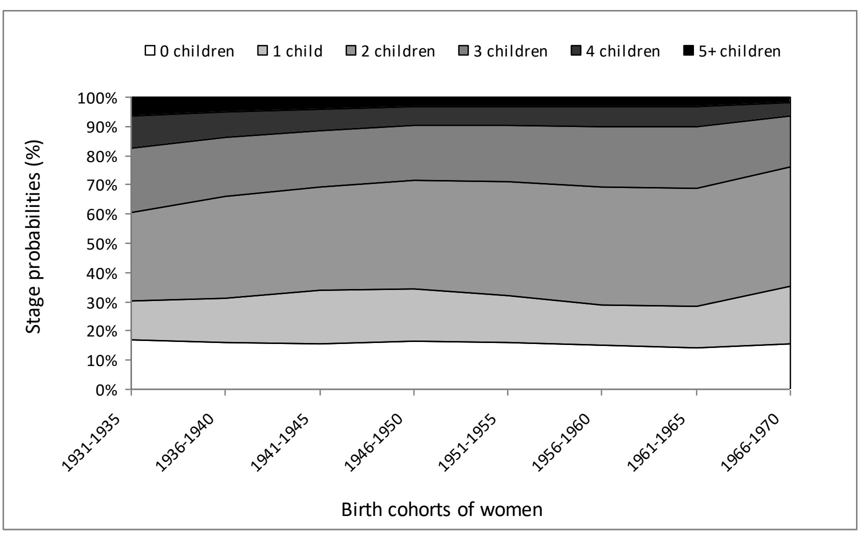

Figure 4. Distribution of stage probabilities of births – women aged 30-34

Analysing the values of stage probability of successive births for women aged 35-39, based on Table 5 and Figure 5, we can observe the highest probability of second births. However, for subsequent cohorts, beginning with the oldest one, we observe a drop in the number of higher-order births.

Table 5. The stage probabilities of successive births – women aged 35-39

Birth cohorts	0 children	1 child	2 children	3 children	4 children	5+ child.
1931-1935	0.1202	0.1116	0.3264	0.2542	0.1195	0.0681
1936-1940	0.1117	0.1313	0.3793	0.2265	0.0988	0.0524
1941-1945	0.1080	0.1596	0.3922	0.2175	0.0815	0.0412
1946-1950	0.1107	0.1593	0.4119	0.2127	0.0718	0.0336
1951-1955	0.1063	0.1382	0.4319	0.2166	0.0744	0.0326
1956-1960	0.0996	0.1206	0.4379	0.2323	0.0759	0.0337
1961-1965	0.0925	0.1252	0.4476	0.2317	0.0738	0.0292

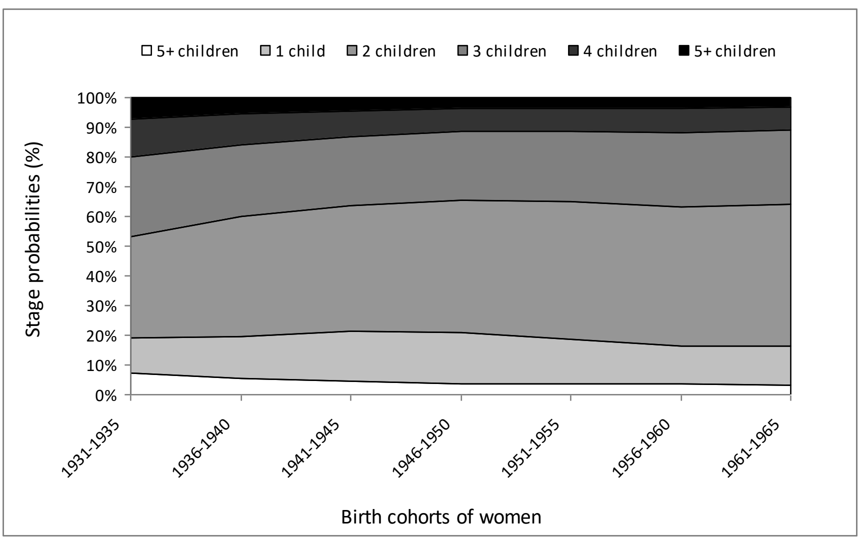

Figure 5. Distribution of stage probabilities of births – women aged 35-39

The results presented in Tables 6 and 7 are not significantly different than the ones presented in Table 5. Therefore, the figures for the women aged 40-44 and aged 44-49 have been omitted. We can observe that the percentage of childless women is very similar for all generations analysed, and the most common number of births is 2.

Table 6. The stage probabilities of successive births – women aged 40-44

Birth cohorts	0 children	1 child	2 children	3 children	4 children	5+ child.
1931-1935	0.0870	0.0992	0.3486	0.2764	0.1249	0.0639
1936-1940	0.0799	0.1182	0.4076	0.2451	0.1017	0.0475
1941-1945	0.0769	0.1467	0.4250	0.2332	0.0814	0.0368
1946-1950	0.0781	0.1468	0.4462	0.2289	0.0712	0.0288
1951-1955	0.0742	0.1240	0.4675	0.2321	0.0743	0.0279
1956-1960	0.0687	0.1063	0.4719	0.2490	0.0756	0.0285

Table 7. The stage probabilities of successive births – women aged 45-49

Birth cohorts	0 children	1 child	2 children	3 children	4 children	5+ child.
1931-1935	0.0648	0.0895	0.3664	0.2937	0.1271	0.0585
1936-1940	0.0592	0.1081	0.4295	0.2584	0.1023	0.0425
1941-1945	0.0568	0.1359	0.4497	0.2446	0.0808	0.0322
1946-1950	0.0569	0.1367	0.4725	0.2396	0.0696	0.0247
1951-1955	0.0534	0.1123	0.4953	0.2427	0.0727	0.0236

Based on the presented stage probability results for successive birth cohorts we can single out two cohorts: the post-war baby boom cohort 1951-1955 and the younger analysed cohort 1971-1975. For birth cohort 1971-1975 we can see that the percentage of childless women is larger than in the 1951-1955 cohort. Moreover, we can observe that the number of successive births is getting lower. The greatest value of state probabilities for first births for women aged 20-24 was obtained for birth cohort 1971-1975. This value for cohort 1951-1955 is similar to other cohorts. Similarly for women aged 25-29, but this difference between birth cohort 1971-1975 and other cohorts is much deeper. Based on the stage probabilities of second births values for 1951-1955 and 1971-1975 cohorts there is a visible decline for women aged 20-24 and 25-29.

Finally, we compare the stage probability values for 1951-1955 and 1971-1975 cohorts, for third births. For 1951-1955 cohort we can observe an increasing trend for third birth for each age group, starting with women aged 15-19. For the youngest birth cohort 1971-1975 the trends are the total opposite of the ones exhibited by 1951-1955 cohort.

Analysing the stage probability values for first births we can see that the first birth occurs most frequently among women aged 20-24 and 25-29, regardless of their year of birth. We can see that the highest probability of first births in the age group 25-29 occurs in the youngest generation of women 1971-1975, and the lowest probability occurs in the oldest generation. Moreover, the highest probability of first births for this cohort is also in the age group 20-24. Therefore, it can be concluded that among women aged 20-24, the women of birth cohort 1971-1975 with the highest probability gave birth to the first child, compared to other cohorts. On the other hand, the women of birth cohort 1971-1975 aged 20-24 begun decline in successive births.

5. Conclusions and Discussion

The goal of this study was to analyse the fertility behaviour of women in Poland, based on stochastic fertility tables constructed for 5-year generations from 1931-1935 to 1976-1980. We used stochastic fertility tables based on the staging process. This approach allows considering in modelling the sequence of events, not only each event separately.

Based on the presented results (Tables 1-7), it was found that there is no indication to reject the investigated hypotheses. It follows from the Tables 1-7 that the oldest birth cohorts: 1931-1935 and 1936-1940 are characterized by the largest probability of forth and subsequent births. Moreover, the 1951-1955 and 1956-1960 birth cohorts are characterized by a high staging probability of second and third births. Furthermore, the highest changes in the values of stage probabilities can be observed in the case of the last two generations: 1971-1975 and 1976-1980. They are the result of the reaction to the socio-economic and cultural transformation in Poland after 1989. The results of probability estimation clearly show that in every remaining cohort the probability of higher-order births is decreasing (Figure 1-5). The observed changes in fertility have been conditioned by various economic and socio-cultural factors, including migration. The analysis of these factors requires a different approach and is the subject of analysis performed by Polish and foreign researchers (Kotowska et al., 2008; Olah and Frątczak, 2013; Frejka et al., 2016).

There are various theories which can help explain the transformation changes of cohort fertility patterns in Poland. We must agree with McDonald's theory (McDonald, 2006; 2008), who argued that the emergence of low fertility is associated with two waves of social change that have profound effects upon family formation behaviour in the past 40 years. The first wave of change beginning in the 1960s was an expansion of social liberalism (the so-called reflective modernization) and the second wave beginning in the 1980s was an expansion of economic deregulation, the so-called new capitalism, but the most important is the labour market deregulation. While in the period of socialism in Poland, that is until 1989, these waves could not act with full force, for example because of government regulation of labour market, similarly to other socialist countries, their effect and importance became much more intense from the beginning of the transformation period. This translates into drastic changes in younger analysed cohorts: 1971-1975, 1976-1980. The labour market participation of women and their fertility is also the subject of many studies. In (Kotowska et al., 2008), authors indicated the connections between women's employment and their fertility. They hypothesize that female employment would have decline more if the women had not reduced their fertility. Moreover, the authors suggest that since the beginning of the 1990s the significance of educational achievements of women and their decision to have a baby have been characterized by a rapid development of higher education in Poland.

All theories related to the demographic changes described by the Second Demographic Transition (Van de Kaa, 1994; 1996; Lesthaeghe, 1991; 1998), that is: (a) the theory of increased female economic autonomy (Becker, 1991), (b) the theory of relative economic deprivation (Easterlin, 1976; 1979), and (c) the theory of ideational shift (Lesthaeghe and Surkyn, 1988; Bumpass, 1990**)** may be useful for explaining the changes in cohort fertility in Poland. On the other hand, in Poland after 1989, the intensity of changes of cohort fertility patterns increased rapidly along with the socio-economic transformation processes, which directly follows from the distribution of stage probabilities of births for women aged 20-24 (Figure 2). Therefore, it is worth agreeing with the opinion of Espanding-Andersen and Billari (Espanding-Andersen and Billari, 2015), who state that because of the high intensity of changes in families in post-transitional societies, the explanation of the changes using the abovementioned three theories related to the Second Demographic transition is no longer sufficient. Similarly to many other transformation countries from Central and Eastern Europe, Poland is experiencing the process of both cohort and cross-section transformation, which is determined by numerous phenomena and processes.

The changes in actual cohorts translated into the changes of cross-sectional fertility and fertility rates, which is reflected in the low values of cross-sectional fertility rates. Our results (Figure 3) indicate that for women aged 25-29 a decline in the stage probability of second births takes place; at the same time, the stage probability of first birth is getting higher. This is consistent with other studies showing that there are significant changes in the nuclear family model in Poland (Frątczak, 2001; Frątczak and Kozłowski, 2005). During the transformation period in Poland the model of nuclear family changed from two-child model into one-child model, with a high percentage of childless families in the general structure. These changes were explained by some researchers using the effect of shifting, which in developed countries has been observed for cohorts of women born after World War II (Sobotka et al., 2012). However, more recent analysis of 15 Central and East European (CEE) countries, including Poland, confirms these tendencies (Frejka et al., 2016) and shows that despite the growth in fertility rates in the late 2000s, the fertility still remains at a low level.

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