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POLAND AND UKRAINE IN THE LIGHT OF PARADYSZ'S PERIOD FERTILITY MODEL

The article reflects research issues, which are currently considered to be of utmost importance in methodology of period fertility analysis. In the cohort analysis we dispose many possibilities to describe human reproduction process. The period analysis is not so reach and we would like to use the same methods in the both one. Many years ago one of us have proposed a decomposition of the period total fertility rate in order to calculate period "theoretical" birth intervals. Combining the two systems demographic analysis (parity progression ration and increment–decrement tables) we decompose the "classic" total fertility rate (TFR) on the last and non–last children in period analysis.

Keywords: period fertility analysis, period birth intervals, last and non–last children decomposition of the total fertility rates by order.

Introduction. In modern fertility analysis we distinguish the tempo and the structure of births. In cohort analysis there are many ways to describe the human reproduction process. Period analysis, on the other hand, does not offer as many possibilities, and we would like to use the same methods in the both types of analysis. Many years ago one of us proposed a decomposition of the period total fertility rate in order to calculate period–based "theoretical" birth intervals. The first reference to "Paradysz's model" was probably made in the textbook edited by J. Kurkiewicz in 2010 with respect to birth intervals. On page 193 of the textbook one can find the following table, where Paradysz's model is compared with Ryder's model.

Table 1. **Mean birth intervals (in years) in real cohort 1955–60, Poland**

Formula	Mean intervals between successive births in years						
	1 and 2	**2 and 3**	**3 and 4**	**4 and 5**	**5 and 6**	**6 and 7**	**7 and 8**
N. B. Ryder (1969)	3.57	3.53	4.18	4.21	5.86	9.31	4.03
J. Paradysz (1985)	.3,21	2.90	1.88	1.57	2.44	3.41	1.08
J. Paradysz (1995)	3.70	4.54	4.49	4.20	3.84	3.40	3.41

Sources: own case study on the basis of [3–5, 7].

What can be said about these results? In the case of Ryder's model, what strikes us is the very high mean interval between the 6th and 7th births: 9.31 year. Another suspiciously high value is the interval between 5th and 6th births: 5.86 year. In real generations, even in modern conditions of controlled fertility, such mean birth intervals do not normally occur. Moreover, studies of birth spacing in real generations suggest that intervals tend to decrease with increasing birth order. This tendency is not evident in Ryder's model.

Methodology. Paradysz's model (1985) is not satisfying, either. Mean birth spacing are too small, and although initially they tend to decrease, they do significantly increase for higher–order births. It should be noted at this point that Table 1 refers to the real population. For this reason the model does not account for changes in the calendar of births in real generations. We will try to solve these problems later on. J. Paradysz, who devoted a number of articles to birth intervals in 1980s and had initially developed his model independently of Ryder, later on came to the conclusion that Ryder's approach was more valid. The difference between the two models was the fact that J. Paradysz's original proposal, which is also used by J. Kurkiewicz, did not account for the distinction between last and non–last children, as was the case in N.B. Ryder's model (1969).

Ryder's model.

Assuming that the mean age at *p–order* birth is a weighted mean of the probability of giving birth and not giving birth of a child of a given order and the mean age of giving birth to a non–last and the last child, i.e.:

$$\bar{x}(p) = \bar{x}'(p) \cdot A(p) + \bar{x}''(p) \cdot \left[1\text{-}A(p)\right] \qquad (1)$$

The formula is a weighted mean of the two remaining means weighted by the birth coefficient (in cohort analysis it can be called birth probability) ***A(p)*** or not giving birth to the p–*th* child ***(1–A(p))***.

The mean age of the last born child can, according to N.B. Ryder [1969], be expressed as:

$$\bar{x}'(p) = \bar{x}(p)\text{-}\left[\bar{x}''(p)\text{-}\bar{x}'(p)\right] \cdot \left[1\text{-}A(p)\right] \qquad (2)$$

Ryder suggested calculating the interval between births of the order *p* and *p*+1 N.B. using the following formula:

$$B(p) = \bar{x}(p+1)\text{-}\bar{x}'(p) \qquad (3)$$

or making use of (2):

$$B(p) = \bar{x}(p+1)\text{-}\bar{x}(p) + (1\text{-}A(p)) \cdot \left[\bar{x}''(p)\text{-}\bar{x}'(p)\right] \qquad (4)$$

When observing births in a given calendar year, despite knowing the interval elapsed since the last birth, one does not know whether a given child is the last one or whether his mother will have more children in the future. To solve this problem N.B. Ryder assumed that:

$$\bar{x}''(p) = \bar{x}(p+1) \qquad (5)$$

Analysis of empirical data from Poland [4, p. 63] suggests that accepting Ryder's hypothesis yields dubious results, which is evident in Table 1.

Paradysz's adjusted model (1995).

The revised approach involves integrating two methods of fertility analysis: input–output tables and gross maternity function. The proposed solution of calculating birth intervals involves decomposing gross maternity function *F(x,p)* into *F'(x,p) and* into *F''(x,p)* in the following manner:

$$F'(x,p) = F(x,p) \cdot \left[1\text{-}Q(x+1, p+1)\right] \qquad (6)$$

and

$$F''(x,p) = F(x,p)Q(x+1, p+1) \qquad (7)$$

where: *F'(x, p)* – maternity function for women who do not give birth to their last *p–th* child at age *x* but will still give

birth *p*+1 times in the future; *F"(x,p)* – maternity function for women who at age *x* give birth to their last *p–th* child.

The starting point for this approach is the well–known concept of the probability of giving birth to a child of the order *p*+1 at age x for mothers who have given birth to *p* children by age x. This probability can be estimated using the formula known from input–output tables.

$$P(x,p) = \frac{F(x,p+1)}{I(x,p)} \quad (8)$$

where: *F(x, p+1)* is partial fertility coefficient decomposed by age and birth order, and *I(x,p)* is a function of living to age x for women who have given birth to *p* children

Using the probabilities above, we can introduce probability *Q(x,p)* of not giving birth to children of a given order by the end of the child bearing age.

$$Q(x,p) = \prod_{z=x}^{50} [1\text{-}P(z,p)] \quad (9)$$

The model's validity can be tested by applying the following identities:

a) mean number of last children per woman is equal to the number of first children:

$$F(1) = TFR" \quad (10)$$

where *TFR"* denotes the number of last children;

b) the sum of last children of consecutive orders amounts to the "total" number of last children:

$$TFR" = \sum_{p=1}^{d} F"(p) = \sum_{p=1}^{d} \sum_{x=a}^{b-h} F"(x,p) \quad (11)$$

where *a* and *b* denote, respectively, the lower and upper limit of a woman's childbearing age, while h is the class interval of women's age;

c) The sum of last and non–last children is equal to the conventional total fertility rate:

$$TFR = TFR' + TFR'' \quad (12)$$

Results. A great importance of the problems considered here can provide a full of emotion discussion in many countries over the causes of the very low total fertility rate in the last quarter. However, to say that the majority of European countries are on the road to self–destruction, it is also hard to justify, as once fears about overcrowding resulting from a baby boom. Thanks to the works cited above NB Ryder, we know that the baby boom was a result of acceleration of the births tempo in real women generations. However the main difficulty lies in the fact that the birth tempo changes we can find out only when almost of real generations come out of women reproductive period, and so, theoretically, after 35 years. Hence the need for period birth intervals analysis in the way as we count total fertility rates. Our proposed methodology gives such possibility. Presenting its usefulness we use the fertility rates by women age and birth order from the Human Fertility Database for Ukraine and Russia and the Polish database Demografia from Central Statistical Office. Some of these possibilities are shown in the several diagrams.

We are starting with conventional maternity function for Poland Ukraine and Russia in order to compare our results on the neutral ground. We choose the last available data from the Human Fertility Database for Russia and Ukraine and from Polish Central Statistical Office for our country. For comparison in all three countries chose the year 2009 as the most recent.

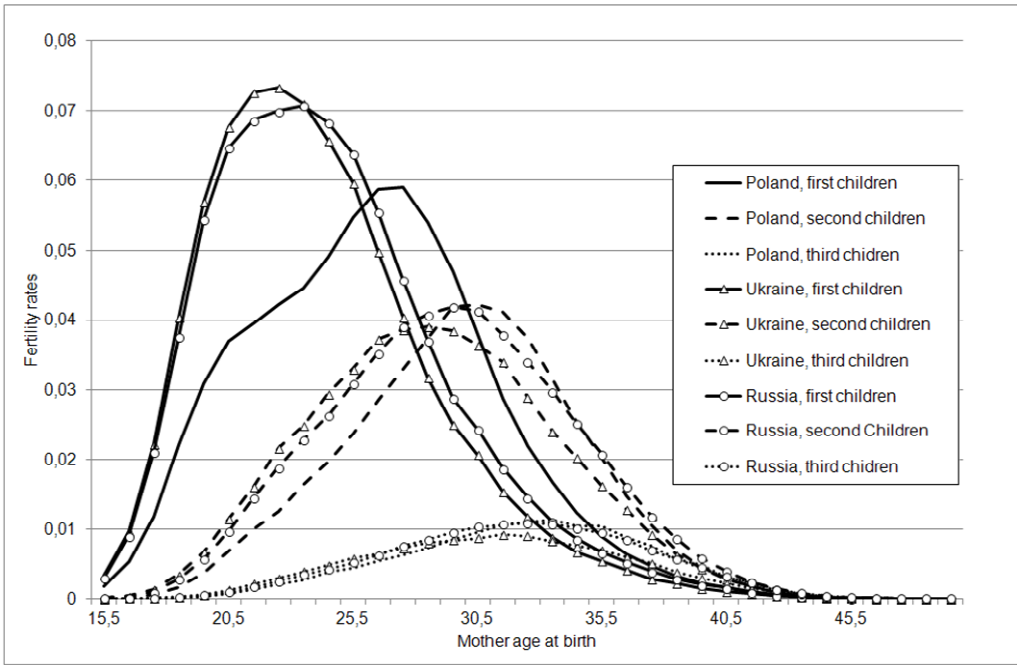

Fig. 1. Comparison of fertility rates in Poland, Ukraine and Russia in 2009, all children by birth order

Source: the own calculation on the base of The Human Fertility Database for Russia and Ukraine and Central Statistical Office for Poland.

As we can see on fig. 1, Poland is quite different from the her east neighbors. The first children were in Poland much less frequent, F(1,2009) = 0,704, in Ukraine 0,771 and in Russia 0,800 first children per statistical woman. On the other hand in Poland we note much higher mean age at first birth – 26,2 years in comparison 24,2 in Ukraine and 24,6 in Russia. In the case of second and the third children the differences were much smaller although the Polish woman gives birth to second child at 29,9 years while the Russian at 29,5 and the Ukrainian at 28,8. Traditional analysis of fertility rates do not tell us much about reproductive behavior change in the last quarter. Each birth order is analyzed

separately without connections between them. However, according to the logic of transversal analysis can be considered the birth of all the order so as to have taken place in only one calendar year. Thus, we can say in this case, not only the number of children born in the hypothetical generation in period approach, but also about their spacing during a woman's life, ie birth intervals. For this purpose, in accordance with the formulas 6 and 7, we have made decomposition traditional female fertility rates p–th order for F'(p), when p–th child is not the last one and F"(p) for the children without younger siblings. Fig. 2 and 3 show the results of decomposition of classical maternity function F(xp) on the part that we attribute to women giving their birth p as the last – F"(xp) – and the non–last – F'(xp).

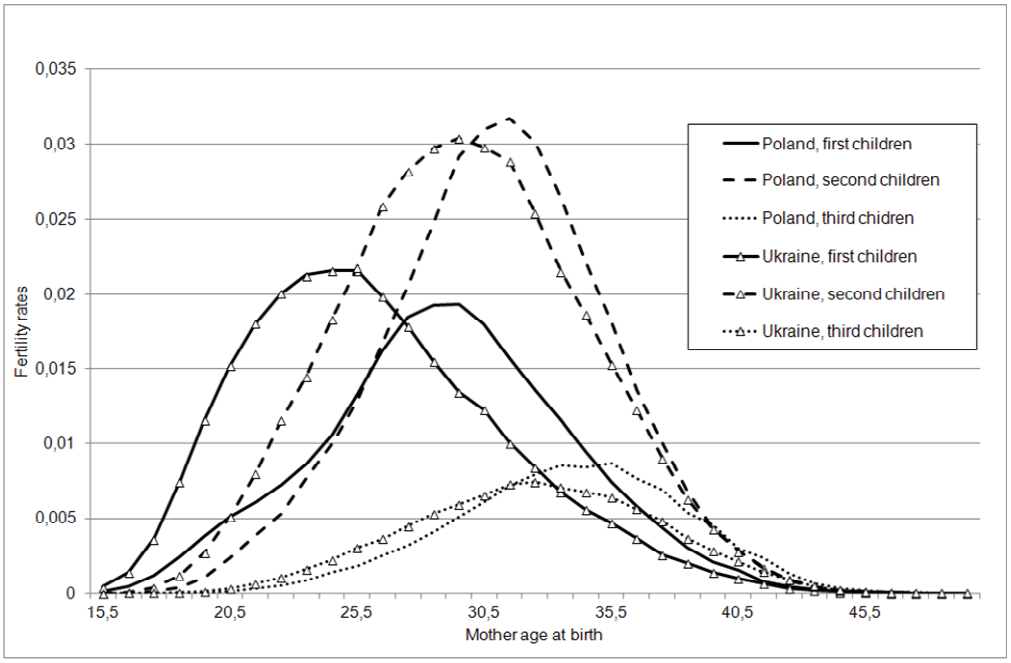

Fig. 2. Comparison of fertility rates in Poland and Ukraine in 2009, last children by birth order

Source: the own calculation on the base of The Human Fertility Database for Ukraine and Central Statistical Office for Poland.

The first children as last ones in 2009 in Ukraine and Russia were more frequent – F"(1) = 0,269 – than in Poland – F"(1) = 0,227. Relatively even greater differences we find in the average age of the birth of her only child. In Poland mean age at only child birth was in 2009 29,1 in Russia 26,8 and in Ukraine 26,3 years. In the case of second birth as last (without younger siblings) the differences were smaller: Ukraine – 29,8; Russia – 30,5 and Poland – 31,0 years.

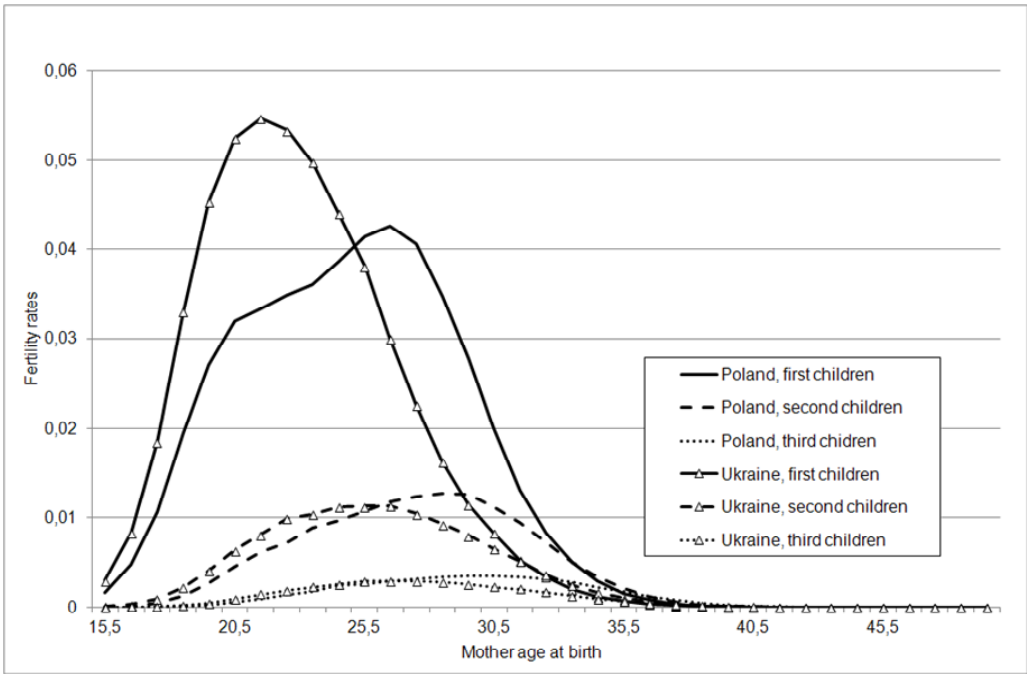

Fig. 3. Comparison of fertility rates in Poland and Ukraine in 2009, non–last children by birth order

Source: the own calculation on the base of The Human Fertility Database for Ukraine and Central Statistical Office for Poland.

The birth of the first child, which was not the last, were also more frequent in 2009 in Russia (F'(1) = 0,532) and Ukraine (F'(1) = 0,502) than in Poland (F'(1) = 0,478). The mean age at birth of the not–last first children was in Ukraine 23,0; in Russia 23,5 and in Poland 24,6 years. The second non–last children were more frequent in Russia [F'(2) = 0,147], next in Poland (0,142) and in Ukraine (0,126). The mean age at the third birth was respectively 26,8; 27,5 and 26,0 years. It means probably different strategies of family constitution in all three countries.

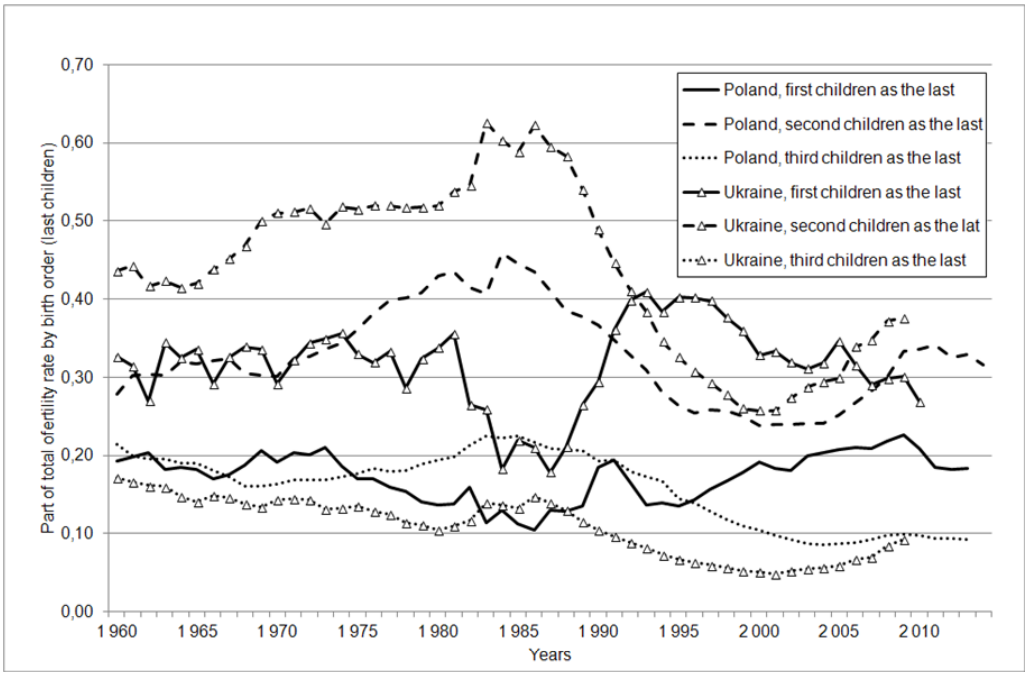

Fig. 4. The part of total fertility rate of last children (without the younger siblings) by birth order and calendar years Poland and Ukraine

Source: the own calculation on the base of The Human Fertility Database for Ukraine and Central Statistical Office for Poland.

Our method of female fertility analysis provides a number of parameters, so that can be better diagnose the population reproduction processes. Such parameters have calculated and showed in fig. 4. In fig. 4 and the following ones we show a very great breakthrough in the countries of former Soviet Union in eighties. In Poland in this time we observe the first baby boom echo, but on the Ukrainian and Russian demographic turning point it seems not important. However, non–last children category indicates just the opposite. On the basis of Fig. 5, we can conclude that the Polish dynamics of the first child was very similar to the Ukrainian.

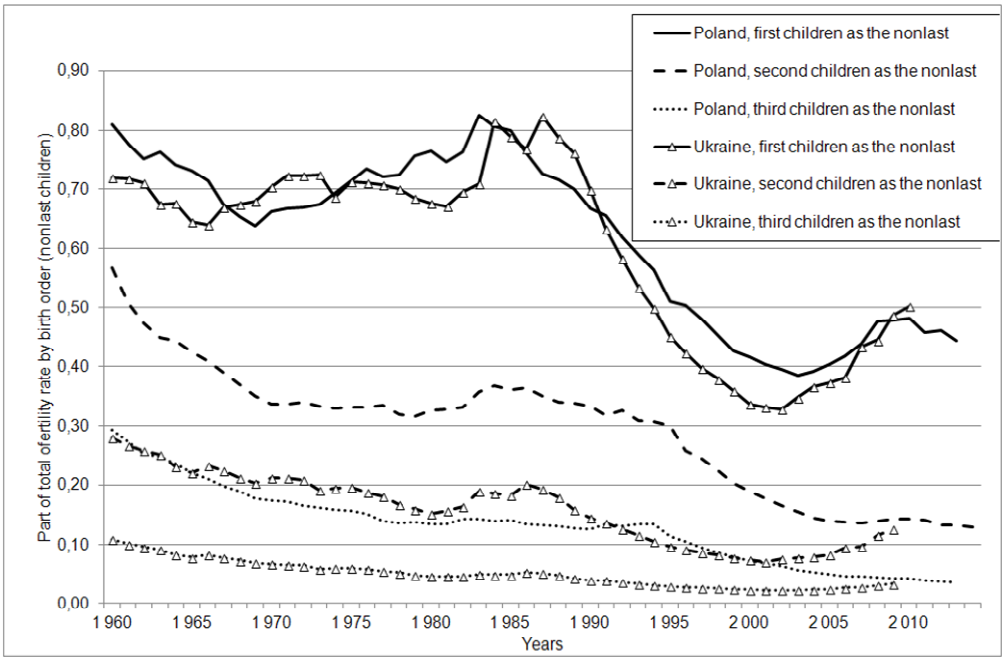

Fig. 5. The part of total fertility rate of non-last children (with the younger siblings) by birth order and calendar years Poland and Ukraine

Source: the own calculation on the base of The Human Fertility Database for Ukraine and Central Statistical Office for Poland.

So far, we considered two categories of fertility (last and non-last children), regardless of the observed decline in female fertility. Now we consider their structure – Fig. 6. In Ukraine is visible turn point in mid eighties as concern the first children only. In the both countries the share of last children is growing.

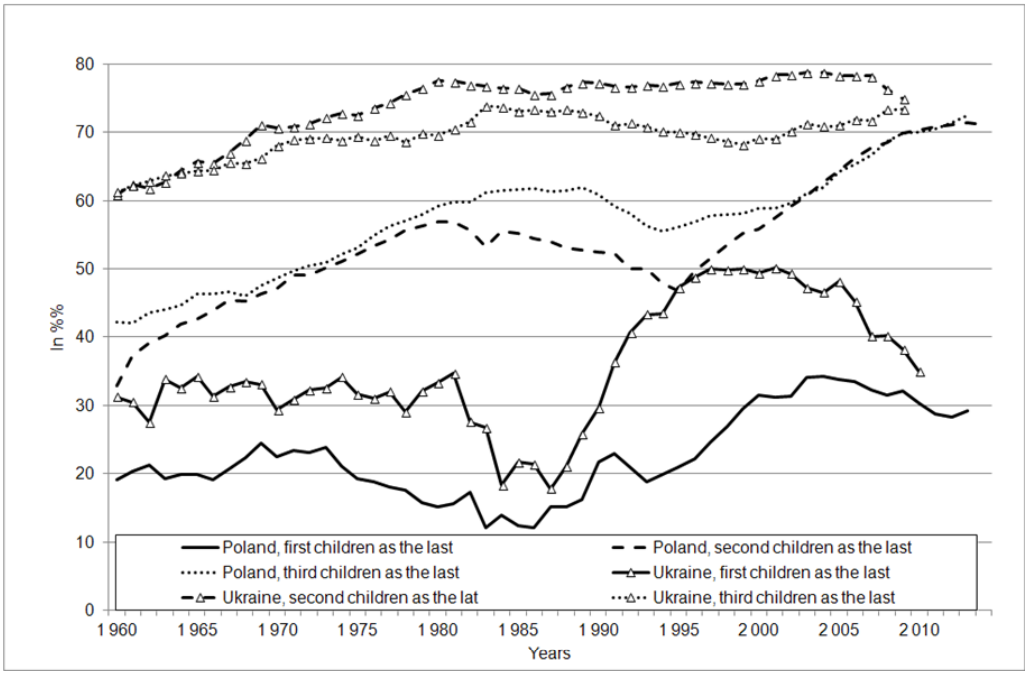

Fig. 6. Total fertility rate of last children (without the younger siblings) by birth order and calendar years in pourcentages of "classical" total fertility rates Poland and Ukraine

Source: the own calculation on the base of The Human Fertility Database for Ukraine and Central Statistical Office for Poland.

Looking at Fig. 3 may seem strange, but the first children as the last one in 2009 were relatively on the same level in all three countries from 32,2 % in Poland to 34,9 % in Ukraine of TFR – see fig. 6. In the case of parity 2, the percentages of last children in TFR(2) and TFR(3) were higher 70–80 % in the years 1970 – 2009 in Russia and Ukraine. In Poland this level was achieved in the last decade. Much higher differences we can see as concern the tempo of fertility. The Polish women all time have a higher mean age at maternity in all three subpopulation. Looking for socio–political determinants again we turn to comparisons between Ukraine and Russia. After all, legal systems and the economic situation of the population have a significant impact on women's fertility decisions. In the fig. 7 we can see very great similarity of this countries. Much more than Poland and Ukraine.

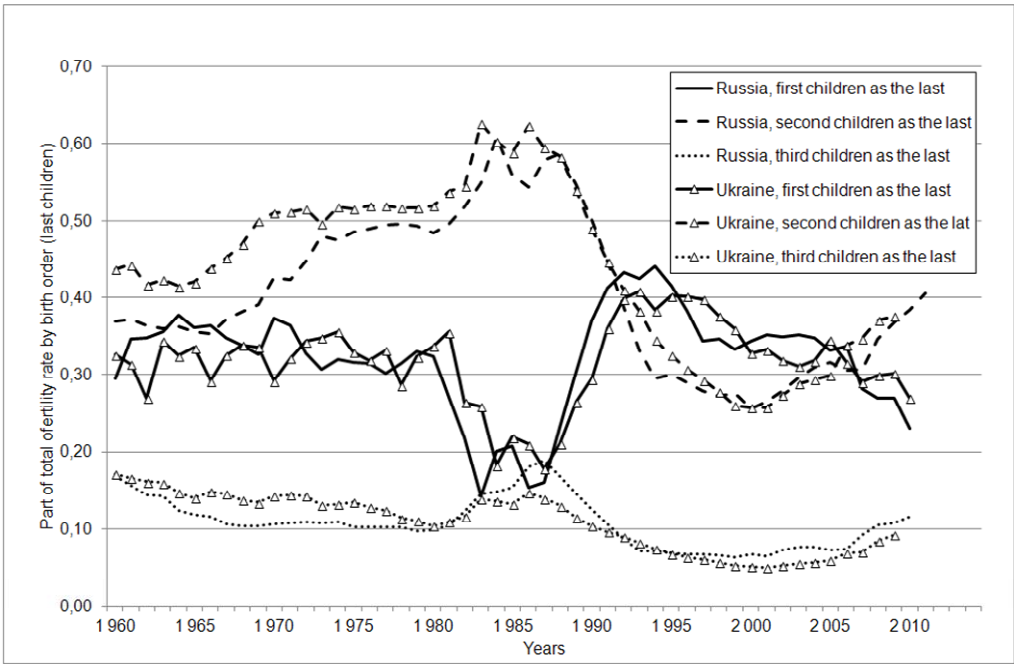

Fig. 7. The part of total fertility rate of last children (without the younger siblings) by birth order and calendar years Russia and Ukraine

Source: the own calculation on the base of The Human Fertility Database for Ukraine.

Figure 8 is the culmination of our analysis. Period birth intervals satisfy our desire to use the same research tools in the cohort and transversal analysis. Here again we see significant similarity course of procreation in Poland and Ukraine. However, as we checked, the similarity of Russia and Ukraine is much higher.

Fig. 8. Period birth intervals in Poland and Ukraine

Source: the own calculation on the base of The Human Fertility Database for Ukraine and Central Statistical Office for Poland.

The Polish current statistics of birth intervals – see table 26 in CSO Internet database http://demografia.stat.gov.pl/bazademografia/Tables.aspx – that our methodical proposition gives a plausible results. In this both sources the mean birth intervals are quite similar but not identical. As regards international comparisons, it is striking similarity shaping large gap between the birth of the first and second child with the fact that Ukraine is almost constantly a longer by one year.

Conclusion & Discussion:

1. Paradysz's adjusted model from 1995 allows to calculate the number of useful parameters to better diagnose the current demographic situation in terms of period fertility analysis.

2. Paradysz's adjusted model (1995), in addition to **birth intervals**, provides a number of crucial parameters, which – taken together and treated separately – can serve as the basis for projections of the demographic cycle from the point of view of period and cohort analysis:

a) ***P(x,p), Q(x,p)*** – probability of giving birth and not giving birth to *p*–th child,

b) ***F'(x, p)*** – maternity function for women who do not give birth to their last *p*–th child at age x will still give birth p+1 times in the future.

c) ***F"(x,p)*** **–** maternity function for women who at age x give birth to their last *p*–th child.

3. Our method allows us to calculate the number of useful parameters to better diagnose the current demographic situation in terms of cross–sectional analysis. Among these parameters are period birth intervals. In the present article we are analyzing the tempo and structure of women fertility in Poland and Ukraine starting from 1960 in the terms of Paradysz's model.

4. Through to our analysis we can conclude a few turning points. The most important seems to us year 1985 in Poland, Ukraine as well in Russia, which also was partially included for comparisons in the years 1960–2009. In terms of the number of non–last children Ukraine is very similar to Russia while "last" children without younger siblings were at a similar level to the Poland. The differences between the Poland and Russia were much large.

5. Overall, in the long term course of reproduction of the population is quite similar in Poland and Ukraine, but there are also differences. However, there is greater similarity compared Ukraine with Russia than with Poland.

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ПОЛЬЩА ТА УКРАЇНА У СВІТЛІ МОДЕЛЛІ НАРОДЖУВАНОСТІ ЗА ПЕРІОД ПАРАДИША

У статті відображено питання дослідження, які в теперішній час мають надзвичайно важливе значення в методології аналізу народжуваності за період. Когортний аналіз розкриває великі можливості для опису процесу людського відтворення. Оскільки період аналізу не достатньо великий, було застосовано однакові методи дослідження для обох країн. Багато років тому один з нас запропонував розкладання періоду сумарного коефіцієнта народжуваності для розрахунку періоду "теоретичних" інтервалів між народженнями. За допомогою комбінації двох систем демографічного аналізу (імовірності народження дитини певної черговості і таблиць вибуття – поповнення) ми розклали "класичний" сумарний коефіцієнт народжуваності (СКН) для дітей останньої та не останніх черг народження в аналізі за період.

Ключові слова: аналіз народжуваності за період, період інтервалу між народженнями, розкладання сумарного коефіцієнта народжуваності за черговістю народжень останніх та не останніх черг.

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ПОЛЬША И УКРАИНА В СВЕТЕ МОДЕЛИ РОЖДАЕМОСТИ ЗА ПЕРИОД ПАРАДИША

В статье отражены вопросы исследования, которые в настоящее время имеют чрезвычайно важное значение в методологии анализа рождаемости за период. Когортный анализ раскрывает большие возможности для описания процесса человеческого воспроизводства. Поскольку период анализа недостаточно большой, было применено одинаковые методы исследования для обеих стран. Много лет назад один из нас предложил разложения периода суммарного коэффициента рождаемости для расчета периода "теоретических" интервалов между рождениями. С помощью комбинации двух систем демографического анализа (вероятности рождения ребенка определенного очередности и таблиц выбытия – пополнение) мы разложили "классический" суммарный коэффициент рождаемости (СКН) для детей последней и не последних очередей рождения в анализе за период.

Ключевые слова: анализ рождаемости за период, период интервала между рождениями, разложение суммарного коэффициента рождаемости по очередности рождений последних и не последних очередей.

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THE SYSTEM OF STATISTICAL OBJECTIVE AND SUBJECTIVE INDICATORS OF MEASURING QUALITY OF LIFE

This article examines approaches to defining and measuring quality of life. Each approach to measuring the quality of life contains information that is not contained in the other measures. It describes the economic, subjective and social indicators. The strengths and weaknesses of those indicators are also analyzed.

Keywords: quality of life index; objective indicators; subjective indicators; quality of life; measuring quality of life.

Introduction. The basic responsibility of any government is to create better conditions of life for its citizens. Nowadays measuring quality of life is one of the most actual problems not solely in Ukraine but in countries all over the world. It is interesting to examine quality of life and measuring of it, especially taking to account the global financial crisis and numerous effects of it. Today leading Ukrainian scientists study a problem of measuring quality of life with the assistance of United Nations Development Program (UNDP) in Ukraine. Quality of life refers to the overall welfare within a certain society, focused on enabling each member an opportunity of accomplishing its objectives.

Quality of life refers to not solely indicators of material standard, but also to various subjective factors that influence human lives. It is very often determined using descriptive measures like satisfaction and happiness. Most researchers agree that the use of both objective and subjective measures provides the best overall picture. But the main problem is to select the right indicators both objective and subjective.

The object of the current research is subjective and objective indicators of quality of life.

The research aim of the paper is to define and analyze the subjective and objective indicators of quality of life, which necessitated the solution of the following *research tasks*: research existing approaches to measuring quality of life; analyze subjective and objective indicators of quality of life; investigate the possibilities of using both subjective and objective indicators that have the greatest impact on the quality of life.

Discussion of quality of life (QOL) dates back to Plato and Aristotle [15]. Early efforts to define and measure QOL took either an economic or objective social indicators approach. But studies in the 1970s showed that objective measures of life conditions accounted for only a modest proportion of individuals' subjectively reported QOL [9]. QOL is the subject of academic debate in economics, particularly in the related field of happiness studies, a research area shared with psychologists and sociologists. Most of this literature considers the effect of medical interventions on the QOL, or subjective well–being of individuals or groups of individuals with shared characteristics. Quality of life has been recognized as an important construct in a number of social and medical sciences such as sociology, political science, economics, psychology, philosophy, marketing, environmental sciences, medicine, and others. However, each academic field has developed somewhat different approaches to investigate the construct of quality of life. Researchers have called for more sophisticated and philosophical research methods in the field that include both qualitative and quantitative designs.

Some components of quality of life assessment explored in the works of such scientists as Becker R.,