POPULATION CHANGE AND FERTILITY DECLINE IN INTERWAR POLAND: SPATIAL PERSPECTIVES

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„It is better to be approximately right Than precisely wrong”
John Maynard Keynes

PLAN OF THE PRESENTATION

✓ Introductory remarks
  • The objectives of research,
  • Sources of statistical data
  • Methods of analysis,
  • Socio-economic determinants of demographic processes in Poland in the years 1918-1939
✓ Changes in the state and structure of the population
✓ Changes in fertility
✓ Changes in mortality
✓ Natural increase of the population. Reproduction of the population..
✓ Spatial diversification of vital statistics of population. Identification of differences between groups of provinces (between the western and eastern)
✓ Spatial diversification of female fertility measured by the Princeton European Fertility Project indices,
✓ Conclusions
THE OBJECTIVES OF RESEARCH

✓ Presentation of population changes in interwar Poland.
✓ The location of changes in fertility, mortality, reproduction of the population in the context of the concept of the first demographic transition.
✓ In particular, determination of phases of demographic transition.
✓ Determination of the population explosion (maximum of natural increase).
✓ Consideration of disparities between particular provinces of Poland (groups of voivodships) in demographic processes due to economic and socio-psychological consequences of different rules of partitioners (Prussia, Austria and Russia) and hence diversity of socio-economic development of Polish provinces.
✓ Identification of differences in demographic processes between particular Polish provinces – an attempt to determine demographic development lagging in a given province in relation to others.
✓ Diversity of female fertility based on the Princeton European Fertility Project indices – spacial perspectives.
DATA SOURCES

The sources of figures:

- official data published by the Central Statistical Office (CSO), including
  - The results of the Polish census of 1921 (30 September) and the census of 1931 (9 December) – basic information about the size and the structure of the population,
  - data on the current registration of population vital statistics,
  - the balances of the size and population structure as of 1.01,

- and also data from analytical studies like S. Szulc, M. Kędelski, S. Borowski, E. Vielrose, K. Zamorski

Note 1
Full comparability of data is limited because different areas were covered by particular censuses (for example, the census of 1921 did not cover Upper Silesia and Vilnius Land; the census of 1931 covered the whole territory of Poland in borders from 1931)

Note 2
In opinion of many demographers in the interwar period data regarding the vital statistics of population were not satisfactory. Shortcomings of registrations were territorially differentiated. The most accurate registration of the vital statistics was in the western provinces, and the least in the eastern provinces and slightly better in the central provinces. This was due to inappropriate registration of demographic facts among the Jewish population. This fact was reflected in the official publications of the CSO.
DATA ANALYSIS METHODS

The analysis of the process of demographic transition presented in the paper is based on the four-phase model.

**Phase of demographic transition**
phase I - high stationary, phase II - early expanding, phase III - late expanding, phase IV - low stationary

However, this analysis (in terms of changes in the rate of births and deaths) can be done from the second phase because the time series of the natural movement in the Second Polish Republic are too short.

In order to determine the **beginning and end** of the "right" demographic transition (beginning of the phase II and IV), in the case of raw fertility and mortality rates, the **non-linear regression - approximation by the anti-logistic function** - \( y(t) \) in combination with a method of simple substitution were used. (*look B.Radzikowska*)

\[
\hat{y}(t) = c - \frac{a}{1 + be^{-dt}}
\]

The process of demographic transition (the process of displacement of one technology by a new one) according to JC Fisher and RH Pry method of a simple substitution on fertility (mortality) occurs when the value of anti-logistic function is equal to 10% of the maximum level - point \( T_1 \), and ends at 90% of the maximum level - \( T_2 \).

The approximation of the **exponential function** was used in order to determine the population explosion (maximum population growth).

"Population Explosion" is a period in which there are maximum values of the rate of birth – in the time of interval from turning point of phases II and III to the moment in which decreasing tendency of fertility is falling (for example: inflection point of fertility trend) 245.

*B. Radzikowska, „Płodność w Polsce w kontekście teorii przejścia demograficznego. Modelowanie i prognozowanie”, Wrocław, 1995*
SOCIO-ECONOMIC DETERMINANTS OF POPULATION PROCESSES IN POLAND IN THE YEARS 1918-1939

Selected socio-economic determinants of demographic processes in Poland in the years 1918-1939:

✓ Consequences of the war:
  • economic losses - war destructions caused by the war and robbery economy of occupants; broken economic ties with the former partitioners of Poland after 1914,
  • demographic losses - loss of population, and disturbances of demographic processes: intensive migration movements, and changes in the population structure, distortions of trends of vital statistics of population.

✓ difficulties in merging lands of three partitions - differences in the economic and social structure in different parts of the country – groups of voivodeships,

✓ structure of the economy - agricultural character of the Polish lands (in 1929, agricultural production accounted for about 68% of the total value of production), including the unfavorable structure of agriculture (in 1931 – farms up to 5 ha accounted for approximately 64% of all farms, and farms with an area of 50 hectares or more - 0.5% and 45% of the land),

✓ large economic fluctuations,

✓ social problems (such as illiteracy, unemployment, overcrowding of villages)

✓ complicated national-religious structure of the population.

THE PARTITIONS OF POLAND (Austria, Prussia, Russia)
1772 - first partition
1793 - second partition (Austria did not participate)
1795 - third partition of Poland
With this partition, the independent Polish state ceased to exist.

[Atlas historyczny Polski, B. Gediga 1996, s. 18.].

1914-1918 The First World War

the Second Polish Republic

1939-1945 The Second World War
After the demarcation in 1923 the area of the Second Polish Republic was 388.6 thousand km², of which land of former Russian partition was approximately 69% of the territory, Austrian partition - 20%, Prussian partition - 11%.

Change in the Polish area in 1939 resulted primarily from the joining of Trans-Olzian Silesia (about 906 km²) and minor border areas near the border with Czechoslovakia in October 1938. Moreover, boundaries of Silesian and Cracow voivodships were changed. For administrative purposes, Poland was divided into voivodships, powiats and gminas. There were 16 voivodships, and Warsaw as a city with the rights of the voivodship.

Area and population of Poland based on census 1931

<table>
<thead>
<tr>
<th>Specification</th>
<th>Area</th>
<th>Population</th>
<th>per 1 km²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in thous. of km²</td>
<td>in %</td>
<td>in thous.</td>
</tr>
<tr>
<td>Poland total</td>
<td>388,6</td>
<td>100,0</td>
<td>31942</td>
</tr>
<tr>
<td>Groups of voivodships</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central</td>
<td>137,8</td>
<td>35,5</td>
<td>13390</td>
</tr>
<tr>
<td>East</td>
<td>124,4</td>
<td>32,0</td>
<td>5548</td>
</tr>
<tr>
<td>West</td>
<td>47,2</td>
<td>12,1</td>
<td>4499</td>
</tr>
<tr>
<td>South</td>
<td>79,2</td>
<td>20,4</td>
<td>8505</td>
</tr>
</tbody>
</table>

Source: Mały Rocznik Statystyczny 1939, GUS, Warszawa

The census of 1931 showed that the population of Polish was about 31.9 million. Most people lived in the central district (the largest area among others) - 13.4 million. Eastern and western districts are particularly interesting. The smallest one (in the sense of area and population) was western district. Its area was 2.5 times smaller than the area of the eastern one. However density of population in the West of Poland was over twice as much as in the eastern district.
In the interwar Poland was divided into groups of voivodships corresponding more or less to former partitions, which were different in respect to economy, culture, customs, law. Particularly strong differences emerged between the Russian partition areas - the eastern lands and the western lands of the Prussian partition.
The first census of 1921 included questions about both nationality, mother tongue and religion. The census of 1931, contained questions only about the mother tongue and religion, there was not a question about nationality.

**Nationality**

According to the census of 1921 the total number of Polish population declared Polish nationality was **69.2%** of the total. In the post-war Poland, the population structure according to a national declaration was studied in the census of 2002 (Polish nationality was declared by **96.7%** of the total population) and in 2011 (homogeneous Polish national identity was declared by **93.9%**.).

**Confession. Religion**

Religion, according to the census form explanations is a confession to which a person "formally belonged" regardless of its religious belief. Non-confessional is a person who does not belong to any religious connection. According to censuses, in 1921 and 1931 Catholic religion (75%) dominated in Poland. Believers of the Orthodox and the Jewish formed relatively large groups.

The data indicate a difference in the population structure by declared religious denominations in the analyzed groups of voivodships.

Source: "Statystyka Polski", seria C, z. 92, GUS, Warszawa, 1937, s.22,
CHANGES IN THE SIZE AND DISTRIBUTION OF POPULATION

The graph shows the dynamics of the population on Polish territory in the years 1895-1939 (in Polish borders of interwar period) and in the years 1946-2011 (in present Polish borders).

The consequence of the First World War was the loss of about 4.028 million of population, approximately 13.3% of population before the war. In 1927, 8 years after the war, the Polish population reached a level from 1914.

Population in the Polish state within borders from 1939 (but without land regained in 1938) increased by 8,567 thousand (32.6%). The average annual population growth was 428 thousand of people, while in the period 1895-1914 only 331 thousand. For comparison, in the decade 1950-1960 in Poland (in contemporary borders) annual population growth of 381 thousand persons was recorded.

Nowadays a stabilization of the population number is observed. The average annual population growth for the period 1990-2010 was only 6.4 thousand people.
In the interwar period, there were large disparities in the population dynamics of the individual Polish districts. Eastern districts had the largest population dynamics. In the years 1919-1939 the number of people increased by 2,306 thousand, which was 59.9% of the population from 1919.

- High population growth also occurred in the central district - population increased by 33.4%.
- In the years 1919-1939 the smallest increases in population occurred in remaining districts of Poland.
- In the western provinces population increased only by 901 thousand, i.e. 22.6% in relation to the beginning of 1919.

Source: Wiadomości Statystyczne 1931,1939, GUS, Warszawa, Mały Rocznik Statystyczny, 1939, GUS, Warszawa,
In the period 1919-1938 the population trend of Polish territory was linear. The largest deviations from the trend line occurred in the early post-war years.

Form the model of two separate linear regression of trend one obtains that the rate of population growth in Poland was higher before 1925 (519 thousand persons/year) than in subsequent years (406 thousand persons/year).

A similar situation took place in the central, southern and eastern districts, while in the western districts - the rate of population growth was lower in the first years after the war (21 thousand persons/year) than in subsequent years (54 thousand persons/year).

Source: own work based: *Wiadomości Statystyczne* 1931, 1939, GUS. Mały Rocznik Statystyczny, 1939, GUS, Szulc S. (1936), „Ruch naturalny ludności w Polsce w latach 1895—1935”, E. Stańczyk, „dynamika zaludnienia...
In the interwar period more people lived in rural areas (73% in 1931) than in cities (27%).

A western district is characterized by the greatest degree of urbanization (35% in 1931), then central (33%), and the smallest – eastern (14%).

Dynamics of changes in size of population in urban and rural areas is clearly visible in the graphs.

Urban population has been increasing and stabilizing proportionally to the increase and stabilization of population in recent years.

Rate of population was higher in urban areas than in rural areas. The largest urban population growth was in the eastern districts, and the lowest in the central.
Structure of population of Poland by age on the basis of national population census

In the chart three basic age groups are distinguished: 0-14 years - children, aged 15-64 - the potential labour force and 65 years and over – seniors. The chart shows process of population aging. The proportion of the population composed of children (0-14 years) is declining and the proportion of the population that is elderly (aged 65 years and over) is rising.

Biological age groups:
0 – 14 — children (demographic youth),
15 – 64 — adults excluding elderly people, 65 and more — elderly people (demographic old age).
The aging population is illustrated by the gradual increase in the dependency ratio of the population aged 15-64 by the elderly (65 years and over) and the decrease in the dependency ratio by children (0-14 years) - particularly evident in the lands of the West. In 1931, the western regions were characterized by the lowest interest of children and the highest interest of the seniors.

The chart presents the vital statistics of the population in Poland. In almost every year of the period a significant excess of births over deaths was observed. Hence, population natural increase was positive (negative values occurred only in the years 2002-2005). Before the First World War, as well as in the interwar period, Poland compared to other European countries had high natural increase rate. Annual average natural increase rate in Poland was 16.4‰ in the years 1909-1912 whereas in Europe 12.1‰. Despite a significant reduction in population natural increase (years 1925-1938) values of the coefficient were in Poland still relatively high compared to the most European countries.
Based on empirical data (the number of births for the years 1895-1911 and 1925-1938) the parameters of anti-logistic function, which fit to the data best ($R^2 = 0.977$) were estimated. Using method suggested by B. Radzikow-ska (1988) - a combination of anti-logical function approximation and the method of simple substitution, one can specify:

- the beginning of Phase III - $T_{1\_BIRTHS} = 1903$
- the beginning of the Phase IV - $T_{2\_BIRTHS} = 1977$

Due to insufficient data the estimation of the number of anti-logical function parameters is only indicative.

Thus the following were obtained: $a = 46.14, b = 15.06, c = 46.8, d = 0.06,$

- $T_{1\_BIRTHS} = 1903$ and $T_{2\_BIRTHS} = 1977.$

This function has a point of inflection (change in convexity) for $T_p_{\_BIRTHS} = 1940$, i.e. after 1903 there was a significant decrease in fertility - to 1940 fertility decreases sharply, and after 1940 – it falls slightly, until the stabilization of intensity of birth is reached.
In the first years after the war there was a positive trend, and in subsequent years - with some variations, the negative trend.

The phenomenon of a strong increase in the frequency of births in the early post-war years (from 30.5‰ in 1919 to 35.6‰ in 1923) can be regarded as a period of compensation in relation to the period of the war, characterized by low levels of intensity of births.
CHANGES IN MORTALITY. POLAND TOTAL

Based on empirical data - deaths rates in the years 1895-1911 and 1925-1938 (data for the years immediately after World War I were omitted) the parameters of anti-logistic function, which fit to the data best \((R^2 = 0.986)\) were estimated.

Next, the beginning of Phase II - point \(T_1_{\text{DEATHS}}\) (reduction in mortality is higher than reduction in births) and point \(T_2_{\text{DEATHS}}\) (mortality is stabilized) were fixed. The stabilization of death rates is continued for further but slower decrease in births. Hence the point \(T_2_{\text{BIRTHS}}\) is the beginning of Phase IV. It was obtained from the anti-logical function estimated for intensity of births.

The following values were obtained: \(a = 22.16, b = 4.70, c = 30.65, d = 0.06\), and \(T_1_{\text{DEATHS}} = 1885, T_2_{\text{DEATHS}} = 1959\). This function has an inflection point for \(T_p = 1920\), i.e. after 1885 year a significant reduction in mortality was observed and mortality went down remarkably before 1920 and after 1920 it decreased slightly. In 1959 the mortality is stabilized. Values of the function decreased by 1.3 \(\%\) in the period 1880-1890 and by 3.4 \(\%\) in the years 1910-1920, by 3.3 \(\%\) in the years 1920-1930 and by 2.7 \(\%\) in next years.

As in the case of birth rate dynamics of death rate ($Y_{DEATHS}(t)$) was calculated for the period 1919-1938. The model of non-linear regression with the crease for the independent variable (the breaking point in 1923) was used.

Both in the first years after the war, and in a subsequent period, the trend was negative. In the period 1924-1938 compared to the previous period, the average annual decline in mortality was 9 times lower (the slope of the line was only -0.30 ‰ / year).

Such high values of deaths rates in the first years after the war were caused by infectious diseases and poor material conditions.
TREND BIRTH RATES BY GROUPS OF VOIVODSHIPS IN 1919-1938

Starting from 1923 the highest values of live births per 1,000 population were observed in the eastern provinces and the lowest in the western provinces.

In 1938 the last year of the research there were 26 recorded births per 1,000 population in the eastern provinces, and 24 births per 1,000 population in the western provinces.

It is worth noting that before the First World War birth rates in different groups of voivodships differed very slightly.

The change in the ordering of the districts was observed. Before the war, the highest coefficients were in western and southern voivodships (not in the eastern and southern). This change was a direct result of unequal falls of coefficients in different districts.

Source. Own work based Wiadomości Statystyczne 1931,1939,GUS, Warszawa, Szulc S. (1936), „Ruch naturalny ludności w Polsce w latach 1895—1935”
The estimated functions show that the earliest clear collapse of mortality trend occurred in the western and southern districts in 1871 and 1875 respectively. From that moment the "right" demographic transition took place on these territories. Due to the strong decline in the value of the mortality rates (the fertility rate was still remained at a level comparable to that of phase I) a strong increase in the rate of natural increase was observed (population explosion). The highest rates of population growth were in the western, central and southern districts at the turn of the nineteenth and twentieth centuries (in the western district - in 1898). Only in the case of the eastern district higher growth of natural increase (population explosion) occurred during the Second Polish Republic (about 1926).
In order to determine the demographic modernization delay in the eastern voivodships compared to western, correlation coefficients between theoretical values (estimated from anti-logistic functions) of birth and death coefficients are calculated, with the phase shift (see figure below).

The highest value of the coefficient of correlation was achieved,
- if the function illustrating the births rates trend in the eastern territories was shifted by 15 years
- if the function illustrating the trend in deaths rates in the eastern territories was shifted by 20 years

**Antilogistic functions for western and eastern voivodships of Poland (1875-1938)**

Source. Own work based Wiadomości Statystyczne 1931,1939,GUS, Warszawa, Szulc S. (1936), „Ruch naturalny ludności w Polsce w latach 1895—1935”
During the first years of the interwar period the rise in the value of coefficient of natural increase was observed. Due to the high level of mortality overall natural increase was lower after the World War I than before the war.

- The coefficient of natural increase gradually (with some variations) decreased in the years 1924-1938
- Based on empirical data (birth rates in the years 1895-1911 and 1925-1938) the parameters of the exponential function were estimated

\[ \hat{y}(t) = e^{a_4 t^4 + a_3 t^3 + a_2 t^2 + a_1 t + a_0} \]

and the point at which the function reaches its maximum was identified. \( T_{\text{MAX}} = 1903 \) *.

The demographic explosion in the Second Polish Republic occurred in the late nineteenth and early twentieth century.

*It should be noted that due to insufficient number of data the estimation of the parameters of the exponential function is only indicative.
REPRODUCTION OF THE POPULATION OF POLAND. NATURAL INCREASE.
TRANSITION PHASE PERIODS

West

Central

East

South

BIRTHS

DEATHS

NATURAL INCREASE

births-approximation by anti logistic function
deaths-approximation by anti logistic function
natural increase-approximation by exponential function (n=4)
natural increase-empirical points

phase I
phase II
phase III

T_max
T_1 (births)
T_1 (deaths)

R^2=0.854
R^2=0.684
R^2=0.925
R^2=0.778

T_max=1902
T_max=1907
T_max=1904
T_max=1901

1870 1875 1880 1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940

1870 1875 1880 1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940

1870 1875 1880 1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940

1870 1875 1880 1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940
On Polish territories, both in the period before World War I and in the years 1919-1938 an expanded reproduction of the population was observed. In the years 1896-1911 coefficients of demographic dynamics did not change a lot - for every 100 people who died there were from 160 to 176 newly born. In the period 1919-1923 a strong increasing tendency of demographic dynamics coefficients was observed, while in the years 1924-1938 - with some variations - the downward trend was detected. Coefficients of demographic dynamics were different in different Polish districts. In the years 1923-1938 high demographic dynamics was in eastern voivodships - almost twice more births than deaths. In the years 1895-1911 the western lands were characterized by the highest values of the analyzed coefficient.
**Total fertility rate** refers to the number of children which would be born to the average woman during the course of her entire reproductive period (15-49 years of age) assuming that in particular phases of this period she would give births with an intensity observed during a given year, i.e., in assuming age-specific fertility rates for this period to be constant.

During the Second Polish Republic, comparing to the period before the war, a significant drop in total fertility rate was observed (*look south of Poland*).

**Gross reproduction rate** refers to the number of daughters which would be born to the average woman assuming that a woman during her reproductive age will give births with an intensity which is characteristic for all women giving births in the year for which the reproduction rate is calculated (constant fertility rates).

According to the calculations done for the 1927-1928 and 1931-1932, the highest values of gross reproduction rate were in the eastern district, and the lowest in the western one.

At the turn of the nineteenth and twentieth centuries, on average one woman gave birth to over 3 daughters (assuming the constancy of fertility rates) during her breeding period. It means that a generation of mothers would be replaced by a three times more numerous population of daughters - 20 years later by a twice more numerous population of daughters. In the interwar period there was extended reproduction (gross rate guaranteed a simple replacement of generations).
During the considered period female fertility rates in the Second Polish Republic were ones of the highest comparing to other European countries.

In the years 1921-1936 a further gradual decline in female fertility rates was observed.

Not only in a whole country, but also in each group of voivodships a decrease in female fertility rates was observed (the highest in western voivodships).

There were significant differences in marital fertility by age, depending on the area of the Second Polish Republic - particularly high value of marital fertility rates were detected in the western voivodships.

Western voivodships also showed the greatest disparity between the general fertility and marital fertility.
Based on the estimated values of overall fertility indices in the years 1923-1938 (with constant age structure of women from 1931) one can claim that in the Second Polish Republic there was a decline in the total fertility index.

In 1923, the total fertility ($I_f$) was 34.0% of maximum fertility, and in 1938 - at the level of 23.3%.

In the years 1900-1931 in the Polish territories, the values of the marriages index were decreasing, too. The index in 1931 was 0.488 ($I_g$). At that time married women gave a birth to about 49% of children that might be born by all married women in urban areas - 35%, and 54% in rural areas.
As mentioned earlier, in the considered period, the highest fertility was recorded in the eastern districts in 1931 and it accounted for 31.9% of the maximum level of fertility, while in the western districts - 25.9%.

The highest index was recorded in the eastern district - 0.596, while the lowest in the western -0.457. There were small differences in the level of marital fertility indices by districts of the Second Polish Republic. In 1931-1932 married women from eastern provinces gave birth, on average, to approximately 51.1% of children that might be born by all married women and married women of the western provinces - 50.4%
CONCLUSIONS

• An approximation of the population trend on Polish territories during 1919-1938 was linear.
• The largest deviations from the trend line occurred in the first years after the war.
• The main determinant of the population size was natural increase – net migration rate was not very important.
• The linear regression equations with the break in 1925 yields the that overall population growth rates in Poland and in the eastern, central and south districts were higher in the first years after the war, than in next years. Eastern voivodships were characterized by the largest increase in population.
• A slight changes in the age structure of the population of the Second Polish Republic were observed. These changes show the gradual aging of the Polish population.
• Based on the concept of the first demographic transition model the beginnings of phase II and phase III were specified. The estimates show the demographic transition at the turn of the century. "Right" demographic transition (bigger reduction in mortality than in fertility) was observed on Polish territory around 1885.
• The estimation of anti-logistic function for each district yields that evident break of mortality trend occurred first in the western and southern districts (about 1871 and 1875). From that moment on these lands "right" demographic transition took place.
• Between the districts (groups of voivodships), there were large disparities in levels and dynamics of fertility, mortality and reproduction of the population. The highest values of fertility rates occurred in the eastern districts, the lowest - in the western districts.
• Despite a decline in fertility rates and the gradual reduction in gross reproduction rates, the expanded reproduction of population was observed on Polish territory in the period before World War I. (Rates allowed for the simple replacement of generations).
THANK YOU FOR YOUR ATTENTION!