
Demographic Development of Polish Voivodeship Cities in 1999-2022

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Abstract:

Purpose: The aim of the paper is to analyse and evaluate the components of population change in voivodeship centres in Poland in the period 1999-2022. The spatial approach allows one to observe the heterogeneity and diversity of demographic processes in individual cities. To this end, an assessment was made of the examined cities, considering changes in the number of population and its components - the balance of natural and migratory movements, as well as the role of individual elements in shaping the real population growth of the examined settlement units.

Design/Methodology/Approach: The research analysis employed statistical and cartographic methods to present the research results. These methods enabled the determination of the dynamics, nature, and scale of changes in demographic processes occurring in the surveyed settlement units. Indicators and proportions describing the relative values of the studied phenomena formed the basis for detailed analysis. To examine the relations between the components of actual growth, the method developed by J. W. Webb was used, allowing the determination of the state of population development of the spatial units, considering the interdependencies between natural increase or decrease and positive or negative migration balance.

Findings: The results clearly illustrate diversity in the population changes of specific Polish voivodeship cities between 1999 and 2022. Most of the analysed settlement units saw a decrease in their population potential in this period, typically due to both natural and migration-related decrease (11 cities). An increase in population was primarily recorded in the largest cities in the country, i.e., Warsaw, Kraków, Wrocław, and Gdańsk, as well as those which expanded their population potential as a result of extending their territory (Rzeszów, Zielona Góra), largely due to migration inflow to these centres.

Practical Implications: Changes in the population potential of cities significantly impact their socio-economic development. The population status of urban centres is considered a crucial indicator of their settlement attractiveness. As the population increases, the economic potential, the diversity of economic functions, and the level of development of technical and social infrastructure also increase, leading to enhanced satisfaction of various social needs. Conversely, a decrease in the population, has the opposite effect, impacting both economic and social development.

Originality/Value: The originality of the study stems from a multifaceted analysis of population changes in voivodeship centres in Poland, examining their directions and dynamics, while taking into account the impact of individual components of real growth. This

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analysis may also serve as a basis for forecasting changes that will occur in voivodship towns in the future.

Keywords: *Demographic development of cities, capitals of administrative regions, Poland.*

JEL codes: *C00, J10, J11, Y10.*

Paper type: *Research article.*

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1. Introduction

The administrative units of the first order in Poland are the voivodships. As of 1 January 2019, an administrative reform was implemented, reducing the number of voivodeships from 49 to 16. As a result, 31 localities lost their status as voivodeship cities, and the number of voivodeship centres decreased to 18² (Figure 1).

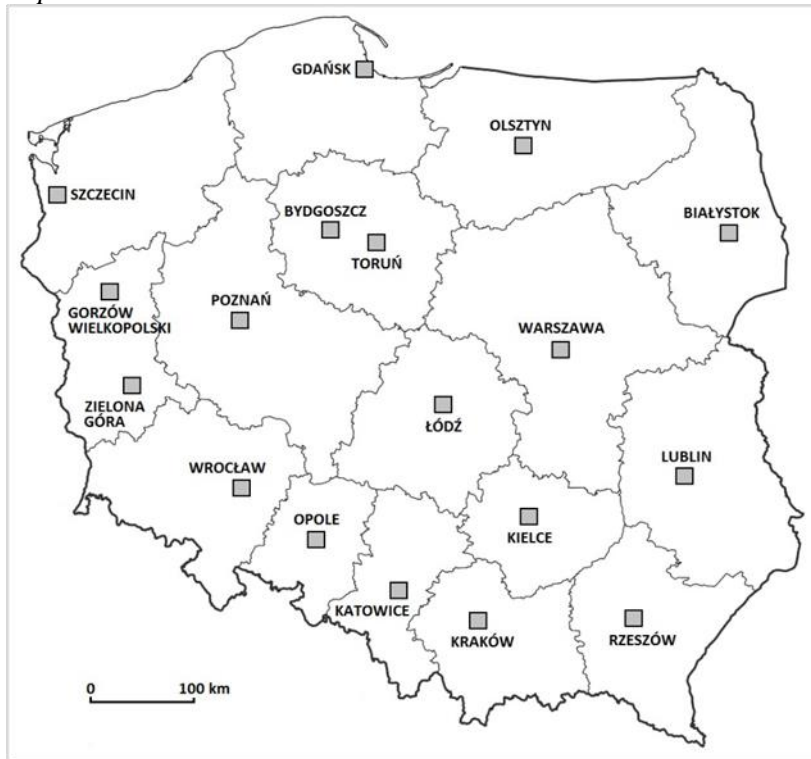
Simultaneously, a voivodeship self-government was established, acquiring significant competencies. The status of a voivodeship city influenced the transformation of these centres in various aspects, including demographic change. The primary aim of the study is to analyse and evaluate the components of population changes in voivodeship centres in Poland, in the period 1999-2022.

The spatial approach allows one to observe the heterogeneity and diversity of demographic processes in individual cities. For this purpose, the towns under study were evaluated regarding changes in population and its components – the balance of natural and migratory movements, and the role of individual elements in shaping the real population growth of the studied settlement units was determined.

The research utilized analysis techniques based on methods developed by the theory of statistics, geography, and demography, aimed at determining the dynamics, nature and scale of changes in demographic processes taking place in the analysed voivodeship centres (Cristea *et al.*, 2022; Thalassinos *et al.*, 2019).

²*The higher number of voivodeship cities than of the voivodeships themselves is due to the fact that in two cases of voivodeships - Lubuskie and Kujawsko-Pomorskie – two cities fulfil the function of the capital of each region – Gorzów Wielkopolski (seat of the voivode) and Zielona Góra (seat of the voivodeship assembly) and Bydgoszcz (seat of the voivode) and Toruń (seat of the voivodeship assembly) respectively.*

Figure 1. Researched voivodeship centers in Poland against the background of voivodeship borders



Source: Own elaboration.

The presented research is part of the current Polish scientific literature related to demographic transformations of Polish cities. Among the most important publications in this regard, we should mention, Petryszyn (2002), Szukalski (2014; 2018), Śleszyński (2016), Janiszewska (2019), Bocheński and Rydzewski (2020).

2. Methods and Data Sources

The study utilized simple statistical analysis methods and cartographic methods to present the research results. These methods enabled the determination of the dynamics, nature, and scale of changes in demographic processes occurring in the surveyed settlement units. Indicators and proportions describing the relative values of the studied phenomena formed the basis for detailed analysis.

In order to show the dynamics of population changes taking place in the studied voivodeship centres, a modified version of the single-basis dynamics index was applied:

$$(1) \quad TZ = \left(\frac{L_{j(tk)}}{L_{j(tp)}} \right) \times 100 - 100$$

where:

$L_{j(tp)}$ – population of the initial year in unit j,

$L_{j(tk)}$ – population in the final year in unit j.

As the single-basis dynamics index does not allow the full identification of the nature of the course of the population change process, a measure of dynamics in the form of a chain index was used for this purpose, which enabled the specification of the nature of population change:

$$(2) \quad D = \left(\frac{L_{t+1}}{L_t} \right) \times 100 - 100$$

where:

L_{t+1} – population in the year under review,

L_t – population in the preceding year.

The coefficient of variation was employed to show the differences in the intensity of population change dynamics in successive years of the analysed period. For each study area, the mean absolute and standard deviation were calculated from the chain indices of population change dynamics, and the coefficient of variation was derived from the following formula:

$$(3) \quad V_L = \frac{s_j}{|\bar{x}|_j}$$

where:

s_j – standard deviation of chain index values,

$|\bar{x}|_j$ – absolute value of the arithmetic means of the chain indices.

On the basis of the index calculated for each area, the cities in which the changes from year to year were of equal intensity and those in which the changes were of varied intensity in the studied period were selected.

In the analysis of the determinants of population changes in voivodeship centres, selected demographic characteristics, such as real growth and its components – natural and migratory movement, which have a decisive impact on the course of population change in the studied settlement units, were considered.

Besides the above-mentioned sources, the population is also influenced by changes in the administrative borders of the studied units³. In order to examine the relationship between the above-mentioned elements of real growth, the method

³In several cases in the period 1999-2022, changes in administrative boundaries had a significant impact on population changes in the analysed voivodeship centres – Warsaw (2002), Białystok (2006), Rzeszów (2006-2010), Zielona Góra (2015), and Opole (2017).

developed by J.W. Webb was used, allowing the determination of the state of population development of settlement units (in this case, voivodeship towns), considering the interdependencies between natural increase or decrease and positive or negative migration balance.

This method consists of categorising the unit under study into one of eight types of population development, depending on the sign and absolute value of the indicators of the two characteristics analysed (Runge, 2007) (Table 1).

Table 1. Types of population development according to J.W. Webb

Type	Relationship of natural movement (NM) and migration balance (MB)	Population change (actual population increase or decrease)	Description
A	+NM>-MB	increase	natural increase outweighing migration loss
B	+NM>+MB	increase	dominance of natural increase over migratory increase
C	+NM<+MB	increase	dominance of migratory growth over natural growth natural increase
D	-NM<+MB	increase	migration growth outweighs natural decrease
E	-NM>+MB	decrease	natural decrease outweighs migratory increase
F	-NM>-MB	decrease	migration loss and even greater natural loss
G	-NM<-MB	decrease	natural loss and even greater migration loss
H	+NM<-MB	decrease	migration loss outweighs natural increase

Source: Own elaboration based on: Runge, J. 2007. *Research methods in socio-economic geography – elements of methodology, selected research tools*. Katowice: University of Silesia Publishing House.

The main source of information and data for the study of population changes in the voivodeship centres in Poland was the statistical data contained in the Local Data Bank of the Central Statistical Office (as of 31 December each year).

3. Research Results

Under the conditions of the Polish settlement network at the turn of the 20th and 21st centuries, a population value over 100 thousand inhabitants was most often used to delineate large cities (Harańczyk, 1998; Michalski, 1995; Mikołajewicz, 2000). Both at the beginning and at the end of the beginning of the period under study, all analysed voivodeship centres met this size criterion. At both points in time, one city had more than 1 million inhabitants (Warsaw), and another four cities had

more than 500 thousand inhabitants (Łódź, Kraków, Wrocław, Poznań). The group of large centres in Poland was supplemented by cities with more than 300 thousand inhabitants, of which there were 5 in 1999 (Gdańsk, Szczecin, Bydgoszcz, Lublin, Katowice), while in 2022 – the number of cities in this group decreased to four (Gdańsk, Szczecin, Lublin, Bydgoszcz).

Of the remaining voivodeship centres three cities in 1999 and two in 2022 had more than 200 thousand inhabitants. The remaining cities – five in 1999 and seven in 2022 – exceeded 100 thousand inhabitants (Table 2).

Table 2. Population of voivodeship cities in Poland in 1999-2022

City	Population (in thousands), as of 31 December								
	1999	2002	2005	2008	2011	2014	2017	2020	2022
Białystok	288.8	291.7	291.8	294.2	294.3	295.5	297.3	294.7	292.6
Bydgoszcz	377.4	372.1	366.1	358.9	363.0	357.7	352.3	339.1	330.0
Gdańsk	464.4	461.7	458.1	455.6	460.5	461.5	464.3	486.5	470.6
Gorzów Wlkp.	125.9	125.5	125.4	125.2	124.6	124.1	124.3	120.5	116.4
Katowice	333.2	325.0	317.2	309.6	309.3	301.8	296.3	286.4	280.2
Kielce	214.2	211.8	208.2	205.1	201.8	198.9	196.8	187.4	183.9
Kraków	755.4	757.5	756.6	754.6	759.1	761.9	767.3	800.5	803.3
Lublin	359.2	358.4	355.0	350.5	348.6	341.7	339.9	335.1	331.2
Łódź	805.3	785.1	767.6	747.2	725.1	706.0	690.4	673.0	658.4
Olsztyn	171.1	172.5	174.5	176.1	175.4	173.8	173.1	170.7	168.2
Opole	131.0	129.3	128.3	126.2	122.4	119.6	128.1	127.5	126.5
Poznań	584.3	577.1	567.9	557.3	553.6	545.7	538.6	547.8	541.3
Rzeszów	160.6	159.8	158.5	170.7	180.0	185.1	189.7	194.4	197.2
Szczecin	416.8	415.1	411.1	406.9	409.6	407.2	403.9	397.3	391.6
Toruń	212.0	210.7	208.0	206.0	204.9	203.2	202.6	198.8	195.7
Warszawa	1677.3	1688.2	1697.6	1709.8	1708.5	1735.4	1764.6	1861.8	1862.0
Wrocław	643.5	639.2	635.9	632.2	631.2	634.5	638.6	673.6	674.1
Zielona Góra	117.9	118.4	118.2	117.6	119.2	118.9	139.8	140.1	139.3
Total cities	7838.2	7799.0	7746.0	7703.5	7691.2	7672.4	7707.8	7835.3	7762.5

Source: Own elaboration based on: Local Data Bank of the Central Statistical Office 1999-2022.

Having the status of a voivodeship centre undoubtedly has a positive impact on the socio-economic development of these units. One of the most important manifestations of the attractiveness of such settlement areas is the increase in the dynamics of population changes.

Population changes positively influence the economic or infrastructural development of these units, leading to the satisfaction of various social needs. For most voivodeship cities, the period up to the end of the 1980s was a time of dynamic

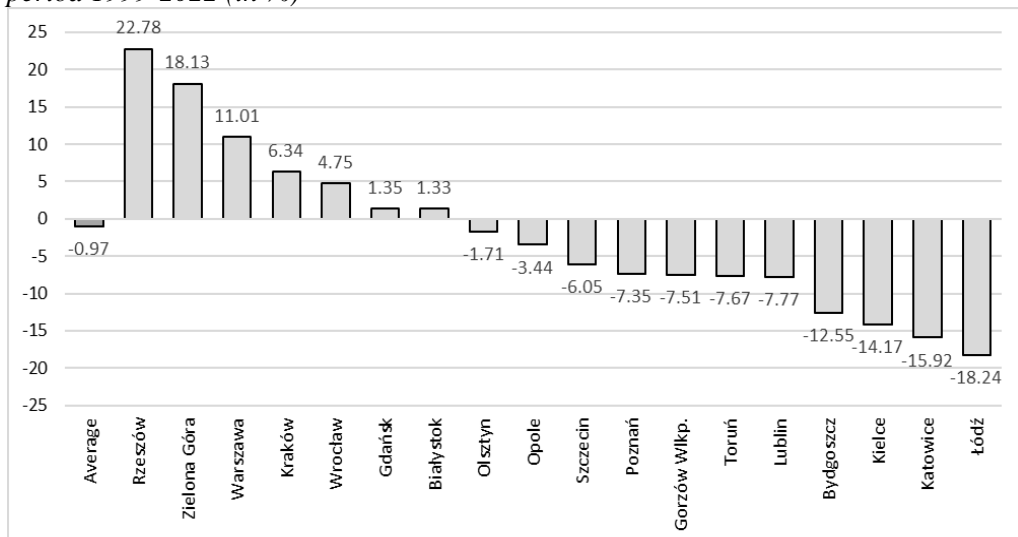
population growth, largely influenced by the administrative status of these units. After the political transformation in 1989, the direction of population change among the voivodeship centres remained positive, but its dynamics clearly weakened.

The effect of these changes was a halt in the population development of the settlements which based their economic potential on the development of a single industrial sector, e.g., Katowice or Łódź, which after the changes at the turn of the 1980s and 1990s were experiencing a period of decline. Additionally, the population development dynamics of the city's population decreased significantly. Moreover, the population development dynamics of the largest urban agglomerations in Poland, e.g., Warsaw, Kraków, Wrocław, or Poznań, were significantly weakened, which was caused by the intensively progressing process of suburbanisation, resulting in the formation of suburban zones around these cities.

In the period 1999-2022, the population of all voivodeship cities decreased from 7838.2 thousand to 7762.5 thousand, a difference of 75.7 thousand people. However, despite the decrease in population, the share of the population of the analysed settlement units in relation to the population of Poland slightly increased – from 20.48% to 20.55%, i.e., by 0.07%.

The average population growth dynamics of all voivodeship cities in the period 1999-2022 had a negative value and amounted to -0.97%. In this juxtaposition, as many as 11 urban centres experienced a decrease in population, with a simultaneous increase in population in only 7 cities (Figure 2).

Figure 2. Dynamics of population changes in voivodeship cities in Poland in the period 1999-2022 (in %)



Source: Own elaboration based on Local Data Bank of the Central Statistical Office 1999-2022.

The highest population growth rates were characterised by Rzeszów (22.8%), Zielona Góra (18.1%), and Warsaw (11.0%), while the greatest decline Łódź (-18.2%), Katowice (-15.9%), Kielce (-14.2%), and Bydgoszcz (-12.6%). The significant population growth of Rzeszów and Zielona Góra was mainly due to changes in the administrative boundaries of these units, which between 1999 and 2022 increased their area by less than 119% and 380% respectively.

In the case of Warsaw, the positive population balance was determined by its administrative function as the country's capital. In the majority of cities, which recorded a decrease in population, it must be objectively stated that the phenomenon of depopulation was caused by the outflow of population to suburban areas, which did not fundamentally weaken the socio-economic potential of a given urban centre⁴.

The decrease in population potential of some voivodship cities in the analysed period was exacerbated by the crisis in the mineral extraction and electrical machinery industry (Katowice) or the textile industry (Łódź).

Since the information on population dynamics depicted by the single-basis index confronts states from only two-time moments (1999 and 2022), which does not allow identification of the nature of the course of the population redistribution process, a measure of dynamics in the form of a chain index was used for this purpose.

Among the cities included in the study with positive population change dynamics, the record years were 1999, when the increase in population was the result of an influx of people from cities that had lost their status as voivodeship centres, and 2010 and 2020. At those points in time, more than 72% of the surveyed cities achieved the highest population growth rates (Table 3).

The highest values of growth dynamics year after year stood out Zielona Góra (16.6% in 2015), Opole (7.9% in 2017), and Wrocław (4.8% in 2020). In the case of the first two cities, undoubtedly, such a rather significant annual growth dynamics was strongly influenced by the increase in the area of both units in that period (in the case of Zielona Góra by almost 380% – 220 km², while Opole by more than 55% – 53 km²).

It is worth noting, however, that a significant increase in the area of a city was not always tantamount to a similar growth in the population of the settlement unit. Examples of the lack of correlation between area growth and population growth can be found in Zielona Góra or Rzeszów. In the first example, between 2014 and 2015, the area of the city increased almost fourfold, with a population increase of just over

⁴An urban centre is defined here as an area comprising a city with its surrounding suburban areas, functionally linked together.

16%, while in the second example, between 2006 and 2010, the area increased by more than 120% and the population by just over 13%.

The year 2020 was clearly marked by the largest population losses, with as many as half of the surveyed settlement units recording the lowest values of population change dynamics (Table 3). The largest decline was in Kielce (-3.8% in 2020), Katowice (-3.7% in 1999), Gdańsk (-3.2% in 2022) and Opole and Gorzów Wlkp. (-2.5% in 2010 and 2020, respectively).

Table 3. Dynamics of population and area changes in Polish voivodeship cities in 1999-2022

City	Dynamics of change 1999-2022 (%)	Highest population growth		Largest population loss		Number of years of population change		City area (km ²)		
		%	Years	%	Years	Increase	Loss	1999	2022	Difference
Białystok	1.33	1.70	1999	0.97	2020	18	6	90	102	12
Bydgoszcz	-12.55	1.90	2010	2.62	2020	1	23	174	176	1
Gdańsk	1.35	3.32	2020	3.22	2022	11	13	262	266	4
Gorzów Wlkp.	-7.51	0.24	2003	2.49	2020	7	17	77	86	9
Katowice	-15.92	0.93	2010	3.67	1999	1	23	164	165	1
Kielce	-14.17	0.88	1999	3.81	2020	1	23	109	110	0
Kraków	6.34	2.75	2020	0.26	2008	16	8	327	327	0
Lublin	-7.77	0.81	1999	1.37	2020	4	20	148	148	0
Łódź	-18.24	-	-	1.58	2010	0	24	295	293	-2
Olsztyn	-1.71	1.00	2000	0.85	2021	12	12	88	88	0
Opole	-3.44	7.93	2017	2.49	2010	3	21	96	149	53
Poznań	-7.35	2.42	2020	0.71	2007	3	21	261	262	1
Rzeszów	22.78	3.72	2010	0.93	2020	17	7	54	129	75
Szczecin	-6.05	0.97	2010	1.15	2020	1	23	301	301	0
Toruń	-7.67	2.81	1999	1.31	2020	3	21	116	116	0
Warszawa	11.01	3.97	2020	0.84	2010	20	4	494	517	23
Wrocław	4.80	4.78	2020	0.45	2000	12	12	293	293	0
Zielona Góra	18.13	1.64	2015	0.76	2020	13	11	58	278	220
Total cities	-0.97	1.06	1999	0.56	2022	8	16	3407	3805	397

Source: Own elaboration based on: Local Data Bank of the Central Statistical Office 1999-2022.

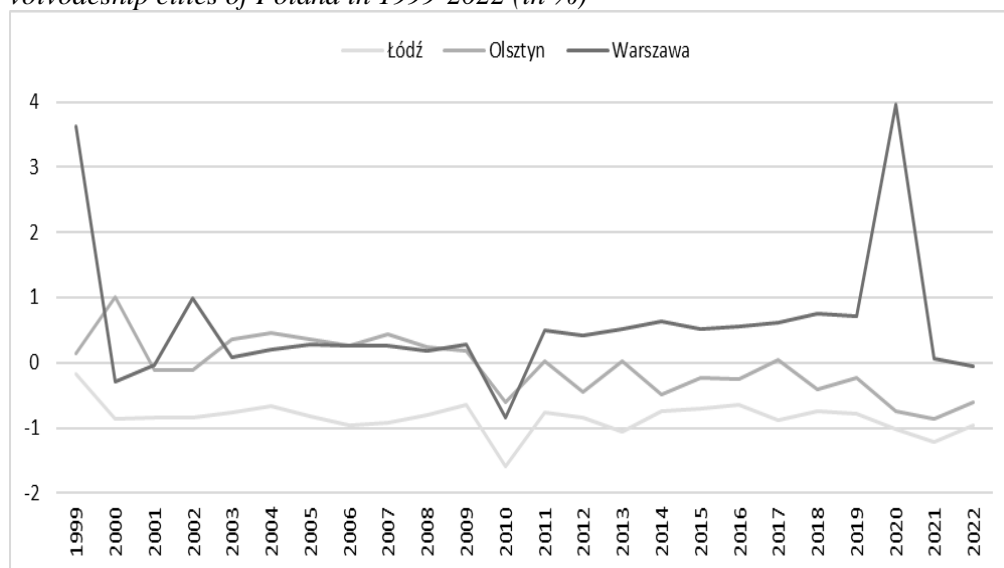
In the first year after the implementation of the administrative reform (1999), most of the voivodeship cities recorded population growth (11 cities), and this situation was repeated in 2017.

Similarly, a decrease in population was most frequently recorded in 2005 and 2022 (16 cities each), while in as many as 21 out of 24-time intervals, a greater number of voivodeship centres were characterised by chain index values with negative values.

The single exceptions to this regularity were the aforementioned years 1999 and 2017 and 2010, when the population change dynamics in an equal number of centres (9 cities each) assumed both positive and negative values. In the period under study, the cities in which positive values of the chain index strongly dominated were Warsaw (20/24), Białystok (18/24), Kraków (16/24) and Rzeszów (15/24).

On the other hand, at the other extreme – with dominance of negative values of the chain index – was Łódź, where the population was constantly decreasing from year to year, as well as Bydgoszcz, Katowice, Kielce and Szczecin, which recorded population growth only once in 24-time intervals. In Olsztyn and Wrocław the periods of population growth and decline were at the same level (12 time periods each) (Figure 3).

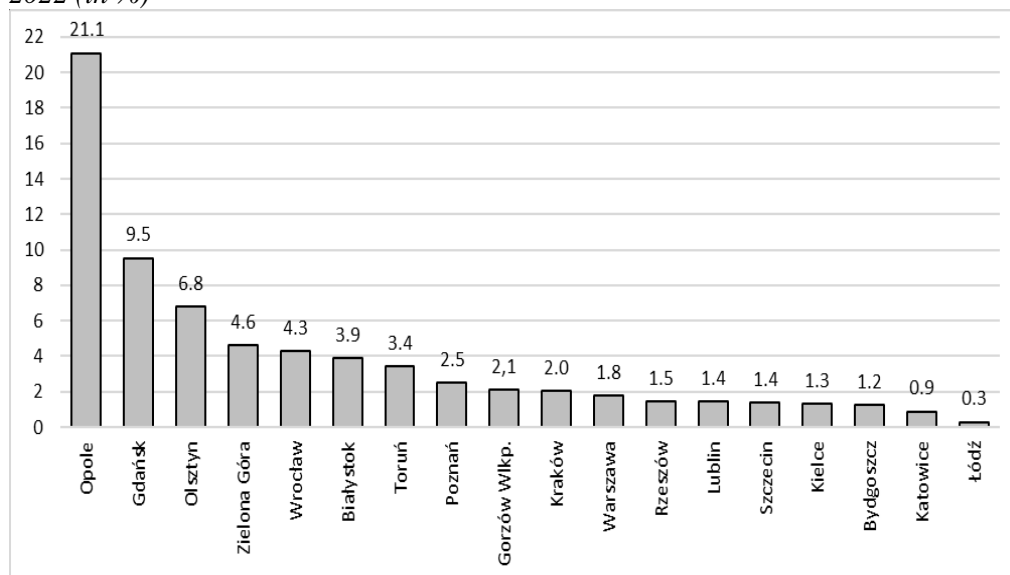
Figure 3. Dynamics of population changes based on the chain index for selected voivodship cities of Poland in 1999-2022 (in %)



Source: Own elaboration based on: Local Data Bank of the Central Statistical Office 1999-2022.

In the successive years of the period under consideration, the dynamics of population change assumed varying intensities in the different study units. In order to illustrate the differences in the intensity of these changes in successive years of the analysed period, the coefficient of variation was employed (Figure 4).

The analysed voivodship centres from 1999-2022 demonstrated significant intertemporal variation in population change dynamics. In half of the analysed cities, the coefficient of variation showed insignificant values, usually not exceeding 2%, with the lowest rates in Łódź (0.3%) and Katowice (0.9%). This indicates that the population changes in these areas have been stable over time.

Figure 4. Coefficient of variation for voivodeship cities in Poland in the years 1999-2022 (in %)

Source: Own elaboration based on: Local Data Bank of the Central Statistical Office 1999-2022.

These cities were distinguished throughout the entire period under study – year after year – by a completely or partially uniform decrease in population – 100% and 96% respectively. Also the next cities in this list characterised by a slight intensification of population change dynamics – Bydgoszcz, Kielce and Szczecin – were characterised by a decisive domination of population decline over population growth, and in the entire analysed period were marked by only one moment in time when positive values of population change dynamics were recorded (similarly to Katowice).

Cities characterised by significant inter-temporal differences in the course of population changes were, above all, Opole (21.1%) and Gdańsk (9.5%), of which Opole was at the same time significant for the highest fluctuation in the intensity of population changes of all the cities analysed. This has been heavily influenced by the increase in its area, which has resulted in significant negative and positive population changes in consecutive time periods, e.g., between 2015 and 2016, there was a population decrease of 0.2 % in Opole, while between 2016 and 2017 there was a population increase of more than 7.9 %.

To determine changes in the demographic situation of voivodeship centres, considering the relation between natural increase or decrease and positive or negative migration balance, Webb's typology was applied, which describes mutual relations between both components of real increase. This provided a depiction of the

variation of real birth rates in Poland's voivodeship cities between 1999 and 2022 (Table 4, Figure 5).

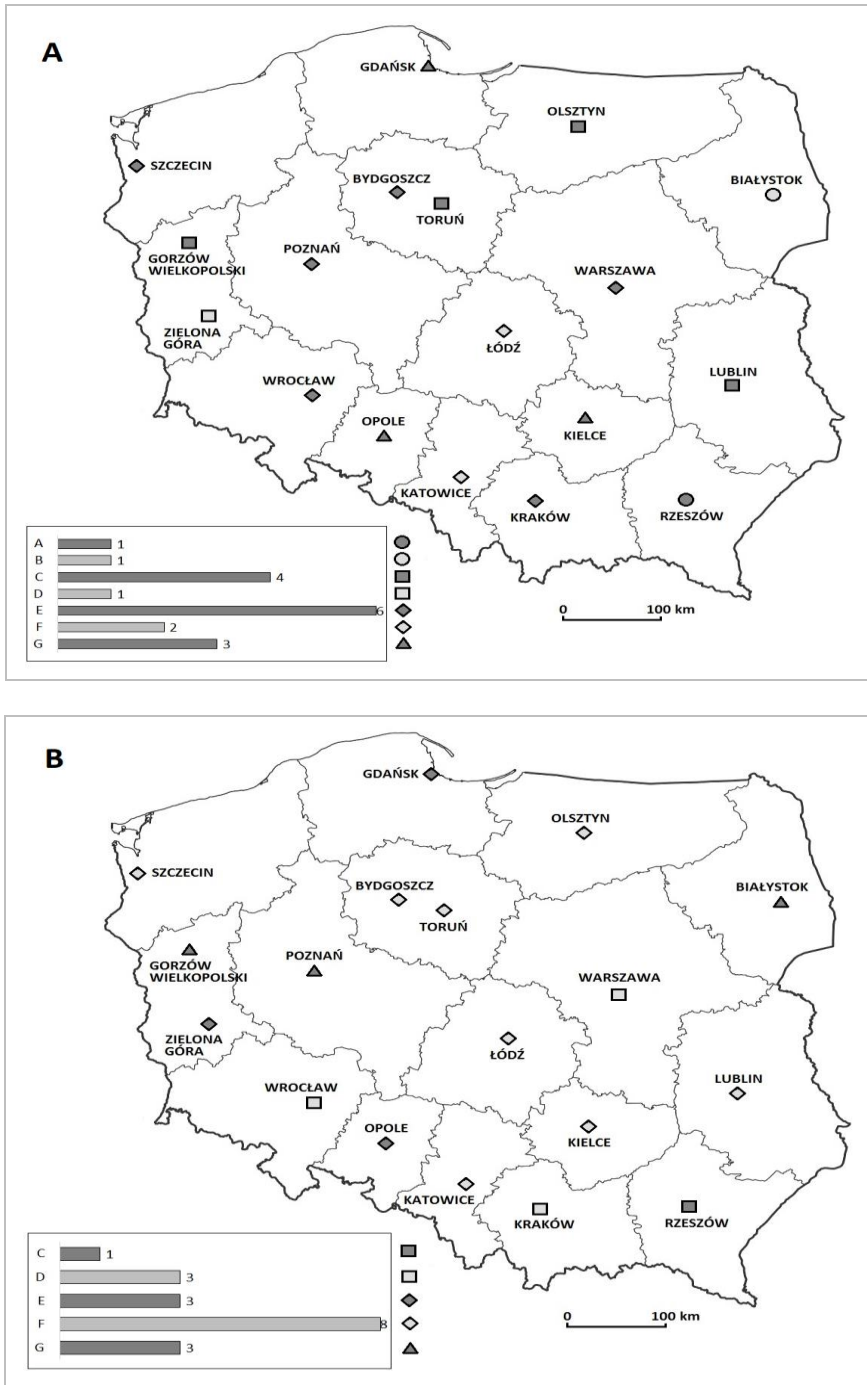
Table 4. Types of population development of voivodeship cities in Poland in 1999-2022

Years/City	Białystok	Bydgoszcz	Gdańsk	Gorzów Wlkp.	Katowice	Kielce	Kraków	Lublin	Łódź	Olsztyn	Opole	Poznań	Rzeszów	Szczecin	Toruń	Warszawa	Wrocław	Zielona Góra
1999	B	E	G	C	F	G	E	C	F	C	G	E	A	E	C	E	E	D
2000	C	F/G	G	A	G	G	E	C	F/G	C	G	F	A	E	H	E	E	C
2001	C	G	G	B	G	H	D	A	F	C	G	F	H	E	H	E	D	D
2002	B	G	F	A	F	G	D	G	F	C	G	F	H	E	H	D	E	D
2003	A	G	G	A	G	G	D	H	F	C	G	G	H	F	H	D	E	D
2004	H	G	G	H	F	G	D	H	F	B	G	G	H	F	H	D	E	H
2005	A	G	G	H	F	G	D	H	F	B	G	G	H	E	H	D	D	H
2006	A	G	G	H	G	G	D	H	F	A	G	H	A	F	H	D	F	H
2007	H	G	G	H	G	G	E	H	F	B	G	H	C	G	H	D	F	H
2008	A	G	B	A	G	H	A	H	F	A	H	H	A	G	H	C	E	H
2009	A	G	A	A	G	H	B	H	F	A	H	H	A	F	H	C	D	B
2010	A	G	A	A	G	H	B	H	F	A	H	H	B	F	H	C	C	C
2011	A	G	A	H	G	H	C	H	F	A	G	H	B	E	H	C	D	C
2012	B	G	G/H	H	G	G	C	H	F	A	G	H	C	E	H	C	D	G
2013	A	G	D	G	G	G	C	H	F	A	G	G	B	E	G	D	D	C
2014	B	G	C	H	G	G	C	H	F	B	G	H	B	F	G	C	C	C
2015	A	G	C	G	F	G	C	H	F	C	E	G	C	E	H	C	D	C
2016	A	G	C	D	G	F	C	H	F	B	C	H	C	E	H	C	C	C
2017	A	G	C	H	F	G	C	H	F	A	B	H	C	E	A	C	C	C
2018	A	G	C	F	F	G	C	H	F	H	C	H	C	E	G	C	C	C
2019	A	G	C	F	F	F	C	C	F	H	C	H	C	E	G	C	C	D
2020	H	F	D	F	F	F	D	F	F	G	E	G	C	F	F	D	D	E
2021	G	F	E	F	F	F	D	F	F	F	E	F	D	F	F	E	E	E
2022	G	F	E	G	F	F	D	F	F	F	E	G	C	F	F	D	D	E
Dominant type	A	G	G	H	G	G	C/D	H	F	A	G	H	C	E	H	C	D	C

Source: Own elaboration based on: Local Data Bank of the Central Statistical Office 1999-2022.

At the beginning and end of the period under study, the voivodeship centres represented all types of population development, except for the H sector (actual population loss due to the prevalence of migration loss over natural increase). In both of the above-mentioned periods, the majority of cities recorded real population loss.

Figure 5. Demographic types of voivodeship cities in Poland in 1999 (A) and 2022 (B)



Source: Own elaboration based on: Local Data Bank of the Central Statistical Office 1999-2022.

The largest number of cities (6 units) from this group in 1999 represented a real loss resulting from the advantage of natural loss over migration growth – type E (Bydgoszcz, Kraków, Poznań, Szczecin, Warsaw and Wrocław). This group included the largest urban centres in the country, which ranked in the top 10 of this classification in terms of population. Negative real growth sectors also included – type F (Katowice and Łódź) and type G (Gdańsk, Kielce and Opole).

In both cases, the components of real growth – natural increase and migration balance – had negative values, while in the first case there was a predominance of natural decrease, and in the second – of migration decrease. Only 7 cities recorded real population growth types at this point in time – A, B, C and D. The largest group of cities represented sector C (Gorzów Wielkopolski, Lublin, Olsztyn and Toruń), which is characterised by both natural and migration growth, with the advantage of the latter. The implication is that depopulation prevailed in 1999, with natural population loss being the main cause.

In the analysed period (1999-2022), there were significant changes in the real growth of voivodeship centres, characterised by an increase in the number of cities with negative real growth values (from 11 cities in 1999 to 14 in 2022). At the end of the analysed period, the variety of population development types represented also decreased (from 7 in 1999 to 5 in 2022).

The voivodeship centres that recorded real population growth in 2022 were only the three largest Polish cities – Warsaw, Kraków, Wrocław (type D – predominance of migration growth over natural decrease) and Rzeszów (type C – domination of migration growth over natural increase). The remaining cities were characterised by depopulation. A change in the type of depopulation is also visible, as many as 8 cities were included in sector F (in 1999 there were only two such cities), where natural decrease exceeded migration decrease (Bydgoszcz, Katowice, Kielce, Lublin, Łódź, Olsztyn, Szczecin, Toruń).

Taking into account the type of real growth represented by cities in the two analysed periods (1999 and 2022), only in 2 of them the state of population development did not change. Among them were Katowice and Łódź, representing the negative real growth type F. In the remaining cities a change took place – in 6 of them a transition from positive to negative real growth types was observed (Białystok, Gorzów Wielkopolski, Lublin, Olsztyn, Toruń, Zielona Góra), next 3 urban units recorded the opposite situation (Kraków, Warsaw, Wrocław).

The remaining 9 cities changed their type of affiliation within a negative (8 cities - Bydgoszcz, Gdańsk, Katowice, Kielce, Łódź, Opole, Poznań, Szczecin) or positive (Rzeszów) real growth. In the period 1999-2022, among the analysed settlement units, type G was recorded most often (88 times out of 432 cases), which dominated in Bydgoszcz (19 times out of 24), Kielce (14 times out of 24) and Katowice and Opole (13 times out of 24).

It is interesting to note that type H was recorded in second place (74 times out of 432 cases), which was the only type that did not occur at both the beginning and end of the study period (1999 and 2022). On the other hand, type B occurred in only 19 cases out of 432, most frequently in Olsztyn (5 times out of 24). Types with negative real population growth definitely dominated over negative ones.

In the period under study, in all voivodeship cities, real decrease occurred 273 times, with only 159 cases of real decrease. The most distinct demographic profile among the voivodeship cities was observed in Łódź, where over the 24 analysed years, the advantage of natural decrease over migration loss was recorded as many as 23 times (type F). At the other extreme was Gdańsk, which in the period 1999-2022 recorded as many as 7 different types of population development (only sector H did not occur).

The analysis shows that the demographic situation of voivodeship cities in Poland is quite significantly spatially differentiated, and in the analysed period one can observe a progressive depopulation of a considerable part of voivodeship centres.

4. Conclusions

Most of the analysed voivodeship centres (10 cities)⁵ reached their apogee of population development in the last two decades of the 20th century. The political changes of the late 1980s and early 1990s contributed to Poland's entry on the path of socio-economic transformation, which resulted in changes in the demographic development of most large urban agglomerations.

At the turn of the twentieth and twenty-first century, the process of suburbanisation developed significantly, causing strong development of suburban zones around the analysed centres and leading to an outflow of population from the city centres to its peripheries. This process is accelerating, with the reach of the main agglomerations extending to increasingly remote peripheral areas.

Thus, Poland is experiencing urban sprawl. Nevertheless, at the end of the analysed period, 7 cities will have reached the highest population values in their history – Białystok and Zielona Góra (2019), Gdańsk (2020), Warsaw and Wrocław (2021), and Kraków and Rzeszów (2022)⁶. In the analysed urban centres, the population transformations in the period under study were quite diverse; therefore they were divided into three groups depicting the dominant directions of demographic development (Table 5).

⁵*The earliest to reach maximum population were Katowice (1986), Łódź (1988) and Poznań (1990).*

⁶*The only voivodeship city that did not record its highest population at the beginning or end of the period under study was Olsztyn (2009).*

Table 5. *Types of population development of voivodeship cities in Poland in 1999-2022*

Type	Cities
Regressive	Bydgoszcz, Katowice, Kielce, Lublin, Łódź, Poznań, Szczecin, Toruń
Stable	Gdańsk, Gorzów Wlkp., Olsztyn, Opole
Progressive	Białystok, Kraków, Rzeszów, Warszawa, Wrocław, Zielona Góra

Source: Own elaboration.

Type one – this group includes mainly cities with a population of over 300,000 in 1999. It is represented by cities which in the period under study were mainly losing their population potential due to the dominance of both natural and migration loss – types F and G (Bydgoszcz, Katowice, Kielce, Łódź), the advantage of migration outflow over natural growth – type H (Lublin, Poznań, Toruń), and in one situation – the advantage of natural loss over positive migration balance (Szczecin).

In the case of Poznań and Szczecin, this was due to the intensification of suburbanisation processes and the development of strongly developed suburban zones around these cities. A similar situation was observed in Bydgoszcz and Toruń, which, due to their relatively close proximity to each other, form a bicentric agglomeration, while the suburban zone around these cities forms one settlement organism.

The population regression in Lublin and Kielce was largely due to the influence of other large centres – Warsaw (Lublin) or Warsaw and Kraków (Kielce). The centres that suffered the most in terms of population were, on the one hand, the centres where industry developed, with plants undergoing painful restructuring or being liquidated as a result of the economic transformation after 1989, e.g. Łódź (textile industry) and Katowice (coal mines, electrical machinery industry), on the other hand – the escape of the population from the city centre to its outskirts (Łódź) or the migration of the population within the Upper Silesian conurbation (Katowice).

Type two – urban centres whose population changes were of a fluctuating nature, characterised by both population gains and losses (types A, G and H dominated in these cities). In these cities, during the period 1999-2022, there were changes in population in both positive and negative directions, with changes not exceeding the value of 7-8% of the population from the beginning of the analysed period (1999).

For the most part, these were centres with a population in the whole-time interval in the in the range of 100-200 thousand inhabitants (Olsztyn, Opole, Gorzów Wielkopolski), of lesser importance in the country's settlement system. In this group of cities, there was a slight decrease in population between 1999 and 2022. The only exception in this type of settlement unit was Gdańsk, where the population increased slightly. This city, together with neighbouring areas of municipalities and urban

units, e.g., Gdynia, Sopot, or Tczew, forms the Tricity agglomeration, with a total population of around one million⁷.

Type three – cities classified in this group are characterised by considerable diversity of population size. There are centres with a population significantly above 500,000 inhabitants – Warsaw, Kraków, or Wrocław, as well as those with a population slightly above 100,000 – Rzeszów and Zielona Góra. In all urban units between 1999 and 2022, there was a progression of population development, where the years of population growth dominated over the years of its decline (types A, C and D).

The greatest dynamics of change was experienced by Rzeszów and Zielona Góra, which owe this situation to the significant expansion of their urban area. In the case of the largest centres (Warsaw, Kraków, Wrocław), the main determinant of population growth was the administrative functions these cities perform in the country's settlement system, as well as their rich historical past.

Białystok, on the other hand, owes its population growth mainly to its location in the sparsely populated north-eastern part of Poland, where, as the largest urban centre, it was an area of significant immigration of mainly young people, resulting in significant population growth.

References:

- Bocheński, T., Rydzewski, T. 2020. Capital cities of former 49 voivodeships in Poland – selected city development issues. *City Analyses*, vol. 3. Scientific Publishing House of the University of Szczecin.
- Cristea, M., Noja, G.G., Thalassinos, E., Cîrciumaru, D., Ponea, C.Ş., Durău, C.C. 2022. Environmental, Social and Governance Credentials of Agricultural Companies—The Interplay with Company Size. *Resources*, 11(3), 30.
- Gołata, E., Kuropka, I. 2015. Demographic change and its implications for selected areas of social policy in big cities in Poland. *Economic Studies. Science notebooks University of Economics in Katowice*, No. 223.
- Harańczyk, A. 1998. *Polish cities in the process of globalization of the economy*. Warsaw: PWN.
- Janiszewska, A. 2019. Demographic problems of large cities in Poland – development or regression? In:] Cieślińska, B. (ed.), *The faces of the big city institutions, organisations, processes*. University of Białystok Publishing House, pp. 23-51.
- Local Data Bank of the Central Statistical Office 1999-2022.
- Michalski, T. 1995. Research issues of large cities in the "Geographical Review" and "Journal of Geographical" in the years 1918-1994. In: 8th Conservatory of City Knowledge: "Centers and peripheries of large cities. Transformation and the future. Concepts and research methods". Łódź, pp. 77-82.
- Mikołajewicz, Z. 2000. Development processes of large Polish cities in the period of transformation. In: Słodczyk, J. (ed.), *Social, economic, and spatial transformation of cities*. University of Opole, pp. 27-42.

⁷CSO Local Data Bank. Retrived from: <https://bdl.stat.gov.pl>.

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- Okólski, M., Fihel, A. 2012. *Demography. Contemporary phenomena and theories*. Warsaw: Scholar Scientific Publishing House.
- Petryszyn, J. 2002. Demographic development of large cities in Poland. In: Słodczyk, J. (ed.), *Demographic and social aspects of urban development*. University of Opole, pp. 13-24.
- Runge, J. 2007. *Research methods in socio-economic geography - elements of methodology, selected research tools*. Katowice: University of Silesia Publishing House.
- Serafin, P. 2018. Changes in the demographic typology of functional urban areas in Poland in 2002-2017. *Bulletin of the KPZK PAN*, 272, pp. 328-343.
- Szukalski, P. 2014. Depopulation of large cities in Poland. *Social Demography and Gerontology. Information Bulletin*, No. 7, University of Lodz.
- Szukalski, P. 2014. The future of voivodship cities in the light of the forecast of the Central Statistical Office of 2014. *Social Demography and Gerontology. Information Bulletin*, No. 11, University of Lodz.
- Szukalski, P. 2018. Demographic development of former and current voivodeship cities. *Social Demography and Gerontology. Information Bulletin*, No. 7, University of Lodz.
- Śleszyński, P. 2016. Current and forecast demographic and migration conditions in development of Poland's city settlement system. *Conservatory of City Knowledge*, 1 (29), pp. 97-106.
- Śleszyński, P. 2018. Demographic challenges of regional development in Poland. *KPZK Studies*, 183, pp. 225-247.
- Thalassinos, E., Cristea, M., Noja, G.G. 2019. Measuring active ageing within the European Union: Implications on economic development. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 14(4), 591-609.