CHANGES IN THE POPULATION AGE STRUCTURE OF CZECH DISTRICTS IN 1989–2019

Luděk Šídlo[1] – Branislav Šprocha[2]

Abstract

Changes in the reproductive behaviour of the Czech population occurring after 1989 have significantly affected the age structure. The more significant the changes at national level, the greater the regional change. The fall in the fertility rate, rising life expectancy, and new spatial patterns in migratory behaviour have significantl affected the population age structure in the Czech regions. This study focuses on Czech districts (LAU 1) and describes changes in the regional differentiation of three main age categories (pre-productive, productive, and post-productive) before presenting a district typology based on these categories. The results confirm the existence of territorial changes in the population age structure. Analyses of regional changes in age structure are an important resource when planning and ensuring accessibility to education, social services and health care, and other services.

Keywords: Age structure, regional differentiation, districts, Czechia, demographic ageing

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INTRODUCTION

The population of Czechia has undergone unprecedented change in the last thirty years and this has affected the rate and timing of fertility and the rate and structure of mortality (see e.g. *Burcin et al.*, 2010; *Fiala et al.*, 2018; *Šťastná et al.*, 2017; *Hašková et al.*, 2019, *Hašková – Pospíšilová*, 2020). Marked changes have occurred in the number and direction of both internal and external migration flows (e.g. *Čermák*, 2005; *Ouředníček – Sýkora*, 2002; *Ouředníček et al.*, 2019). Changes in key demographic processes are evident at the national level, but the greatest differences can be observed at the regional level. Some studies have analysed regional differences in the various components of demographic reproduction (e.g. *Bartoňová*, 1996; *Burcin et al.*, 1999; *Burcin – Kučera*, 2000; *Kašpar et al.*, 2017; *Šídlo*, 2008; *Šprocha – Šídlo*, 2016; *Šídlo – Šprocha*, 2018), but so far the only studies of regional differences in age structure affected by each of the basic components of population development – fertility, mortality, and migration – have been conducted using longer time intervals (e.g. *Bartoňová*, 1999) or different territorial units (e.g. *Grmanová*, 2017).

The main aim of this article is to present the basic trends in regional change affecting the population age structure of Czechia over the last thirty years. The regional units analysed are local administrative units (LAU 1) called districts. Various types of analysis can be used to study population age structure.

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In this study we focus primarily on changes in the basic population age categories defined in relation to economic activity: pre-productive (0–19 years), productive (20–64 years), and post-productive age (65+).

DATA AND METHODS

The data used in this article were provided by the Czech Statistical Office (*CZSO*, 2020) and relate to the population structure by sex and age for Czech districts (LAU 1) in the years 1989–2019 as of 31 December of each year. The data are for the territorial distribution of the district population in the given year and have not been adjusted to reflect boundary changes. Attempts were made to obtain data on the size and age of the population at the municipal level so adjustments could be made to reflect existing boundaries but these were unavailable. According to the CZSO estimates provided along with the data, the most extensive boundary changes took place in 2007 and affected 119 municipalities in 33 districts. Further boundary changes affecting the municipal composition of districts took place in 2000 (1 municipality), 2003 (2 municipalities), and 2005 (28 municipalities). Particular care has to be taken regarding the year 1996, as in that year (in addition to the reallocation of 10 municipalities to different districts) a new district was created – Jeseník (containing 22 municipalities) – consisting of part of the district of Šumperk and a municipality that had belonged to the district of Bruntál. Despite these boundary changes, it was decided that the data was sufficient for the purpose of this article, which is to present changes in the main age categories while focusing on the overall changes in regional differentiation. The assumption underpinning this article is that the addition or removal of one or two small municipalities has no significant effect on the proportion of each age category (in a region?). The district of Jeseník is taken into account throughout the analysis; it is analysed as belonging to one of the 76 districts that existed up to (and including) 1995 and as one of the 77 districts that have existed since 1996.

The method adopted in this study is to take the proportion of the population in each of the three age categories as a means of representing basic changes in the age structure of Czech districts over a thirty-year period. The last part of the article presents a visualisation of the changes in the structure of the three main components using a triangular diagram (also known as an Ossan triangle), a technique that is infrequently used in the Czech literature. In a triangular diagram each side serves as an axis in a system of coordinates and characterises one of the elements of the structure (*Voženílek – Kaňok,* 2011). This type of diagram can therefore be used to illustrate phenomena with a three-part structure, which makes it ideal for illustrating an age structure divided into three basic age categories. Triangular diagrams have been used to great success in, for example, the 'Atlas of the Slovak Population' (*Atlas obyvateľstva Slovenska*, 2006) and to illustrate changes in the age structure in the Visegrad Four countries (*Káčerová – Ondačková*, 2015), but its potential uses are much wider (e.g. to illustrate housing stock structure, see *Kladivo – Halás*, 2012, etc.). The method used in this article to automatically create a data typology using triangular diagrams was developed in a dissertation by S. Ganbaater (2013) at the Department of Geoinformatics, Faculty of Science, Palacky University in Olomouc. Details on the practical uses of this technique can be found in an article by the student's supervisor (*Dobešová*, 2014). This technique is freely available[3] as part of the ArcGIS toolbox, which automatically proceeds through each step of creating the typology on a triangular graph. In other words, it not only plots the relevant points on the graph but also attributes each point in relation to a triangle previously divided up to represent each section of the region or area.

MAIN RESULTS

Changes in the 0–19 age category

Comparing all three basic age categories we see that the most significant changes have taken place in the youngest category, the pre-productive population (0–19 years). This is primarily a consequence

[3] *<http://www.arcgis.com/home/item.html?id=661a8e7c463a4bd2b529f01221efa8f2>.*

Table 1 **Regional differences in the 0–19 age category as a share of the whole population and associated characteristics of the variation in Czech districts 1989–2019, data as of 31 December of the given year**

Interval (%) Indicator	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
34.01–35.00																															
33.01–34.00	5	3	2																												
32.01–33.00	2	4	5	2																											
31.01–32.00	14	12	6	8	5																										
30.01–31.00	21	19	15	11	9	7																									
29.01–30.00	19	22	26	21	14	8	7																								
28.01–29.00	10	8	11	21	25	18	10	8	1																						
27.01–28.00	4	7	10	11	14	27	19	13	8	3																					
26.01–27.00				1	8	10	26	21	16	9	5																				2
25.01–26.00	1	1	1	1		5	11	22	22	17	9	8	4															2	2	2	
24.01–25.00					1	1	2	10	17	27	21	15	10	9	4										1	2	2				
23.01–24.00							1	2	10	18	27	18	23	16	12	10	5	1		1	1	1	2	2	1						
22.01–23.00								1	2	1	12	29	29	33	28	22	18	14	10	5	4	1							1	3	3
21.01–22.00									1	1	1	4	8	16	27	36	34	29	25	27	20	18	11	6	3	2	4	6	8	8	9
20.01–21.00										1	1	2	1	0	3	6	17	28	34	34	32	36	37	34	26	26	28	31	32	33	38
19.01–20.00											1	1	1	2	2	1	0	2	5	7	17	18	23	30	33	31	31	30	28	27	21
18.01–19.00													1	1	1	1	2	2	2	1		1	1	2	10	15	12	8	6	4	4
17.00–18.00																1	1	1	1	2	3	2	3	3	3	1					
Number of districts	76	76	76	76	76	76	76	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
Czechia	29.7	29.5	29.2	28.8	28.2	27.4	26.6	25.7	24.9	24.1	23.4	22.9	22.5	22.1	21.7	21.4	21.0	20.7	20.5	20.2	20.1	20.0	19.8	19.7	19.6	19.6	19.7	19.9	20.1	20.3	20.5
Minimum	26.0	25.9	25.7	25.4	24.8	24.0	23.2	22.3	21.5	20.6	19.9	19.3	19.0	18.6	18.3	18.0	17.7	17.4	17.2	17.1	17.1	17.3	17.3	17.5	17.7	18.0	18.3	18.5	18.6	18.7	18.8
Maximum	34.0	33.7	33.2	32.7	32.0	31.0	29.9	29.0	28.1	27.2	26.3	25.8	25.4	24.9	24.3	23.9	23.4	23.0	22.7	23.1	23.5	23.7	23.9	24.0	24.0	24.3	24.7	25.1	25.4	25.8	26.0
Range	8.0	7.8	7.5	7.4	7.2	6.9	6.7	6.6	6.6	6.5	6.4	6.4	6.4	6.2	6.0	5.9	5.7	5.6	5.6	6.0	6.4	6.4	6.5	6.5	6.3	6.4	6.4	6.6	6.8	7.1	7.3
SD	1.5	1.5	1.4	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.0	0.9	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.2	1.2
CV (%)	5.1	5.0	4.8	4.8	4.8	4.8	4.9	5.0	5.1	5.1	5.2	5.1	5.1	5.0	4.9	4.7	4.7	4.6	4.7	4.8	4.8	4.6	4.8	4.9	5.0	5.2	5.4	5.5	5.6	5.7	5.8

Note: SD = Standard Deviation; CV = Coefficient of Variation.
Source: CZSO (2020).

of changes in the reproductive behaviour of the Czech population that led to falling fertility rates and changes in the timing of parenthood. These changes came to be subsequently reflected in the size of the pre-productive component as a proportion of the whole population, and this became evident over time in all the districts to varying degrees (see Table 1). At the beginning of the period, in 1989, the share of the population aged 0–19 ranged from 26.0 % (Hl. m. Praha, the capital of Czechia) to 34.0 % (Česká Lípa), and ten years later, in 1999, it was between 19.9% to 26.3% (the same districts as in 1989). In other words, the highest value was the same as the lowest value had been at the end of the 1980s. As Table 1 shows, the districts continued to shift towards the lower age category up until the first decade of the new millennium when the variation in this indicator became less distinct. This highlights the fact that nationally significant changes in the size and share of the child segment were taking place on a regional level.

At the end of the 1990s, however, migration processes began to affect the size of the pre-productive segment of the population. Specifically, internal migration, linked to suburbanisation, became increasingly evident in the populations of urban hinterlands, with Praha-západ and Praha-východ rapidly beginning to see a rise in the proportion of their population in this age category. For example, in 2004 Praha-západ had the lowest proportion of individuals aged 0–19 (22.1%), but that then rose to 26% at the end of 2019, thus gradually returning to its 1989 value (27.7%). However, it should be noted that, apart from these two districts, the share of the population aged 0–19 did not exceed 23% in any other district. The lowest proportion (in the period studied) of individuals aged 0–19 was recorded in the capital Hl. m. Praha in 2009, hovering around the 17% mark. However, over the decade this population segment rose slightly to 20%, reflecting the overall changes in the fertility rate seen in Czechia over the last ten years.

Turning to the districts that saw the biggest and smallest changes in the share of the pre-productive population between 1989 and 2019, we find that the biggest decline was in the district of Bruntál, with a fall of over 14 percentage points (from 33.8% to 19.5%). By contrast, the smallest decline was in Praha-západ (mentioned in the previous paragraph), with a decrease of only 1.7 percentage points. These results show that there were (and still are) large differences in the speed and duration of the changes at district level, as we saw with the changes in the proportion of the youngest age category. The migratory appeal of a region therefore has a marked impact on the age composition of the local population, especially in those areas that are attractive to families with children.

Changes in the 20–64 age category

The productive population, defined as people aged 20–64 for the purpose of this article, did not change within the observed timeframe as much as the youngest and oldest age categories did, but that does not mean there are no regional differences in the extent and duration of the change in the share of these segments compared to the population as a whole. As was the case with the youngest age category, the productive population underwent two stages of development, but in reverse to the changes affecting the pre-productive population (Table 2). This was primarily due to the age structure of the population in Czech districts, which had mainly been shaped by the post-war baby-boomer generation (at the beginning of the period studied these generations had yet to reach post-productive age) and the numerically strong 1970s generation. When combined with the falling numbers in the youngest age categories, these large generations initially increased the share of the productive population, which was around 57% of the population in 1989 and by the end of the first decade of the new millennium had risen to 65%. Over time, however, the variation declined, leaving a degree of heterogeneity. The migratory appeal of some districts/municipalities also played a role, with areas proving popular among the productive population recording high immigration levels (see e.g. *Křesťanová et al.*, 2019), and areas with high levels of emigration seeing falls in their share of the productive population. However, in the last decade or so greater heterogeneity was again seen in these areas, with the share of the productive segment falling in all districts to around the original level (58–59%), though the decline began at different times and developed at different speeds. The primary cause of this was the baby-boomer generation reaching post-productive age at the end of the monitored period.

Table 2 **Regional differences in the 20–64 age category as a share of the total population and associated characteristics of variation in Czech districts in 1989–2019, data as of 31 December of the given year**

Interval (%) Indicator	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
70.01–71.00																															
69.01–70.00																															
68.01–69.00																															
67.01–68.00																			1	1											
66.01–67.00																1	1	3	3	3	4	3	1								
65.01–66.00												1	1	4	11	17	24	22	24	18	11	7	4	2	1						
64.01–65.00											5	10	23	28	29	33	35	38	37	39	40	34	23	13	5	2	1				
63.01–64.00									4	12	22	29	27	30	29	20	15	14	12	16	20	29	36	36	29	14	4	1			
62.01–63.00								5	13	23	24	27	22	15	8	6	2				2	4	12	25	36	31	25	7	2	1	1
61.01–62.00						3	10	16	27	28	24	10	4										1	1	6	29	33	35	13	6	2
60.01–61.00	1	1	1	4	6	13	23	37	26	13	2															1	13	28	37	27	10
59.01–60.00	7	6	7	9	16	26	30	16	7	1																	1	6	23	32	34
58.01–59.00	13	17	21	25	36	24	12	3																					2	11	28
57.01–58.00	30	34	32	27	15	10	1																								2
56.01–57.00	20	15	14	11	3																										
55.01–56.00	5	3	1																												
54.01–55.00																															
53.00–54.00																															
Number of districts	76	76	76	76	76	76	76	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
Czechia	57.9	57.9	58.0	58.3	58.8	59.4	60.1	60.8	61.5	62.1	62.8	63.3	63.6	64.0	64.3	64.6	64.8	64.9	65.0	64.9	64.7	64.4	64.0	63.5	63.1	62.6	62.0	61.3	60.7	60.1	59.6
Minimum	55.4	55.5	55.6	56.0	56.5	57.1	57.9	58.5	59.1	59.9	60.6	61.2	61.6	62.1	62.4	62.6	62.9	63.1	63.1	63.0	62.7	62.3	62.0	61.5	61.1	60.6	60.0	59.4	58.8	58.3	57.7
Maximum	60.1	60.0	60.1	60.4	60.8	61.4	61.9	62.6	63.2	64.0	64.9	65.2	65.4	65.4	65.8	66.3	66.7	66.9	67.2	67.1	66.8	66.6	66.3	65.8	65.4	64.9	64.2	63.5	63.0	62.5	62.1
Range	4.7	4.6	4.5	4.4	4.4	4.3	4.1	4.2	4.0	4.1	4.2	4.0	3.8	3.3	3.4	3.7	3.9	3.8	4.1	4.1	4.2	4.3	4.3	4.3	4.2	4.3	4.2	4.1	4.2	4.1	4.4
SD	1.0	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.8	0.8	0.8
CV (%)	1.8	1.7	1.7	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.5	1.4	1.3	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.4

Note: SD = Standard Deviation; CV = Coefficient of Variation.
Source: CZSO (2020).

If we take the year 2007 (when Czechia had its highest proportion of individuals aged 20–64 [65%]) as our dividing line, we find that in the first half of the period the district of Mladá Boleslav changed the most, with the share of the productive population rising by 10 percentage points (from 56.9% to 66.7%). By contrast the smallest change can be seen in the district of Karviná, where the initial value was relatively high (59.9%) but by 2007 had risen by only 5.2 percentage points to 65.1%. In the second half of this period, 2007–2019, the largest change was seen in the district of Děčín, where the proportion of the population aged 20–64 fell by 7.5 percentage points from 65.2% to 57.7%. The smallest decrease was found in the district of Žďár nad Sázavou, from 63.1% to 59.3%, a decrease of 3.8 percentage points. Comparing the changes in these two periods it becomes clear that the most substantial changes taking place were those in the largest age categories, which means that we should assume, particularly when considering the economic implications, that there will be a futher decline in the relative size of the productive population across the country in connection with the transition of the numerically strongest generation from the 1970s into post-productive age.

Changes in the 65+ category

Changes in the size and share of the pre-productive and productive populations combined with the steady decline in the mortality rate and rising life expectancy among older individuals meant that the post-productive population was becoming proportionally larger. As Table 3 shows, the growth was gradual to start with, but in the last few decades it has accelerated and is now being manifested as demographic ageing. By the end of 2019 the 65+ population accounted for more than 20% of the population in 44 districts, although it it did not exceed 14% until 1994. This phenomenon is affecting all Czech districts and can be seen in the decrease in the variation of this indicator across districts over time. However, greater variation can be seen in the last two years, which may indicate dynamic ageing at the top of the age pyramid and larger district-to-district differences in the proportion of the elderly population.

When we compare the changes in the share of the population of post-productive age at the beginning and end of the period, we find that the greatest growth occurred in the district of Bruntál, rising by 12.3 percentage points (from 9.0% to 21.3%) while the lowest level of growth was in Praha-západ, where it increased from 14.6 % to 15.7%. These districts are the same ones we noted earlier as having the largest and smallest changes in the share of the population aged 0–19 between the beginning and the end of the period, and further underlines the fact that the changes in the age structure of Bruntál were significant overall, while those in Praha-západ were much less dramatic. Praha-západ is located in the Prague hinterland and the changes there are a consequence of its migratory appeal. The number of inhabitants almost doubled (98.4%) between 1989 and 2019. A similar pattern can be found in Praha-východ, where the same figure is 96.3%. The third-largest increase in population size was 43.5%, which was found in Brno-venkov and occurred later. It is worth noting that the migration largely occurred within the pre-productive and productive age categories and it offset the demographic ageing processes also in evidence. By contrast, in Bruntál by the end of the period the number of inhabitants had fallen by almost 17% from the initial level (one of the largest decreases of all the Czech districts, which may be partly connected with territorial changes that took place on the territory of the current district in the monitored period; see the methodological part). This shows that age structure is being affected by the basic natural components of demographic reproduction (birth and mortality rates) as well as by migration, and together these have had a significant impact in many districts

A district typology based on the share of the main age categories in the population

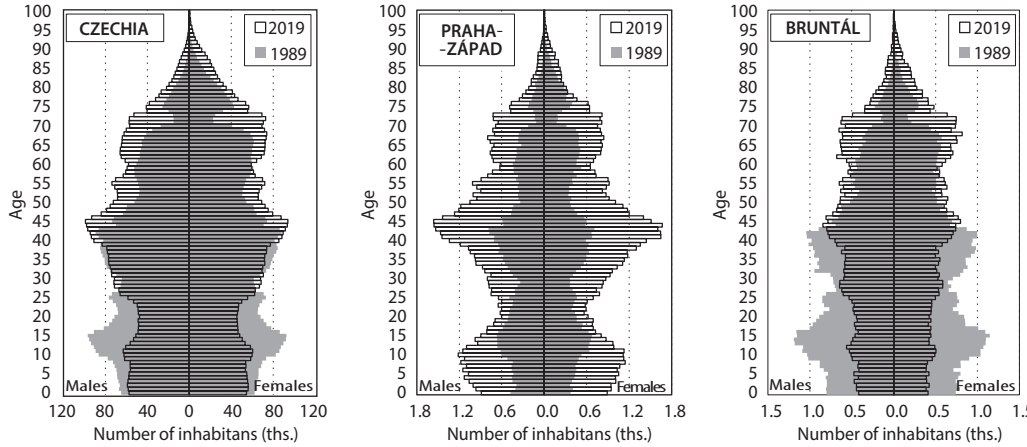
The age structure of the population in Czech districts has changed substantially over the last thirty years. Analysing and creating a typology of these changes that documents both the changes and the variation in the share of each of the three age categories over time is a difficult task. One way to do this is to use a triangular diagram (also known as Ossan triangle).

Table 3 **Regional differences in the 65+ category as a share of the total population and associated characteristics of variation in Czech districts in 1989–2019, data as of 31 December of the given year**

Interval (%) Indicator	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
23.01–24.00																															
22.01–23.00																															2
21.01–22.00																													4	10	18
20.01–21.00																											3	10	17	26	24
19.01–20.00																									5	9	18	30	30	24	22
18.01–19.00																							3	8	13	24	29	22	20	12	8
17.01–18.00																				1	2	5	13	21	30	29	20	10	4	3	1
16.01–17.00							1	1	1	1	1	1	1			1	2	3	5	6	15	18	25	29	22	10	4	3			
15.01–16.00	3	3	1	3	4	6	5	7	7	7	10	12	14	14	13	13	13	18	19	22	28	30	23	13	3	3	1		1	1	2
14.01–15.00	7	7	11	12	12	14	16	16	20	21	20	19	17	19	20	22	26	26	28	29	16	16	7	3	2	1	2	2	1	1	
13.01–14.00	16	16	15	13	16	19	20	25	24	25	23	23	24	25	27	24	21	16	15	11	10	2	5	3	2	1					
12.01–13.00	24	26	27	27	25	18	17	16	13	11	13	12	11	9	9	10	9	9	6	6	6	6	1								
11.01–12.00	12	12	10	10	10	11	10	6	6	6	4	5	5	5	4	5	5	5	4	2											
10.01–11.00	6	6	6	5	3	2	2	4	4	5	5	4	5	5	4	2	1														
9.01–10.00	3	4	5	5	5	5	4	1	2	1	1	1																			
8.01–9.00	4	1		1	1	1	1	1																							
7.01–8.00	1	1	1																												
6.00–7.00																															
Number of districts	76	76	76	76	76	76	76	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
Czechia	12.5	12.6	12.8	12.9	13.0	13.1	13.3	13.5	13.6	13.7	13.8	13.9	13.9	13.9	13.9	14.0	14.2	14.4	14.6	14.9	15.2	15.6	16.2	16.8	17.4	17.8	18.3	18.8	19.2	19.6	19.9
Minimum	7.3	7.5	7.8	8.0	8.2	8.4	8.7	8.9	9.1	9.3	9.6	9.9	10.2	10.4	10.6	10.7	11.0	11.3	11.4	11.7	12.1	12.5	13.0	13.4	13.8	14.0	14.2	14.5	14.7	14.8	15.0
Maximum	15.2	15.2	15.5	15.6	15.7	15.8	16.0	16.2	16.3	16.3	16.3	16.3	16.1	16.0	15.9	16.0	16.2	16.5	16.7	17.1	17.5	17.8	18.4	18.9	19.3	19.7	20.2	20.7	21.1	21.7	22.1
Range	7.9	7.8	7.7	7.6	7.5	7.4	7.3	7.2	7.2	7.0	6.7	6.5	6.0	5.6	5.3	5.3	5.2	5.3	5.3	5.4	5.4	5.3	5.4	5.5	5.6	5.7	6.0	6.2	6.4	6.8	7.1
SD	1.6	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.4	1.4	1.3	1.3	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.2	1.2	1.3
CV (%)	13.3	12.8	12.1	11.9	11.7	11.5	11.3	11.1	10.9	10.7	10.4	10.1	9.8	9.6	9.4	9.0	8.6	8.3	8.1	8.1	8.1	7.9	7.6	7.0	6.6	6.3	6.1	6.0	6.1	6.2	6.4

Note: SD = Standard Deviation; CV = Coefficient of Variation.
Source: CZSO (2020).

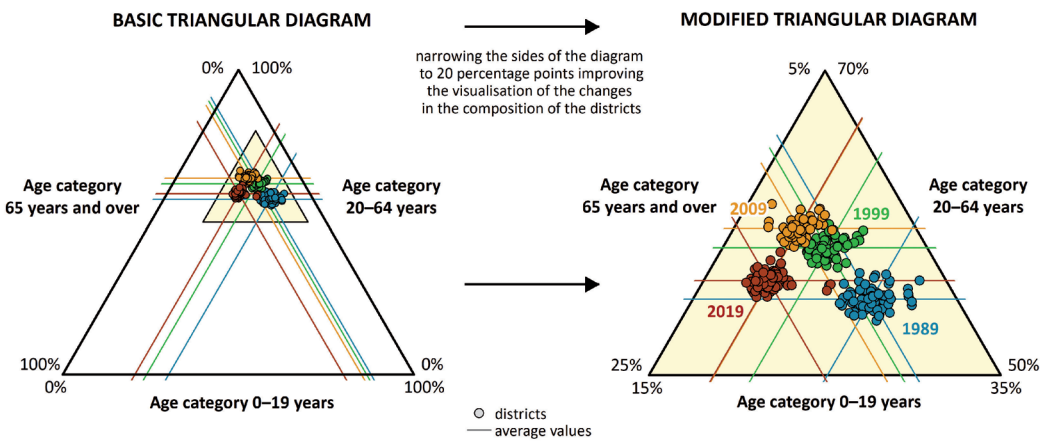
Figure 1 **Comparison of the population age structure between 1989 and 2019 for Czechia as a whole and for the districts of Praha-západ (with the smallest changes in population structure) and Bruntál (with the biggest changes), data as of 31 December of the given year**



Source: CZSO (2020).

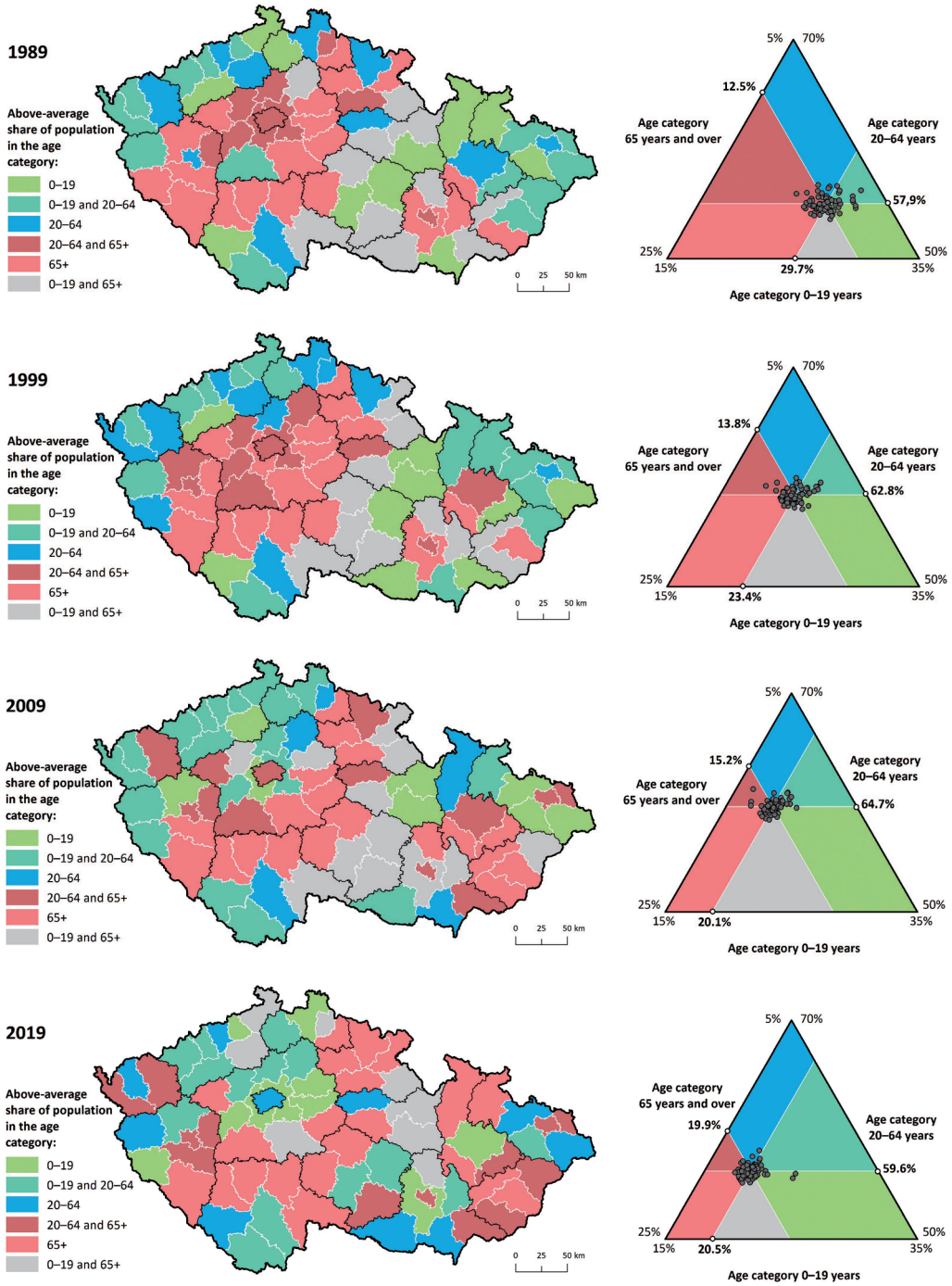
When we created the triangular diagrams for this article, some adjustments first had to be made to each side of the graph. This is because, despite the demographic significance of the changes in the population share of each age category, the changes were hard to identify when observed over a thirty-year period using a 0–100% interval, because the districts in the original triangular graph formed an indistinct cluster (see the left side of Figure 2). The sides of the triangle were therefore adjusted so that all three age categories were in the range of 20 percentage points, improving the visualisation of the changes in the composition of the districts and the overall trend over time. The modified version can be seen on the right side of Figure 2. The districts within the selected year range are clustered together in an upside down U shape. In other words, it shows the declining share of the pre-productive population and the growing

Figure 2 **Triangular diagram and modified version showing the number of persons in each age category for Czech districts in selected years**



Source: CZSO (2020).

Figure 3 **Typology of Czech districts by share of basic age categories based on the triangular graphs for the years 1989, 1999, 2009 and 2019, data as of 31 December of the given year**



Source: CZSO (2020).

share of the post-productive population. The curve is caused by the initial growth followed by a decrease in the share of the productive population.

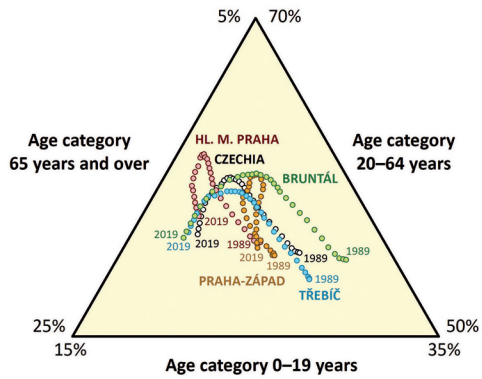
Using the toolbox the average values for each of the observed years can be added by generating straight lines. In Figure 2 the lines are shown in different colours corresponding to the dots indicating the year. These straight lines have the important function of defining the segments of the triangle for the given year, enabling the graph space to be divided up into six different areas showing the above-average proportion of the relevant age categories at the national level. The location of the dots/districts can then be used to create a district typology for each year representing each age category.

Figure 3 shows the changes in the district typologies in ten-year intervals for the duration of the period observed. The end state for the given year is illustrated by the triangular graph, which is divided into six sectors defined by the straight lines connecting the average values and determining the location of the districts on the graph. The cartogram method is then used to allocate the districts to the different sectors.

It is immediately clear that this typology substantially alters the territorial picture. The biggest change can be seen in the Central Bohemian and Moravian regions. In 1989 most of the Central Bohemian districts, as well as the capital Hl. m. Praha, had above-average shares of productive and post-productive inhabitants, but by the end of 2019 the opposite was true. Districts with above-average shares of inhabitants aged 0–19 and possibly also of inhabitants in the 20–64 age category predominated. On the other hand, the Moravian districts, mainly in the northern and south-eastern parts, tended to figure among the areas with above-average shares of productive and/or post-productive inhabitants. But there are also areas of the same type in all four cross-sectional years when compared across districts. Examples are the districts of Klatovy, Strakonice, Písek, and Tábor and Pelhřimov as well, which all have above-average shares of inhabitants aged 65+ in all four years. By contrast the districts in the north-west part (in NUTS 3 region called Ústecký kraj) have predominantly younger inhabitants throughout the period observed.

Changes in the age structure are visualised in the triangular graph for each administrative unit according to year, which allows us to follow any district 'movements' within the system of coordinates and compare them with other regions. Figure 4 shows the changes for Czechia and the capital Hl. m. Praha (the district with the smallest proportion of people at pre-productive age over the long term), Bruntál and Praha-západ (the districts with the smallest or largest changes in age structure, see above), and Třebíč (the district recording the biggest growth in the productive-age population between 1989 and 2019).

Figure 4 **Triangular graph showing the changes in the main age categories between 1989 and 2019, Czechia and selected districts**



Source: CZSO (2020).

The trajectory of the population structure of Bruntál is clearly marked out by the green dots on the graph, illustrating how the share of the pre-productive population fell while the post-productive population rose. By contrast the trajectory for Praha-západ is limited to the centre of the graph, indicating the similarity between the situation in 2019 and 1989. The capital Hl. m. Praha has its own specific developmental curve, which shows how in the second half of the period the proportion of inhabitants aged 65+ grew sharply while the youngest segment of the population increased The district of Třebíč copies the national picture to some degree, except at the beginning of the reference period, when it has a lower final value for the productive population and conversely a slightly higher share of the population of pre-productive age. The triangular graph therefore confirms, by means of visualisation, the different trends in the changes in the proportion of people in the basic age categories over time.

CONCLUSION

The aim of the article was to present regional differences in the age structure of the population in Czech districts over a period of thirty years as simply as possible and to create a district typology using triangular graphs. The conclusion is that two main trends were confirmed that relate to the overall changes in reproductive behaviour among the Czech population: a decline in the proportion of the youngest age category, despite the slight temporary growth recorded in recent years; and a gradual increase in the size and proportion of the elderly population, which has nevertheless accelerated in recent years and comes at the cost of a decline in the productive population. These changes, which are linked to demographic ageing, have dominated to the extent that they have affected all Czech districts to varying degrees. There are areas that exhibit specific characteristics and stand out from the remaining districts. These are mostly districts affected by the suburbanisation that began at the end of the 1990s: Praha-západ and Praha-východ, but also Brno-venkov and Plzeň-sever. The migratory appeal of these districts mainly attracts the younger segment of the productive-age group, who start families in their new location, and this then feeds through into growth in the child population. Consequently, demographic ageing has had less of an impact on these districts than in areas where there have been long-term fertility declines and population losses due to emigration – the northern Moravian districts are an example of the latter.

It is important to analyse regional differences in population age structure and to understand changes and trends in areas where the age composition has a greater effect on the supply and demand of various kinds of services. This applies particularly to education and social and health-care services, where different population structures can substantially affect the local accessibility of these services (see e.g. *Průša*, 2017; *Šídlo – Křesťanová*, 2018; *Maláková et al.*, 2020). These require careful, continual analysis and the information obtained could be used, for example, to link regional estimates to future population development, or when planning the number and size of the facilities that provide these services.

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