Modelling of population development in districts: Case study of Příbram

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Abstract

Modelling of population development in districts is important for policy-makers, because right political decisions require high-quality information. It is important to ensure their relevancy and reliability and that they are provided at the right time as actual as possible. Long-term trends shall be monitored and future development modelled. Regarding demographic data for policy-making purposes, there is a problem with territorial statistics based on NUTS classification as e.g. rural development policy has own territorial division that does not match. For example, for decisions and strategies are needed data on the level of municipalities. However, demographic data collection in municipalities is problematic. When modelling future development of population for example in the area of operation of so-called Local Action Groups (LAG), some corrections of regional data are needed. The aim of the paper is to project the population structure on a case study of a district of Příbram and to discuss how the data about population development can be used in taking decision about local politics. We used component method to project the population development until year 2030. The results show that higher mortality rates that are present in district Příbram in the last decades mean that the average age of population is not comparable to the average of the Central Bohemian region or the national average. Population in the town of Příbram grows old, but the regression will be lower than in similar Czech districts with a comparable demographic structure.

Key words

component method, demographic modelling, districts, local action group, Příbram

Introduction

It is indisputable that the right political decisions require high-quality information. For their processing, it is particularly important to ensure their relevancy and reliability and that they are provided at the right time as actual as possible. Often political decisions are formulated based on historical data. The risk of making the wrong decision can then be eliminated by monitoring long-term trends and modelling of expected future developments (see e.g. paper by Nowok et al., 2013). Another problem with the data is the spatial mismatch. Politics often involves various levels of territories, municipalities, associations of municipalities, etc., for which, however, are not always available data.

Regarding demographic data for regional and rural development policy, both of the above problems are sometimes relevant. Especially territorial statistics, based on NUTS classification has limited predictive capabilities. In rural development, the European Union seeks to respect the principle of subsidiarity and the creatures of the policies and decisions "bottom-up" as close as possible, which the policy applies. Therefore, within structural policies have been developed territorially independent groups of municipalities (so-called micro-regions), whose mission is to contribute to local development for which they need quality data (not only from the area of demographic development). Also rural development policy introduced special partnerships called Local Action Group (LAG) that are working inter-territorially. They aim is to implement the principles of LEADER. They are based on the association of municipalities, associations and profitable sector and uncharacteristically not respect territorial boundaries of regions. For LAG decisions are therefore needed data on the level of municipalities that are members of this group. However, data collection, and

especially demographic, as the village is difficult (Gatere, 1977). Even at the level of regions complications arise when, for example, monitoring of internal migration (Rogers, 1973). The LAG territory is defined by the boundary that borders the cadastral territory of all peripheral municipalities included within the LAG's jurisdiction. Therefore, data at the level of the municipalities that are members of this group are required for LAG decision-making. For the formulation of the LAG strategy, specific data is needed for a small area. However, territorial statistics based on the NUTS classification have only limited information. Nevertheless, they are still important. As we show further, projection of population can be done for the most populated district and can serve as a proxy for other territories. Another way would be to perform projections also for other regions and adjust the need projection by them. The discussion about adjustment of the data from total population on particular sample of population can be found in paper by Šimpach, Langhamrová (2016).

The definition of the countryside itself is also problematic. In the predominantly rural areas of the Czech Republic, according to the OECD definition, only the Vysočina (Highland) Region belongs. However, it is important to distinguish between the city and the countryside because these populations differ in demographic factors. The main factors include a lower level of education, a higher fertility rate and lower abortion, related to family and tradition, and higher mortality due to lower availability of medical care. Data gathering, especially demographic, for municipalities is therefore problematic.

The paper focuses on projections of demographic data in the future, which are necessary for development strategy and policy-making. The aim is to project the population structure on a case study of a district of Příbram, which represent majority (in terms of population) of operation of LAG Podbrdsko. It is discussed how the data about population development can be used in taking decision about local politics.

Data and Methods

Based on the examination of demographic indicators of historical yearbooks of districts of the Czech Republic, which can be combined with information of historical yearbooks, cities and municipalities, there is used the classic demographic approach of complete component method of calculating population projection of LAU 1 Příbram for next 20 years. District of Příbram is a part of the region NUTS 2 Central Bohemia. Given that the data sources due to a lack of detailed and summary information are combined, it is necessary to take into account the existence of other major towns or cities near the district of Příbram, especially Prague and other main towns in the region. Scenarios for calculations of law of human mortality are calculated based on Gompertz (1825) approach. It is taken into account the health situation of the population and worse living conditions in the district caused by mainly mining and the presence of heavy metals in soil. Fertility is modelled in the context of main towns within the district Příbram: Dobříš, Sedlčany, and Rožmitál pod Třemšínem.

The term “gross migration” refers to the total number of migrants (all immigrants and emigrants) who come to the $i^{(th)}$ area (gross immigration I_i) or leave it (gross emigration ${}_iE$) and their summation ($I_i + {}_iE$) is considered as “migration turnover”. The difference between the total number of immigrants and total number of emigrants ($I_i - {}_iE$) is equal to the “migration increment” (or net migration, migration balance, mechanical increment) – and this will be used as an additional information in this study. If the migration balance is positive, it is a net immigration, if negative, it is a net emigration. Using the data published by the CZSO for the (currently last actual) year 2015 there will be calculated migration turnovers and migration balances for the district Příbram and all its neighbouring districts. The schema of internal migration between districts is for one calendar year presented in the Tab. 1.

Tab. 1: The schema of internal migration between districts used by CZSO

District of In-Migration (*j*)	**District of Out-Migration (*i*)**						**Total**
	1	2	…	*i*	…	*n*	
1				⋮			$_1M$
2				⋮			$_2M$
⋮				⋮			⋮
j	…	…	…	$_iM_j$	…	…	$_jM$
⋮				⋮			⋮
N				⋮			$_NM$
Total	M_1	M_2	…	M_i	…	M_n	M

Source: Methodology of CZSO, own construction.

Neighbouring districts will also include the Capital City of Prague (AB Hlavní město Praha), although it is not directly adjacent to Příbram. This is because by Prague is influenced almost everything in the Czech Republic, and it is very important factor for migration in the Central Bohemian region. Other districts neighbouring directly with PB Příbram are: BN Benešov, BE Beroun, PZ Praha-západ, PI Písek, ST Strakonice, TA Tábor, PJ Plzeň-jih and RO Rokycany. In the Tab. 2 there is presented an empirical data published by CZSO in 2015.

Tab. 2: Empirical data of internal migration between neighbouring districts in 2015[1]

			1	2	3	4	5	6	7	8	9	10
			District of out-migration *(i-th)*									
District of in-migration *(j-th)*			AB	BN	BE	PZ	PB	PI	ST	TA	PJ	RO
1	AB	Hlavní město Praha	x	445	377	1634	435	156	131	230	56	68
2	BN	Benešov	695	x	6	74	65	8	7	38	0	2
3	BE	Beroun	853	9	x	157	62	3	7	4	5	38
4	PZ	Praha-západ	3708	57	82	x	81	21	15	18	12	7
5	PB	Příbram	472	58	113	61	x	49	21	27	4	13
6	PI	Písek	165	7	8	15	70	x	135	48	8	6
7	ST	Strakonice	114	6	8	7	29	121	x	12	23	3
8	TA	Tábor	178	54	5	27	42	70	23	x	0	2
9	PJ	Plzeň-jih	54	3	2	9	16	10	15	7	x	49
10	RO	Rokycany	112	0	76	6	16	1	4	1	28	x

Source: data by CZSO, own construction.

The results of migration turnovers and migration balances according to the methodology outlined above (see also paper by Šimpach, Dotlačilová, 2013) are presented in the Tab. 3 and Tab. 4. In the case of migratory turnover, the values over the diagonal must be equal. For the migration balance is true that the values over the diagonal must have the opposite sign. Which region has a positive sign (in its $j^{(th)}$ row), dragged the population from the competitive district (in the $i^{(th)}$ column). District PB Příbram has relatively low positive (or) negative values of the migration balances (in comparison with other districts in the table), so the population structure (in its size) will be probably minimally affected by internal migration. This is the situation for year 2015 only, but according to other historical data published by the CZSO in 2014 and earlier the situation is almost similar. To illustrate and complement our assumptions of future population development, the age-specific net migration balance in district Příbram is shown in Fig. 1. The maximum increase in one age group was 42 persons

[1] *The Capital City of Prague (AB Hlavní město Praha) is included because it affects most of the economic and social behaviour in the Czech Republic and it is in relatively good driving distance from Příbram.*

during the analysed period, the maximum decrease was 46. Otherwise, migratory flows are quite stable and the migration balance is very little for the region.

Tab. 3: Migration turnovers in analysed districts in 2015

			1	2	3	4	5	6	7	8	9	10
			District of out-migration *(i-th)*									
District of in-migration *(j-th)*			AB	BN	BE	PZ	PB	PI	ST	TA	PJ	RO
1	AB	Hlavní město Praha	x	1140	1230	5342	907	321	245	408	110	180
2	BN	Benešov	1140	x	15	131	123	15	13	92	3	2
3	BE	Beroun	1230	15	x	239	175	11	15	9	7	114
4	PZ	Praha-západ	5342	131	239	x	142	36	22	45	21	13
5	PB	Příbram	907	123	175	142	x	119	50	69	20	29
6	PI	Písek	321	15	11	36	119	x	256	118	18	7
7	ST	Strakonice	245	13	15	22	50	256	x	35	38	7
8	TA	Tábor	408	92	9	45	69	118	35	x	7	3
9	PJ	Plzeň-jih	110	3	7	21	20	18	38	7	x	77
10	RO	Rokycany	180	2	114	13	29	7	7	3	77	x

Source: own calculation.

Tab. 4: Migration balances in analysed districts in 2015

			1	2	3	4	5	6	7	8	9	10
			District of out-migration *(i-th)*									
District of in-migration *(j-th)*			AB	BN	BE	PZ	PB	PI	ST	TA	PJ	RO
1	AB	Hlavní město Praha	x	-250	-476	-2074	-37	-9	17	52	2	-44
2	BN	Benešov	250	x	-3	17	7	1	1	-16	-3	2
3	BE	Beroun	476	3	x	75	-51	-5	-1	-1	3	-38
4	PZ	Praha-západ	2074	-17	-75	x	20	6	8	-9	3	1
5	PB	Příbram	37	-7	51	-20	x	-21	-8	-15	-12	-3
6	PI	Písek	9	-1	5	-6	21	x	14	-22	-2	5
7	ST	Strakonice	-17	-1	1	-8	8	-14	x	-11	8	-1
8	TA	Tábor	-52	16	1	9	15	22	11	x	-7	1
9	PJ	Plzeň-jih	-2	3	-3	-3	12	2	-8	7	x	21
10	RO	Rokycany	44	-2	38	-1	3	-5	1	-1	-21	x

Source: own calculation.

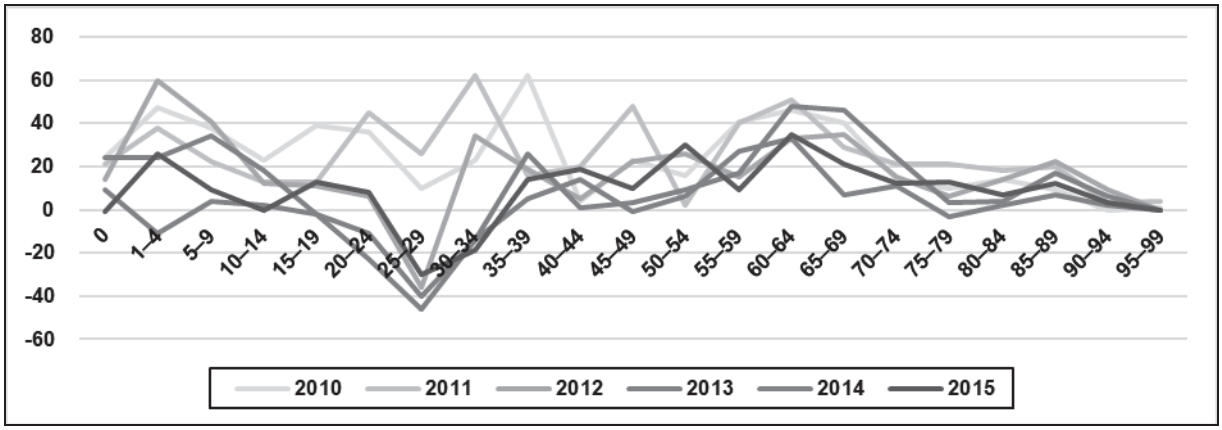

Fig. 1: Age-specific net migration balance in district Příbram in years 2010–2015

Source: data by CZSO, own construction.

Results

Higher mortality rate over the past decade in Příbram and shorter life expectancy at birth[2] causes that prolonging of the life expectancy of population does not keep pace with the average of the Central Bohemia Region, nor with the national average (see e.g. Fiala, Langhamrová, 2012). Nevertheless, despite that the Central Bohemia region has on a nationwide scale the highest total fertility rate (between the years 2010–2015 it ranged from 1.52 to 1.64), level in district Příbram is quite low (between 2010 to 2015 in the range of 1.40 to 1.52). Slimming of the base of the population pyramid will bring issues with keeping existing kindergartens and schools. Migration balance cannot prevent population decline. Based on the demographic statistics, together with the use of partial corrections (especially by stable net-migration balance in the district) and using by the component method (Keyfitz, 1964) we designed the age-and-sex-specific demographic structure of the district of Příbram in 15-year horizon. How the structure might look on 31.12.2030, can be seen in Fig. 2.

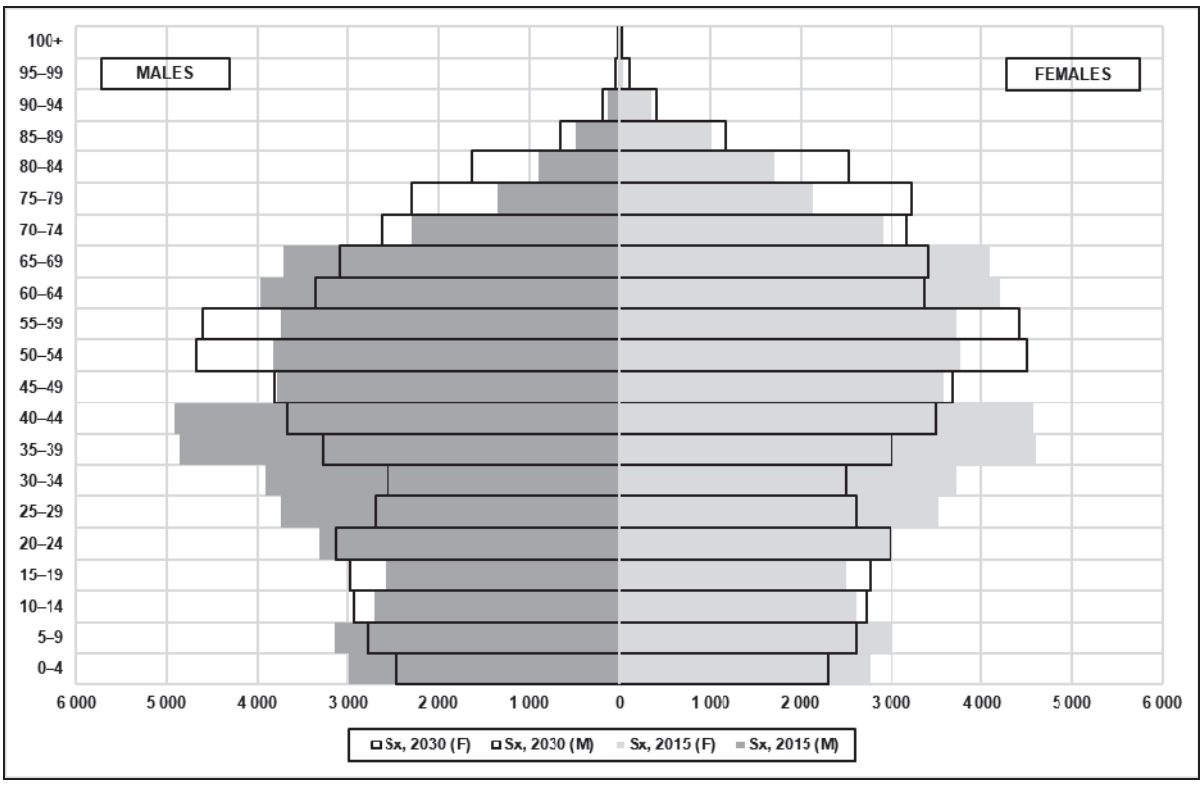

Fig. 2: Age-and-sex specific 5-year population structure in district PB, data actual on 31.12.2015 and 31.12.2030 (projection)

Source: own calculation.

The results show how the region of Příbram become older. (Population structure grows-up at its peak – in the highest ages). Lower life expectancy of male population causes a deformation of this pyramid – in the top-left side of the structure can be seen, that males die faster than females. This is largely because there are worse living conditions that are mainly caused by mining in the past decades and the presence of heavy metals in soil. The Projected decrease in live birth persons between 2016–2020 and 2026–2030 is shown in the Fig. 3 (left). In the Fig. 3 (right) is calculated the future development of Sauvy's age indexes (Sauvy, 1961). The calculation is performed as a ratio of grandparent's generation (aged 50+) and children's generation (0–14 years).

[2] Based on complete mortality tables for period 2011–2015 published by CZSO was calculated the life expectancy at birth for males 75.48 years and 80.95 years for females.

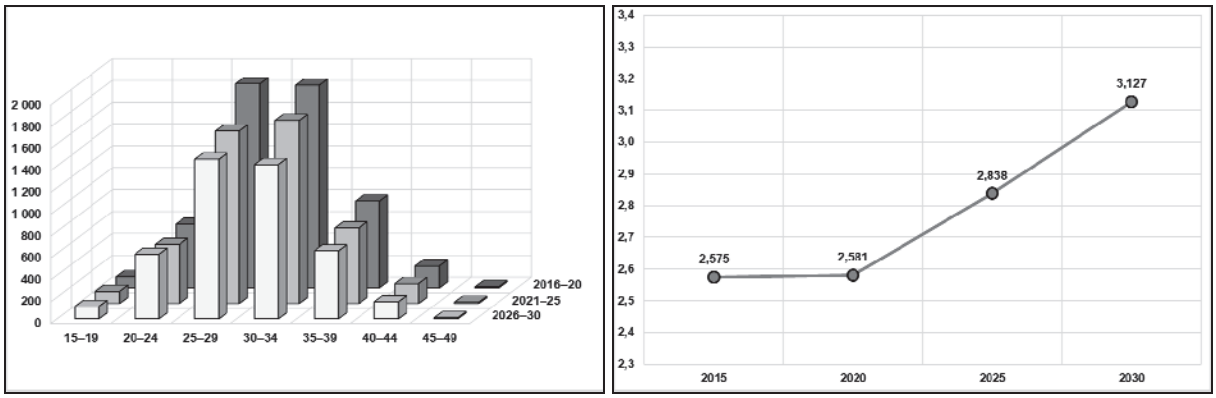

Fig. 3: Projected decrease in live birth persons between 2016–2020 and 2026–2030 (left chart) and calculated future development of Sauvy's age indexes (right chart)

Source: own calculation.

The population will decline throughout the region. Evidence of this decline is shown in the Fig. 4, where the total number of population without distinction of sex is divided into the biological and economic generation (see also book by Sauvy, 1961). The results are both in absolute numbers and proportions in %.

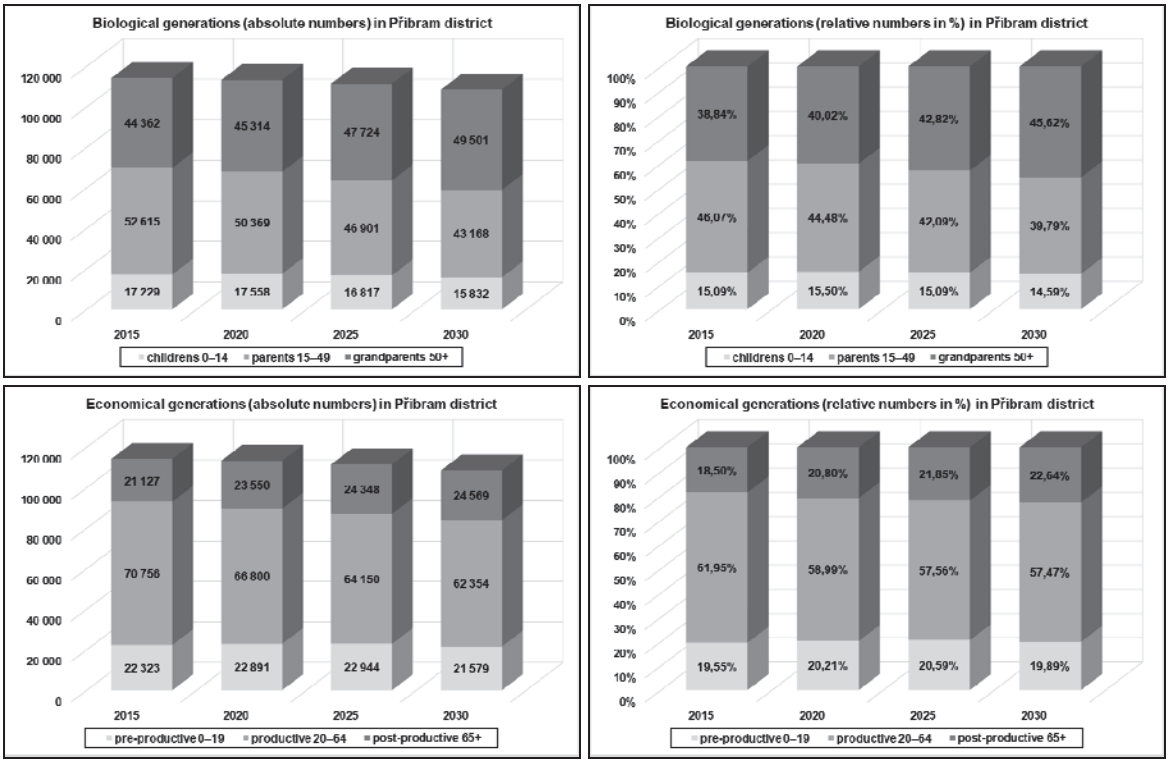

Fig. 4: Projected biological generations in PB (0–14 children, 15–49 parents, 50+ grandparents) in absolute (top left) and relative numbers in % (top right); Economical generations (0–19 pre-productive, 20–64 productive, and 65+ post-productive) in absolute (bottom left) and relative numbers in % (bottom right).

Source: own calculation.

Conclusion

Knowing future age-and-sex structure is of the population important for policy-makers mainly to take decisions in the area of social policy. To maintain the current population

situation in district of Příbram it is essential that the policy-makers support population increase to reach the levels of total fertility rate of the rest of the districts (approximately 1.60). There is sufficient amount of kindergartens and schools in the district, but if the future developments in the next 15–20 years does not change, there is a risk that they will be half empty. The health situation of the population is currently unchangeable. We must wait until the consequences of mining from the period of the past regime wear off and the population will be able to catch up with the level of mortality, which is in the remaining districts of the Central Bohemia, i.e. similar to the national average. Those results shall be reflected also by the strategy of rural development of LAGs. With regard to regional development the district Příbram can support immigration. Support for small and medium businesses in the district can also help to attract new young families who would live and work in the district. A major impulse for the development and popularity of housing in Příbram would be the completion of the highway D4 connecting Písek, capital town of South Bohemia with Prague, that passes Příbram. At present, it is necessary already to reconstruct the oldest sections of which have been built since 1969 and already are beyond expiry date. Completion of the entire connection Písek and Prague is estimated by experts on 4Q 2023.

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