

## DemoSpatial Typology of the Moravian-Silesian Region

Ivan Šotkovský

Department of Regional and Environmental Economics,  
Faculty of Economics, Technical University of Ostrava,  
Sokolská třída 33, 701 21 Ostrava 1, Czech Republic  
ivan.sotkovsky@vsb.cz

**Abstract.** The article is deal with the differences between 22 administrative districts of the municipalities with wide-spread activity (SO ORP) on the territory Moravian-Silesian region in the Czech Republic after year 1970. There are drew up the basic Czech region population and spatial differenceness in the preface. The spatial hierarchy of the Moravian-Silesian region is completed about its 22 administrative districts of the municipalities with wide-spread activity and their population changes during last 37 years.. The spatial typology is given weigh of the three indicators and two index: crude natural increase rate, crude net migration rate, crude total increase rate, vitality index and migration gain index. The analyses on this spatial level is working with the creation of cartogram method for processing of the demographical data . We can use ArcGIS 9.2 as a complete system for authoring, serving, and using geographic information for better processing the spatial data by the help of cartogram method.. Our principal main is to group the all 22 administrative districts of the municipalities with wide-spread activity on the territory Moravia-Silesia region on the basis population growing, population stagnant and population decreasing groups.

**Keywords:** administrative units, natural increase, net migration, total increase, vitality index, Moravian-Silesian region, migration gain index, administrative districts of the municipalities with wide-spread activity.

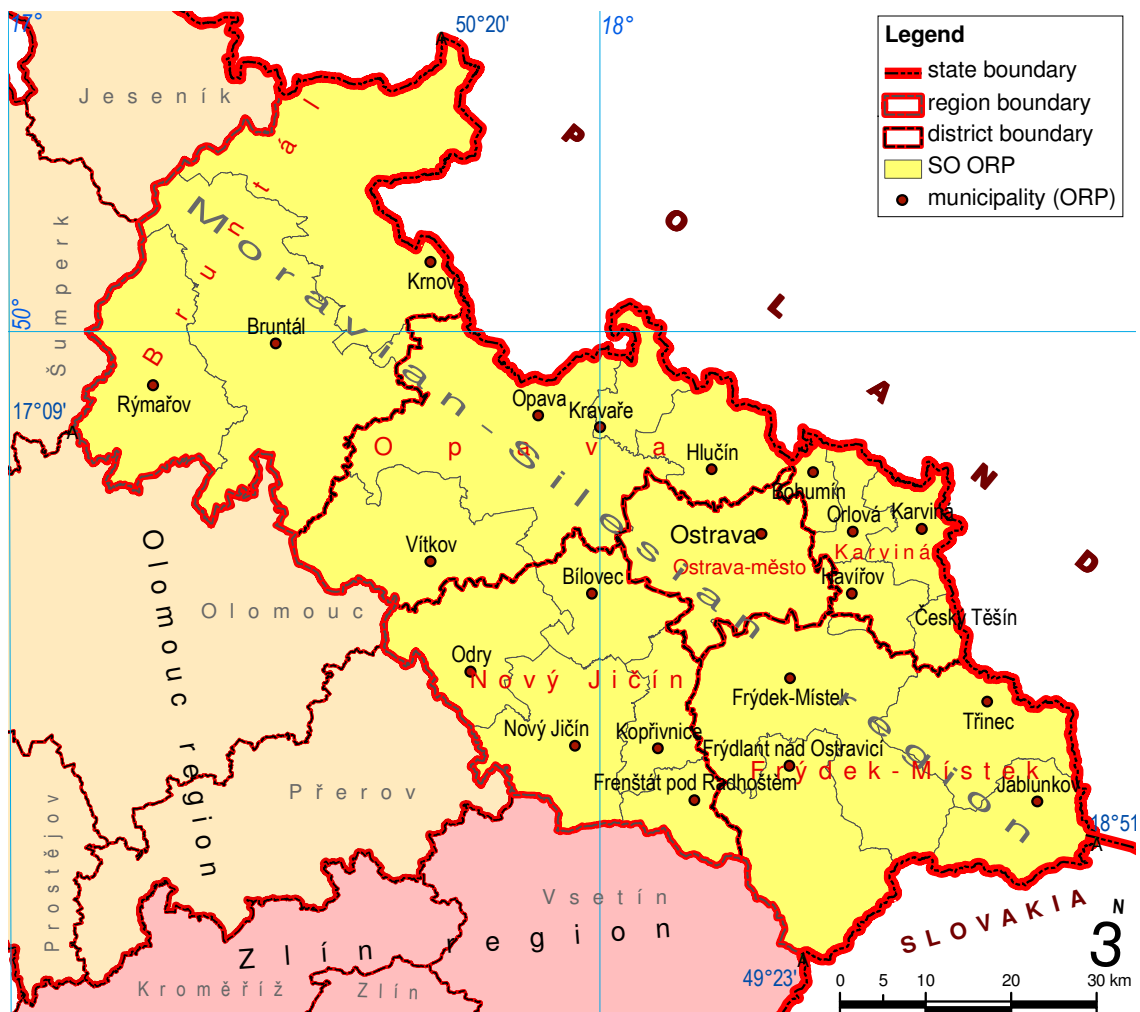
**Abstrakt.** Článek přináší poznatky o prostorové odlišnosti populačního vývoje 22 správních obvodů obcí s rozšířenou působností (SO ORP) na území Moravskoslezského kraje po roce 1970. V úvodu jsou shrnuty základní populační a prostorové odlišnosti českých krajů. Prostorová hierarchie Moravskoslezského kraje je doplněna 22 správními obvody obcí s rozšířenou působností a jejich populačními změnami za posledních 37 let. Jejich prostorová typologie je založena na sledování změny jejich populační velikosti v dlouhodobém časovém horizontu 37 let po roce 1970. Za klíčové ukazatele považujeme hrubé míry přirozené, migrační a celkové měny obyvatelstva a indexy vitality a migračního zisku. Nástrojem k provedení typologie byla metoda hierarchické klastrové analýzy. K efektivní prezentaci prostorové diferenciacce jsme použili metodu kartogramů pro populační charakteristiky vybraného území. Při tomto analytickém kroku jsme využili všech možností softwarového zpracování vybraných prostorových dat pomocí aplikace komplexního geografického informačního systému ArcGis 9.2 a jeho dílčího prostředí ArcView 9.2 a verze ArcMap 9.2. Metodické zpracování se opírá o možnosti zpracování prostorových dat pomocí metody tvorby kartogramů a využití zvoleného škálování pro prezentaci rozdílů primárních ukazatelů změn populační velikosti. Základním záměrem je odhalení zásadních rozdílů mezi správními obvody obcí s rozšířenou působností a jejich rozřídění do tří skupin (populačně rostoucí, populačně stagnující a populačně klesající).

**Klíčová slova:** administrativní jednotky, přirozený přírůstek, migrační saldo, celkový přírůstek, index vitality, index migračního zisku, Moravskoslezský kraj, správní obvod obce s rozšířenou působností.

### 1 Introduction

It is very useful to anywhere when the population is unnoticed part of the science focus. Human resources are one of four the basic economic resources next to capital, soil and technology. Economic behaviour is always affected by living phase. The population is playing the important rule in all basic economic activities as consumption, production and change. And characters of these activities have a strong contexture on the population size and development.

The main aim of this study is to compare differences of the population size change aging process [5] between administrative districts of the municipalities with wide-spread activity (SO ORP) on the territory Moravian-Silesian region in the Czech Republic after year 1970 for the last thirty seven years [4].



**Map 1.** Location and administrative division of the Moravian-Silesian region.

There are those SO ORP in the Moravian-Silesian region (MSR, Map 1): Frýdek-Místek (FM), Opava (OPA), Nový Jičín (NJ), Hlučín (HLU), Třinec (TRI), Karviná (KA), Bílovec (BIL), Havířov (HAV), Krnov (KR), Jablunkov (JAB), Kravaře (KRA), Odry (ODR), Kopřivnice (KOP), Český Těšín (CT), Frenštát pod Radhoštěm (FpR), Ostrava (OVA), Bohumín (BOH), Orlová (ORL), Bruntál (BRU), Rýmařov (RYM), Vítkov (VIT) and Frýdlant nad Ostravicí (FnO).

We can see that in the MSR are big differences between SO ORP (Table 1). The population smallest is Vítkov (only 14 thousands of inhabitants). On the other hand the biggest is Ostrava with the capitol region (more than 335 thousand of inhabitants). The smallest area has Český Těšín (44 km<sup>2</sup>), the largest is Bruntál (630 km<sup>2</sup>).

Total number of municipalities at Moravian-Silesian region is 299 and from this number is 40 towns and 259 villages. The mostly municipalities lies on the area SO ORP Opava (41 municipalities), the least municipalities has SO ORP Bohumín and Český Těšín (both by those). When we will value resident hierarchy, than we can say:

1. Zero urbanisation degree (according to the size principle - sp, municipalities with less than 10 thousand inhabitants) have SO ORP Frýdlant nad Ostravicí, Jablunkov, Kravaře, Odry, Rýmařov and Vítkov.
2. Urbanisation degree more than 80 % have Český Těšín, Havířov, Karviná and Ostrava.
3. Rural character have SO ORP Bílovec (25.62 %), Bruntál (21.08 %), Odry (23.81 %), Rýmařov (25.74 %) a Vítkov (24.34 %). On these territories lives more than 20 % of the population at villages with less than one thousand inhabitants.
4. The highest urbanization degree according to the legislative principle (lp) have Bohumín (100 %), Ostrava (96.8 %) and Český Těšín (95.9 %).

**Table 1.** Quantity and residential hierarchy SO ORP in the Moravian-Silesian region at year 2007.

SO ORP (MSR)	area (km <sup>2</sup> )	total population	density (inh./km <sup>2</sup> )	total villages	density m. rate	total towns	population scale by size m. category (%)					urban. degree (lp)	urban. degree (sp)
							to 199	200 - 999	1,000 - 4,999	5,000-9,999	20,000+		
Bílovec	162	25,852	159	10	6.16	2	0.00	25.62	5.76	29.08	0.00	68.62	39.5
Bohumín	48	29,789	619	0	0.00	2	0.00	0.00	0.00	23.08	76.92	100.0	76.9
Bruntál	630	39,419	63	28	4.45	3	0.75	20.33	19.76	14.78	0.00	65.4	44.4
Český Těšín	44	26,738	602	1	2.25	1	0.00	0.00	4.13	0.00	95.87	95.9	95.9
Frenštát pod Radh.	99	18,957	192	5	5.07	1	0.00	3.00	37.99	0.00	0.00	59.0	59.0
Frydek-Místek	480	108,916	227	35	7.29	2	0.00	10.08	35.54	0.00	54.38	57.8	54.4
Frydlant nad Ostr.	317	22,754	72	10	3.15	1	0.00	13.94	43.64	42.42	0.00	42.4	0.0
Havířov	88	98,555	1,117	4	4.54	1	0.00	0.00	14.73	0.00	85.27	85.3	85.3
Hlučín	165	41,053	248	13	7.86	2	0.00	6.50	58.84	0.00	0.00	44.9	34.7
Jablunkov	176	22,502	128	11	6.24	1	0.00	12.39	62.31	25.30	0.00	25.3	0.0
Karviná	106	74,045	701	3	2.84	1	0.00	0.00	7.81	7.27	84.92	84.9	84.9
Kopřivnice	121	41,668	344	7	5.77	3	0.00	10.72	12.40	21.09	55.79	85.0	55.8
Kravaře	101	21,146	210	8	7.95	1	0.00	11.43	56.31	32.26	0.00	32.3	0.0
Krnov	574	42,567	74	22	3.83	3	0.14	16.33	23.05	0.00	59.23	68.5	59.2
Nový Jičín	275	48,389	176	14	5.08	1	0.00	6.45	39.67	0.00	53.88	53.9	53.9
Odry	224	17,486	78	8	3.57	2	0.97	22.84	0.00	76.20	0.00	76.2	0.0
Opava	567	101,728	179	39	6.88	2	0.52	10.21	26.07	5.28	57.92	63.2	57.9
Orlová	70	46,270	661	2	2.86	2	0.00	0.00	13.68	15.17	71.14	86.3	71.1
Ostrava	332	335,618	1,012	9	2.71	4	0.00	0.68	3.75	3.69	91.88	96.8	91.9
Rýmařov	332	16,641	50	9	2.71	2	0.90	24.84	21.44	52.82	0.00	74.3	0.0
Třinec	235	55,718	237	11	4.69	1	0.00	3.16	19.96	9.30	67.58	67.6	67.6
Vítkov	280	14,086	50	10	3.57	2	2.42	21.92	31.70	43.96	0.00	66.0	0.0
SO ORP MSR	5,427	1,249,897	230	259	4.772	40	0.17	6.19	18.83	9.19	61.37	76.2	65.6

## 2 Measurement methods of the population numbers change

Processes of the natality and mortality belong to basic declarations of the vital [3]. Quality their mutual conditionality in terms of reproduction activity [1] is express by indicator natural increase (**NI**). Natural increase is rise in population caused by birth rate exceeding death rate and excludes any population change due to migration. Crude natural increase rate (**CNIR**) is the number of persons added to a population due to natality and mortality over a given time period (e.g., 1, 5 or more years) and divided by the total mid-year population (**P**) and multiplied by 1,000. That is:

$$CNIR = \frac{NI}{P} \cdot 1,000 \text{ [‰]} \text{ or rather } CNIR = \frac{B - D}{P} \cdot 1,000 \text{ [‰]}. \quad (1)$$

Population change [6] in an area is determined partly by the level of natural increase (**NI**) and partly by the level of net migration (**NM**), the difference between the numbers moving in (immigrant, **I**) and moving out (emigrant, **E**). Crude net migration rate (**CNMR**) is simply the net migration in a year divided by the total mid-year population and multiplied by 1,000. That is:

$$CNMR = \frac{NM}{P} \cdot 1,000 \text{ [‰]} \text{ or } CNMR = \frac{I - E}{P} \cdot 1,000 \text{ [‰]}. \quad (2)$$

Population change (total population increase, **TPI**) is:

$$TPI = NI + NM, \quad (3)$$

or as a indicator "crude total population increase rate (**CTPIR**)

$$CTPIR = \frac{NI + NM}{P} \cdot 1,000 \text{ [‰]}, CTPIR = CNIR + CNMR \text{ [‰]}. \quad (4)$$

We are looking for dissimilarities at population change in area of SO ORP in the Moravian-Silesian region during the last 37 years. We are using the possibilities classification system „time series clustering“. And then we can compile demographic indicators „hierarchical cluster analysis“, because we compare less then 20 spatial units. We are using also method of „centre moving average“ for

three-year periods. Therefore on the time axis of the charts is time period from 1972 to 2006. It is for dynamic typology of the population growth at cohesions regions suitable method.

When we want to compare balance the live birth number ( $B^v$ ) and death number ( $D$ ) of inhabitants we can use also this formula (vitality index,  $vi$ ):

$$vi = \frac{B^v}{D} \cdot 1000 \quad (5)$$

For references territory diversity values of vitality index we will use cartogram method. When we want to compare balance the immigrants and emigrants every SO ORP ( $CIMR^r$ ,  $CEMR^r$ ) with the situation in the Moravian-Silesian region ( $CIMR^{\Sigma r}$ ,  $CEMR^{\Sigma r}$ ) we can use also this formula (migration gain index,  $mgi$ ):

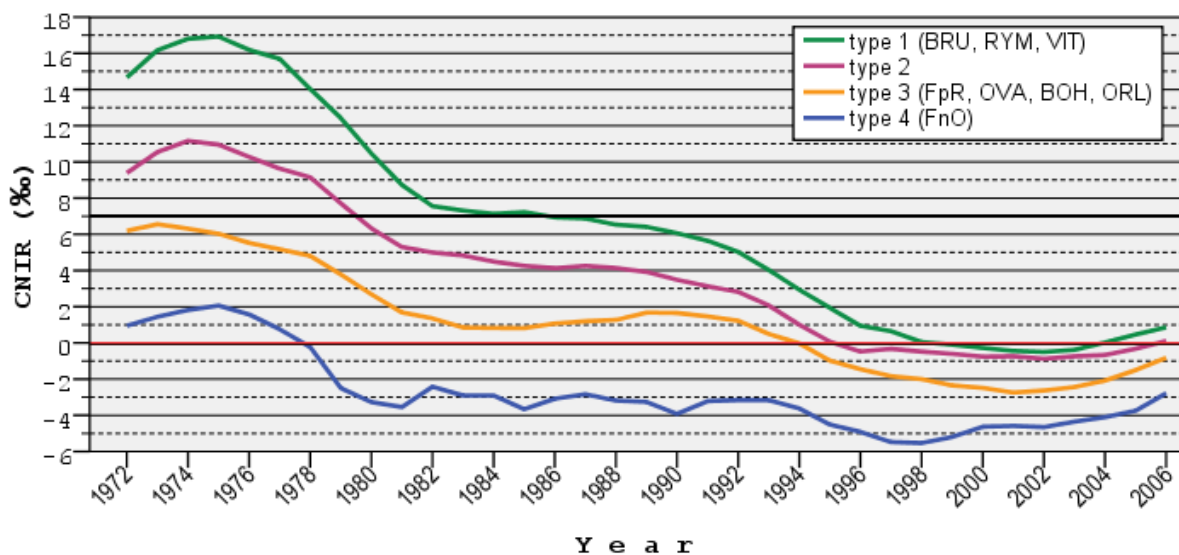
$$mgi = \frac{CIMR^r}{CIMR^{\Sigma r}} - \frac{CEMR^r}{CEMR^{\Sigma r}} \quad (6)$$

We are using the possibilities classification system „time series clustering“. And then we can compile demographic indicators „hierarchical cluster analysis“, because we compare around 20 spatial units. For this typology we are using technics design of the dendrogram. We are using also method of „centre moving average“ for three-year periods. Therefore on the time axis of the charts is time period from 1972 to 2006. It is for dynamic typology of the population growth at cohesions regions suitable method. We are using SPSS software, version 16.0. For references territory diversity values of vitality index and migration gain index we will use cartogram method. All using data come from common evidence natural and migration population change by Czech statistical office.

### 3 Analysis of the natural increase

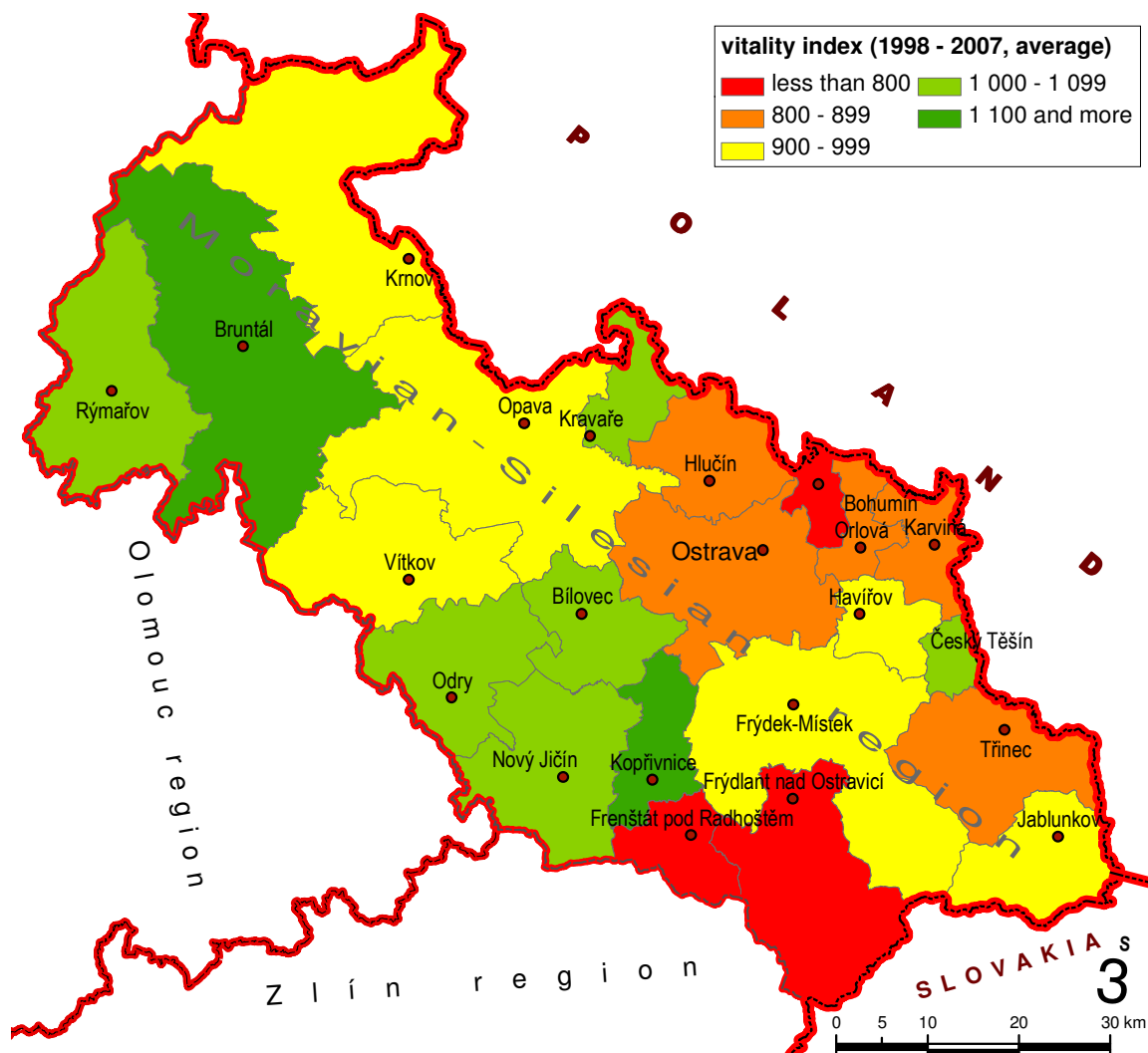
Typology of natural population change makes use technics design of the dendrogram. We have four types as a result of this method (Chart 1). The *first type* of the natural change aggregates administrative district ORP Bruntál, Rýmařov a Vítkov (Chart 1). Values of **CNIR** during the first phase (period 1971 when 1975) grew to 14 till 18 ‰. Than their valuation came down to level around 7 ‰ (in the end of the year 1980) and now is 1 ‰. This spatial units got away with biggest changes of the natural population development. The *second group* includes administrative district ORP Bílovec, Český Těšín, Frýdek-Místek, Havířov, Hlučín, Jablunkov, Karviná, Kopřivnice, Kravaře, Krnov, Nový Jičín, Odry, Opava and Třinec. Their values CNIR drew on to value about 11 ‰ at the first phase. Today situation is a similar as the group one.

**Chart 1.** The types of the natural change trend of the Moravian-Silesian SO ORP during the period 1971 to 2007.



Regions of the *third type* (Frenštát pod Radhoštěm, Ostrava, Bohumín and Orlová) reached to the end of the year 1975 levels around 6 ‰. Their values of the CNIR numbering -1 ‰ in the year 2007. It was even -3 per mille in the year 2001. The worst situation is at the type number 4 during the whole period (1971 – 2007). Only Frýdlant nad Ostravicí belongs to the group four. The value of the crude natural increase rate was negative all over period from year 1978. There was differences between type one and four 14 ‰ in the year 1971 and only 4 ‰ in the year 2007.

We can distinguish three time period with different values of natural increase. One period is between year 1971 and 1980, second between 1981 and 1997 and the last is between years 1998 and 2007. And for the three time period we computed the average value (ten-year average) of vitality index for the administrative district of the municipalities with wide-spread activity (SO ORP) on the territory Moravian-Silesian region. The differences between them will be better to show by way of cartogram method. For this case we used the special software programme ArcGis 9.2.



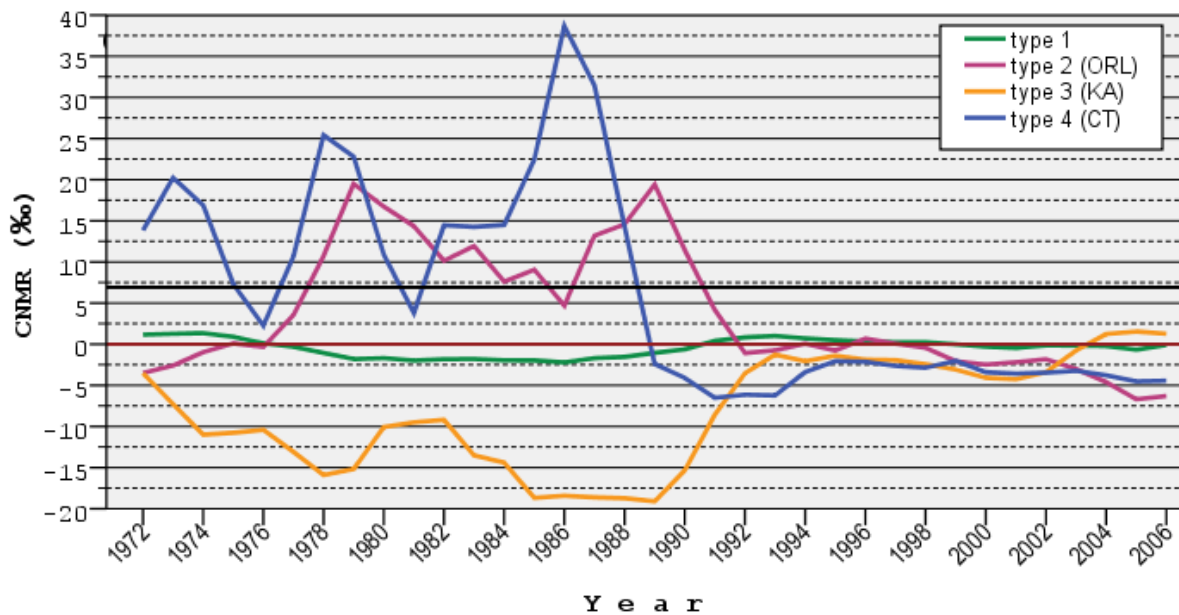
**Map 2.** Cartogram of vitality index of the Moravian-Silesian region.

The most favourable situation from the point of view the last ten years and vitality index (Map 2) is at the administrative districts ORP Bruntál, Kopřivnice, Rýmařov, Odry, Kravaře, Bílovec, Nový Jičín a Český Těšín. On the other hand the worst situation is at the administrative districts ORP Frýdlant nad Ostravicí, Frenštát pod Radhoštěm, Bohumín, Hlučín, Ostrava, Orlová, Karviná a Třinec. These territories are typically by the process of dying-cul..

## 4 Analysis of the net migration

We can differentiate four types of migration behaviour. But for the last 37 years the different migration developments have only three administrative districts ORP: Orlová (type 2), Karviná (type 3) and Český Těšín (type 4). The other nineteen territorial districts have the similar model of the migration behaviour (type 1). Their value of the **CNMR** oscillate around null in the long term. Very bad situation was for nearly twenty years at SO ORP Karviná from year 1971. Net migration achieved even -20 ‰ between years 1985 – 1989. But now the situation is not so dangerous, crude net migration rate is even gently positive. We see that there are two diverse periods (Chart 2): the first is between years 1971 and 1994, the second is between years 1995 and 2007.

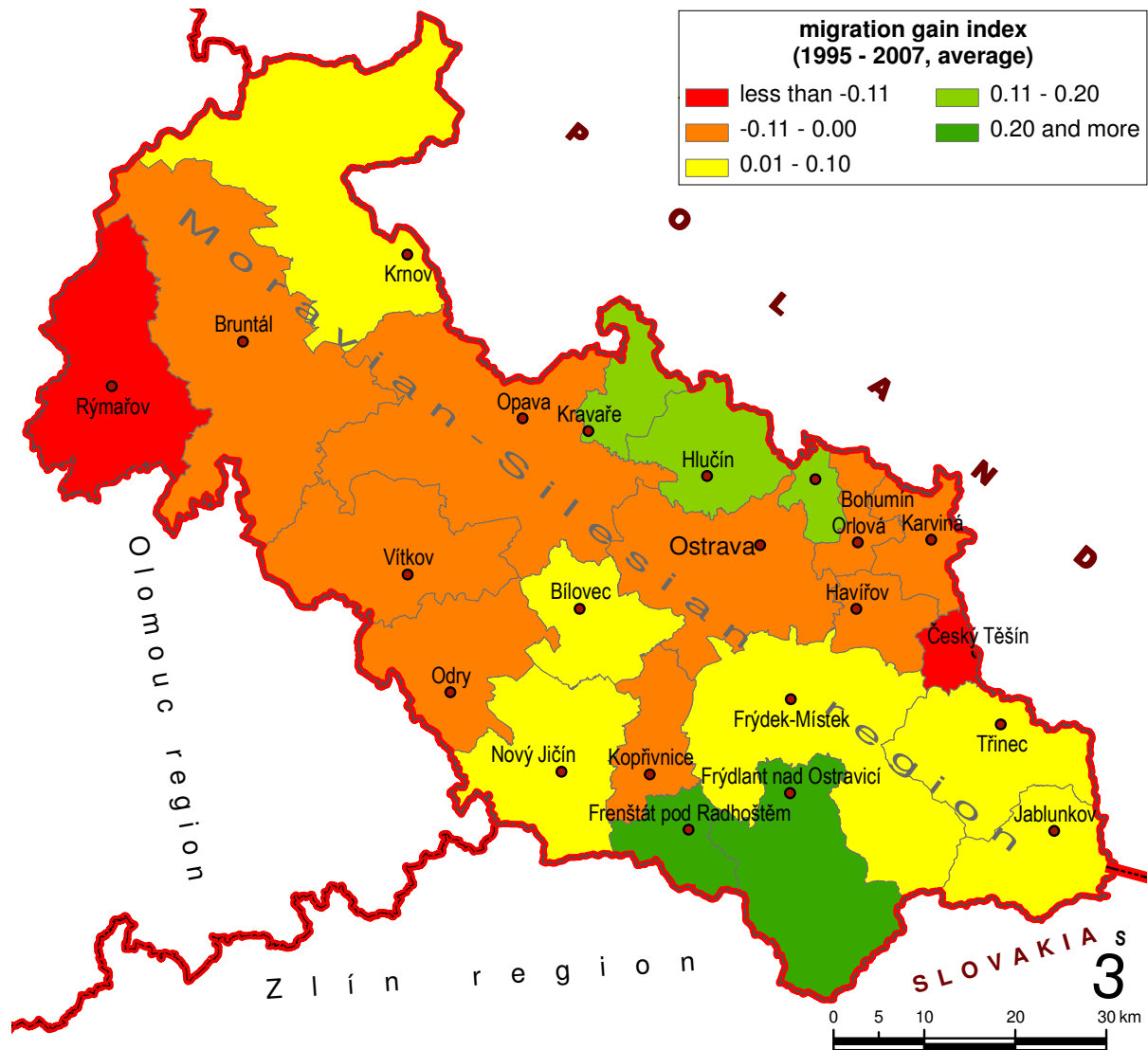
**Chart 2.** The types of the net migration change trend of the Moravian-Silesian SO ORP during the period 1971 to 2007.



The differences between the values of the crude net migration rate are not so big from year 1995 if we compare all four types of the net migration change trend. There was a difference between type two and type three less than 8 ‰ in the year 2007.

When we use the indicator migration gain index (Map 3), it is very useful to operate with the cartogram method. Last thirteen years brought the series of new knowledges. The bad migration situation in the long term is at these administrative districts of the municipalities with wide-spread activity (SO ORP) on the territory of the Moravian-Silesian region: Rýmařov, Český Těšín, Bruntál, Orlová, Kopřivnice, Ostrava, Karviná, Odry, Opava, Havířov and Vítkov. Absolutely worst of all are the first five administrative districts (Rýmařov, Český Těšín, Bruntál, Orlová, Kopřivnice), where the migration gain index is less than -0.05.

If we will value the 37-year period, then the worse position is at SO ORP Rýmařov, Bruntál, Karviná, Odry and Havířov. On the other hand, migration profitable analyses mainly SO ORP Frenštát pod Radhoštěm and Frýdlant nad Ostravicí and then Bohumín, Hlučín and Kravaře.

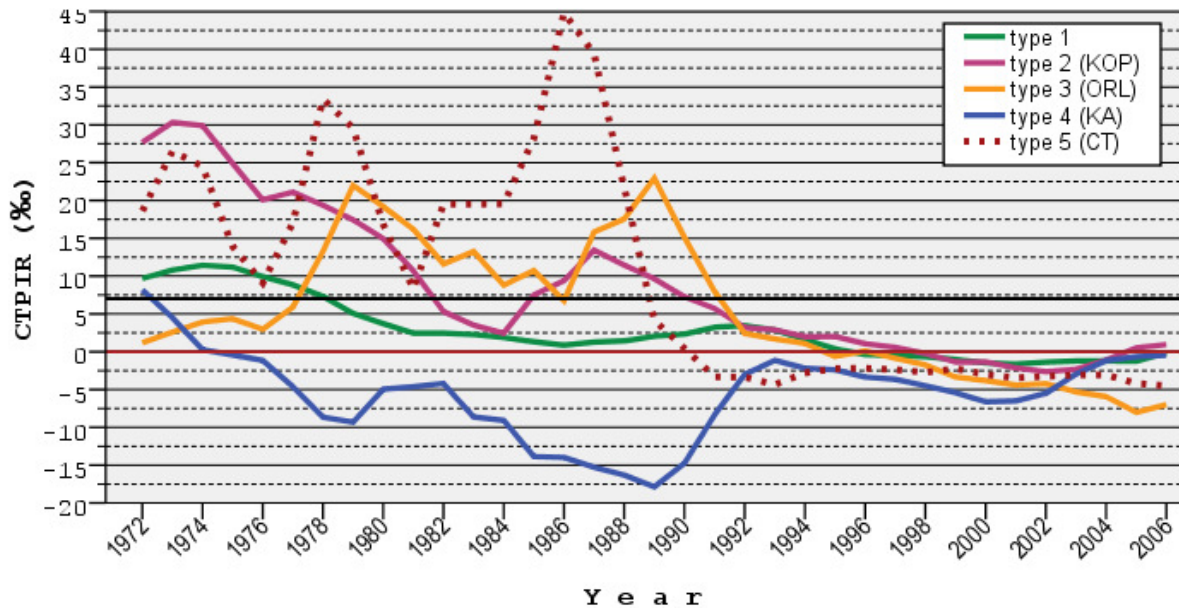


Map 3. Cartogram of migration gain index of the Moravian-Silesian region.

## 5 Analysis of the total population change

If we analyse the total population change by means of the crude total population increase rate (CTPIR) in a longer-term perspective of the last 37 years, we can distinguish five types (Chart 3). The first type consists of a group of the eighteen territorial units. Their CTPIR was relatively well-balanced without the extreme values for all period. In the years 1971 to 1994 they population number was increasing very slowly. And from the year 1995 they don't change their population size. Type 2 consists of only one SO ORP *Kopřivnice*. Their population number was increasing to the year 1994 a then came time of the population stagnation. Orlová (type 3) was increasing the population count to the year 1994 gradually than Kopřivnice. But in? last years it is districts with the biggest waste inhabitants (around - 6 ‰). For the very dramatical we can mark population development at administrative district Karviná (type 4). This territory noted the biggest waste of the population nuber, especially at the period 1975 to 1994. Only from year 2004 is value of the **CTPIR** near the zero. The administrative district Český Těšín (type 5) achieving very unusual population development. It is second the most losing district during the last years. But it was the fastest increasing territory in the time period 1971 to 1990. It is wholly visible that differences between those five typology groups are nearly neutral now.

**Chart 3.** The types of the total population change trend of the Moravian-Silesian SO ORP during the period 1971 to 2007.



## Reference

1. Cox, P. R.: Demography. Cambridge, Cambridge University Press 1978, fifth edition, 393 p.
2. Jones H.: Population Geography. London, Paul Chapman Publishing Ltd 1990, second edition, 321 p.
3. Newel, C.: Methods and models in Demography. Chichester, John Wiley & Sons Ltd 1994, 217 p.
4. Šotkovský, I.: Comparison of the Moravian-Silesian Population Development with Regions NUTS 2 in Longtime Period. In: ECON '07 (selected research papers). Ostrava, Ekonomická fakulta VŠB – TUO, 2007, p. 219-226. ISSN 0862-7908, ISBN 978-80-248-1651-7.
5. Šotkovský, I. : Age Distribution and Aging Process of the Moravian-Silesian Population (Regional Disparities on the Level of the Cohesion Regions in the Czech Republic). In: International statistic-economic days at University of Economics in Prague, 2nd volume of the scientific conference, University of Economics, Prague, 2008, 6 p., ISBN: 978-80-86175-62-1
6. Woods, R., Rees, P., H.: Population Structures and Models. London, Allen & Unwin 1986, 417 p.