NEW DEMAND PATTERNS FOR PUBLIC TRANSPORT DUE TO DEMOGRAPHIC CHANGE

Working paper

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Authors:
Doc. Ing.Marián Gogola, PhD. University of Zilina
Doc. Mgr. Dana Sitanyiová, PhD. University of Zilina
Ing. Ľubomír Černický, PhD. University of Zilina
Ing. Milan Veterník, PhD. University of Zilina

Introduction

According the EU commision the EU is facing unprecedented demographic changes (an ageing population, low birth rates, changing family structures and migration). In the light of these challenges it is important, both at EU and national level, to review and adapt existing policies. The changes on demography has importnat impact on the future demand on all forms of transport.

The EU strategy [65] called Europe 2020 for smart, sustainable and inclusive growth sets important targets to lift at least 20 million people out of poverty and social exclusion and to increase employment of the population aged 20-64 to 75%. The main initiatives of the Europe 2020 strategy, including the Platform against Poverty and Social Exclusion and the Agenda for New Skills and Jobs, support efforts to reach these targets.

We know that transport is one of the basic sectors that significantly affect socio-economic development and growth in living standards. Mobility and its quality is one of the key elements of assessment standards in the countries of the European Union (EU). In passenger transport the quality depends largely on satisfying the everyday needs of citizens, including the level of access to work, schools, shops, accessibility to social care and to leisure activities. For large urban areas with increasing population it is not problem. But in recent years, there is an accompanying phenomenon of development, such as in developed countries, also in Slovakia, Czech republic, Hungaria, Poland and other countries the increase of road transport which is represented by significant growth of negative impacts on the environment, increase congestion in urban areas and the growth of road accidents. In passenger traffic the growth of individual automobile transport is reflected by a significant decline in the performance of public passenger transport (rail, bus and public urban transport).

Transport is very important for social, cultural and economic success of each community - from urban centres to rural communities. The traditional interconnection between economic success transport and mobility has shifted in the last decade due to:

- recognition of the adverse effects of motorized transport on the environment,
- social exclusion of those who do not own a passenger car,
- rising costs and lack of conventional fuels for transport,
- or demographic changes.

Exactly, the significant demographic changes which mostly all of European countries are experiencing in the last decade are characterized by the transition to a new model of reproductive behaviour of the population. For instance the current population development in East European countries is characterized by the same process that took place in the developed Western and Northern Europe from the mid 60s to late 70s. As reflection of the current situation in terms of travel behaviour are also significant the changes in the demography, such as age, gender, household composition or income of its members.

The issue of rural areas where is significantly changed the population call for new approaches. Why? The answer is very simple. Access to health care, education, work and other services (e.g., shopping centres) for people living and working in rural areas is a key issue around the world. [49] The term accessibility has several definitions; for example in

terms of economic and social opportunity, accessibility can be defined as proximity or facility for spatial interaction [51]. Here we can find the important taks of transport supply mainly for rural areas which are highly dependend on provided transport services or transport infrastructure. Accessibility to public transport play important role in social inclusion especially for rural areas.

1. Demographic and socio-economic changes in selected EU countries

A large amount of works have studied the impact of socio-demographic variables on travel behaviour and found a significant relationship between travel behaviour and variables such as age, gender, household composition, household income and so on. [1,2,3]

Demography is the social science dealing with the study of human populations reproduction. It reviews all of the events and processes related to the reproduction of human populations. [4]

Demographic development in Slovakia is characterized by a gradual slowing down of population reproduction. The result of that is a deterioration of reproductive rates and age structure of the population. The aging process continues, as demonstrated by the higher average age of the population of both sexes. In terms of individual continents, Europe is the continent with the slowest population growth. In Europe, it showed the smallest population growth the Central Europe, where in some countries, e.g. in Hungary or Poland there is a decrease in population. Recently, every year there is population declining, also in Romania and Bulgaria and some other countries which are not mentioned in the Table 1 and Figure 1. [5]

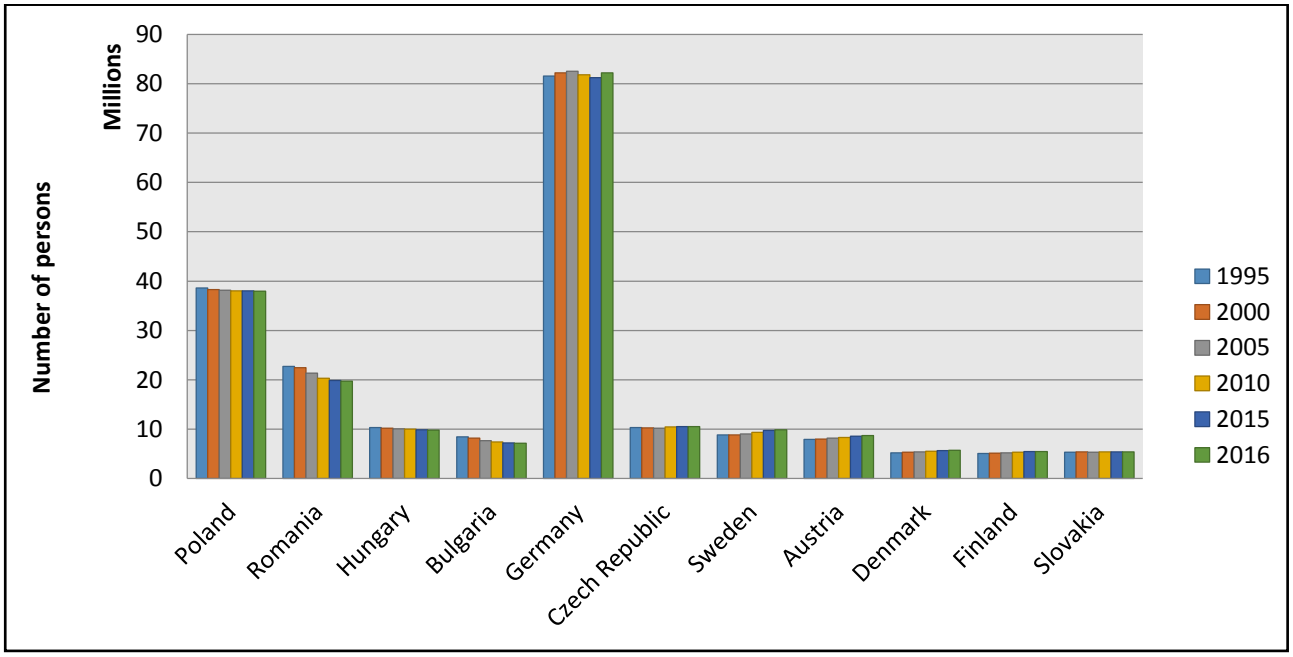

Figure 1 Demographic development in selected countries of EU 1995 – 2016 [6]

Table 1 Demographic development in selected countries of EU 1995 – 2016 [6]

Krajina\Rok	1995	2000	2005	2010	2015	2016	Change 1995/2016
Poland	38 580 597	38 263 303	38 173 835	38 022 869	38 005 614	37 967 209	-1,59
Romania	22 712 394	22 455 485	21 382 354	20 294 683	19 870 647	19 759 968	-13,00
Hungary	10 336 700	10 221 644	10 097 549	10 014 324	9 855 571	9 830 485	-4,90
Bulgaria	8 427 418	8 190 876	7 688 573	7 421 766	7 202 198	7 153 784	-15,11
Germany	81 538 603	82 163 475	82 500 849	81 802 257	81 197 537	82 162 000	0,76
Czech Republic	10 333 161	10 278 098	10 198 855	10 462 088	10 538 275	10 553 843	2,14
Sweden	8 816 381	8 861 426	9 011 392	9 340 682	9 747 355	9 851 017	11,74
Austria	7 943 489	8 002 186	8 201 359	8 351 643	8 576 261	8 700 471	9,53
Denmark	5 215 718	5 330 020	5 411 405	5 534 738	5 659 715	5 707 251	9,42
Finland	5 098 754	5 171 302	5 236 611	5 351 427	5 471 753	5 487 308	7,62
Slovakia	5 356 207	5 398 657	5 372 685	5 390 410	5 421 349	5 426 252	1,31

Source: Eurostat

Household size

Another factor that has an impact on travel behaviour is age. According to several studies and statistics, there are differences in the travel behaviour of children, young people, adults and older people. These differences occur because they are interested in different types of activities. Children are primarily interested in educational and playing activities, young people mainly in educational and social activities, adults in work-related activities and the pensioners are primarily interested in social and leisure activities. These activities influence their travel distance. For example, children's activities are generally concentrated in a small area. Therefore children travel on short distances, because their goals such as primary-secondary schools and parks are usually concentrated not far from their homes. It is different for adults. Their activities are scattered. Their job can be located at different distances from home, they can socialize in parks and restaurants or they can carry out other activities in different parts of the city. [26,27]

The ageing of population will change the households' structure (smaller family units) so that social institutions will be required more and more to replace family care. More resources will be needed for structures and services dedicated to people in age: their specific needs will have to be addressed in urban planning, infrastructures and services design. [25]

Figure 2 Distribution of households by size in EU countries for the years 2005-2015 [20]

On the following figure 3 we can see the composition of housholds in EU countries.

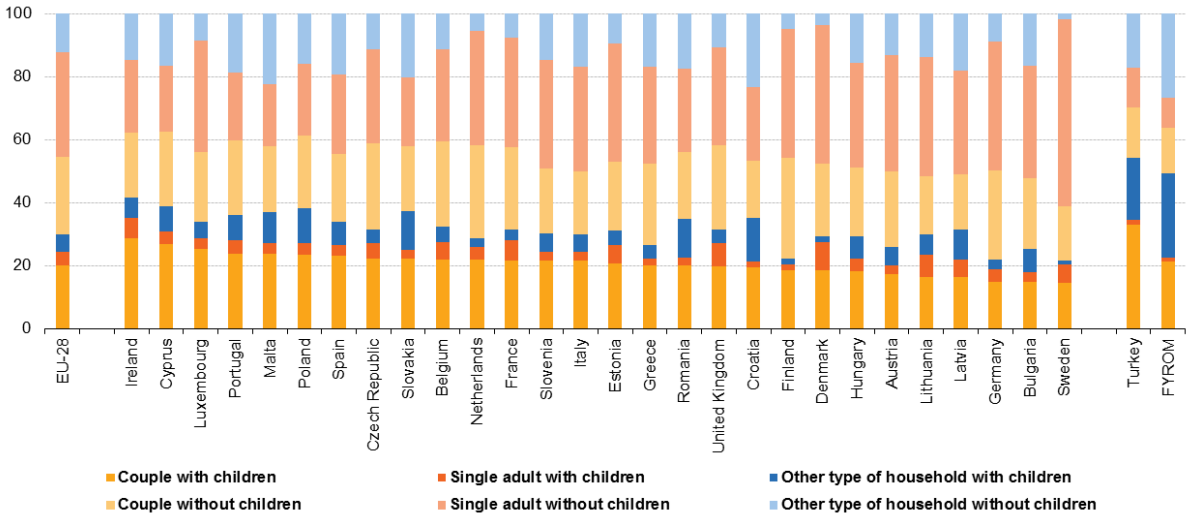

Figure 3 Composition of households in individual EU countries in 2015 [20]

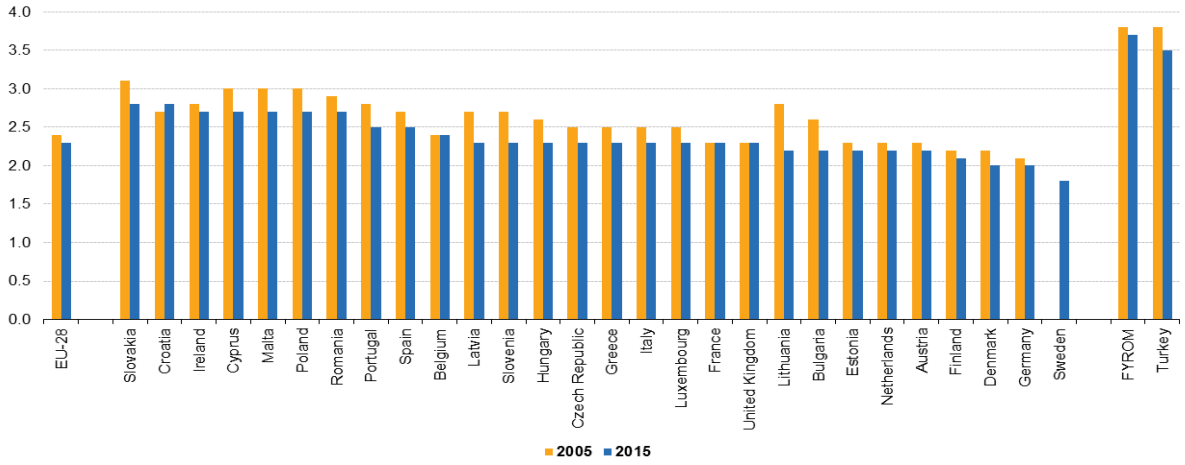

Figure 4 Average household size, comparison 2005 and 2015
(average number of households) [20]

Household income

Household income level is an important variable that affects the travel behaviour of population. Many studies show that low income of people or households allocates less fund for travelling, compared to people with high income. That means that people or households with high income can travel more often and longer because they are able to spend more money. [21,22] Statistics also show that income level has an effect on the car ownership. High income allows people to own a car, but this argument is debatable, because some experts have found that the level of income has a negative correlation to the car ownership. Car ownership is then influenced by other factors such as household size, cultural habits and so on. [23]

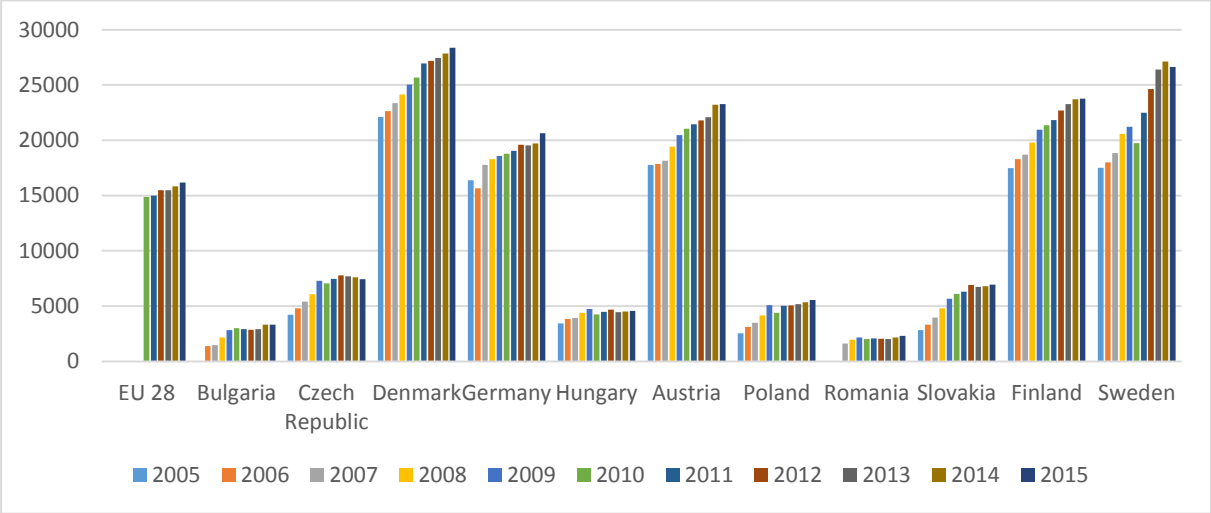

Figure 5 Comparison of Average Household Income in Individual Countries in 2005-2015 [6]

Table 2 Comparison of Average Household Income in Individual Countries in 2005-2015 [6]

Year / Country	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
EU 28	:	:	:	:	:	14 879	15 000	15 490	15 472	15 829	16 178
Bulgaria	:	1 379	1 479	2 180	2 828	3 017	2 911	2 859	2 924	3 320	3 332
Czech Republic	4 233	4 802	5 423	6 068	7 295	7 058	7 451	7 791	7 694	7 622	7 423
Denmark	22 116	22 637	23 349	24 154	25 027	25 672	26 944	27 184	27 434	27 861	28 364
Germany	16 395	15 646	17 774	18 304	18 586	18 795	19 043	19 592	19 545	19 712	20 644
Hungary	3 447	3 849	3 936	4 400	4 739	4 241	4 493	4 696	4 449	4 512	4 567
Austria	17 758	17 854	18 156	19 413	20 469	21 058	21 463	21 807	22 073	23 211	23 260
Poland	2 531	3 111	3 502	4 154	5 090	4 402	5 032	5 057	5 174	5 339	5 560
Romania	:	:	1 604	1 954	2 172	2 036	2 089	2 049	2 018	2 158	2 315
Slovakia	2 830	3 313	3 970	4 791	5 671	6 117	6 306	6 927	6 737	6 809	6 930
Finland	17 481	18 304	18 703	19 794	20 962	21 349	21 826	22 699	23 272	23 702	23 763
Sweden	17 501	17 993	18 848	20 573	21 231	19 728	22 498	24 639	26 413	27 120	26 639

Source: Eurostat

Unemployment

Another important factor is the working status. The above mentioned studies show that people who work part-time usually travel more than those who work full-time, because they are involved in more than one activity, for example shopping, supervising children to school or escorting elderly. [24]

However, there is a significant difference in the case of the unemployed people. As the unemployed do not have regular income, their number of daily journeys is also decreasing. [25]

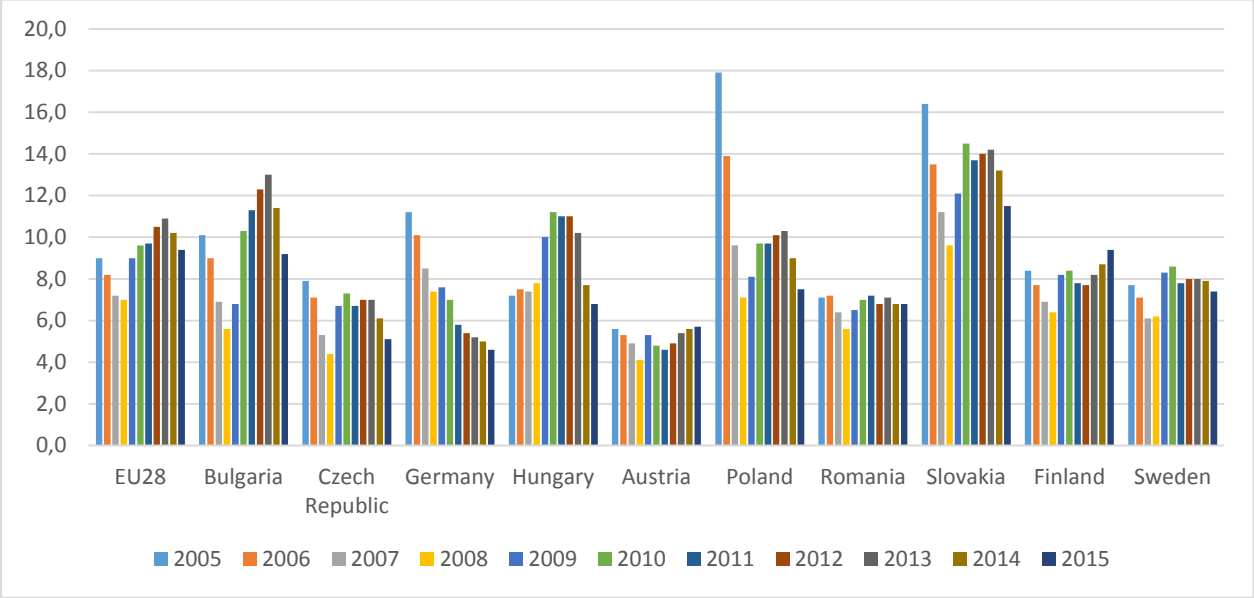

Figure 6 Unemployment in selected EU countries in 2005-2015 [6]

Table 3 Unemployment in selected EU countries in 2005-2015 [6]

Year / Country	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
EU28	9,0	8,2	7,2	7,0	9,0	9,6	9,7	10,5	10,9	10,2	9,4
Bulgaria	10,1	9,0	6,9	5,6	6,8	10,3	11,3	12,3	13,0	11,4	9,2
Czech Republic	7,9	7,1	5,3	4,4	6,7	7,3	6,7	7,0	7,0	6,1	5,1
Germany	11,2	10,1	8,5	7,4	7,6	7,0	5,8	5,4	5,2	5,0	4,6
Hungary	7,2	7,5	7,4	7,8	10,0	11,2	11,0	11,0	10,2	7,7	6,8
Austria	5,6	5,3	4,9	4,1	5,3	4,8	4,6	4,9	5,4	5,6	5,7
Poland	17,9	13,9	9,6	7,1	8,1	9,7	9,7	10,1	10,3	9,0	7,5
Romania	7,1	7,2	6,4	5,6	6,5	7,0	7,2	6,8	7,1	6,8	6,8
Slovakia	16,4	13,5	11,2	9,6	12,1	14,5	13,7	14,0	14,2	13,2	11,5
Finland	8,4	7,7	6,9	6,4	8,2	8,4	7,8	7,7	8,2	8,7	9,4
Sweden	7,7	7,1	6,1	6,2	8,3	8,6	7,8	8,0	8,0	7,9	7,4

Source: Eurostat

There are also another interesting data provided by Eurostat. For instance the % o people younger than 60 years and living in the very low work intensity by NUTS 2, see table 4.

Table 4 People living in households with very low work intensity by NUTS 2 regions (population aged 0 to 59 years)

regions (NUTS2)	2012	2013	2014	2015	2016
Jihozápad	4,8	5,2	5,8	5,0	4,9
Jihovýchod	4,9	3,2	4,3	4,5	4,8
Croatia	16,7	14,7	14,6	14,4	13,6
Liguria	7,6	9,4	10,0	8,7	:

Hungary	13,4	13,5	12,7	9,4	8,1
Közép-Magyarország	10,7	12,0	12,8	9,5	7,0
Dunántúl	12,3	11,9	11,3	9,0	7,0
Alföld és Észak	16,1	15,9	13,7	9,6	9,9
Poland	6,8	7,1	7,3	6,9	6,4
Region Centralny	5,5	6,3	6,5	6,2	4,6
Stredné Slovensko	7,5	7,5	9,3	9,2	7,1

Source: Eurostat

The evaluation of At-risk-of-poverty rate by degree of urbanisation especially for rural areas shows table 5.

Table 5 At-risk-of-poverty rate in % by degree of urbanisation for rural areas of RUMOBIL countries

GEO/TIME	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
European Union (28 countries)	0	0	0	20,5	20,8	19,6	19,9	20,1	19,8	0
Czech Republic	9,9	8,3	8,5	10,2	11,2	10,4	9,5	10,7	9,1	8,5
Germany	17,2	18,0	19,2	18,8	17,8	16,2	16,4	15,3	14,5	0
Croatia	0	0	0	29,0	27,2	26,6	25,6	24,4	26,5	27,0
Italy	23,9	23,0	22,4	21,4	23,0	24,1	25,4	24,8	20,2	0
Hungary	16,7	16,2	17,1	17,7	19,2	21,5	21,9	21,0	18,7	18,9
Poland	22,7	22,5	22,8	23,5	23,4	24,2	25,0	24,1	24,8	23,9
Slovakia	13,9	13,2	14,6	15,6	16,4	17,2	15,4	16,2	15,0	17,3

Source: Eurostat

This factor varies from 8 % in Czech republic to 27% in Croatia. Another statics represents the table 6 that is focused on the income by NUTS 2 regions, see Table 6.

Table 6 Income of households by NUTS 2 regions

Region NUTS 2	2007	2008	2009	2010	2011
Jihozápad	7 200	8 400	7 800	8 000	8 400
Jihovýchod	7 100	8 200	7 600	8 000	8 200
Sachsen-Anhalt	14 500	15 300	15 200	15 800	16 500
Liguria	20 500	20 900	19 700	19 400	19 800
Emilia-Romagna	24 500	24 500	22 800	22 500	23 000
Észak-Alföld	4 200	4 900	4 400	4 500	4 200
Mazowieckie	7 500	8 700	7 700	8 600	8 900
Stredné Slovensko	5 700	6 700	6 800	7 000	7 300

Source: Eurostat

Car ownership

Car ownership is an important determinant of passenger travel behaviour and it is fundamentally interconnected with residential location and decision-making regarding motorised trips. Ownership rates increased significantly during the 70s, and for lower-income households during the 80s, but flattened and declined in some cases during the 90s.

The period of growth in per capita vehicle ownership rates coincided with Baby Boomer's peak driving years, significant growth in the proportion of women employed outside the home, rising disposable income, low fuel prices, and suburbanization. The car ownership rate in Western Europe is reaching saturation point, and a confluence of events and changes in lifestyle may lead to a possible reduction in the next decades.

Nowadays people living in urban areas are provided with several public transport and car sharing options to satisfy their mobility needs, and slow mobility (walking and cycling) is gaining increasing attention; the ageing population will inevitably modify its long-term mobility patterns relying more and more on public transport as driving capability will expire; the observed trends of re-urbanisation and consumers' increased preference for walkable neighbourhoods will probably slow down the urban sprawl trends and reduce car dependency; in addition, (as further explained later on when discussing the change of lifestyle) younger generations are showing more interest in technological gadgets and social networks rather than in owing a car. [25]

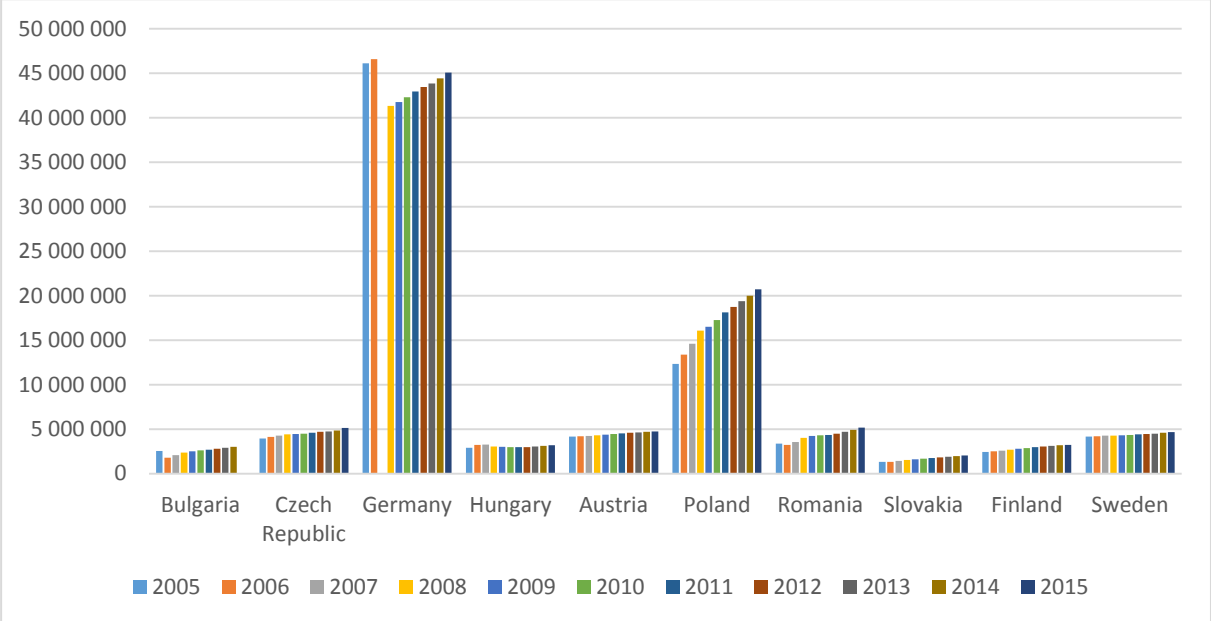

Figure 7 Development of the number of registered cars in selected EU countries in the period 2005-2015 [6]

Table 7 Development of the number of registered cars in selected EU countries 2005-2015 [6]

Year Country	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Bulgaria	2 538 000	1 768 000	2 082 000	2 366 000	2 502 000	2 602 000	2 695 000	2 807 000	2 910 235	3 013 863	:
Czech Republic	3 959 000	4 109 000	4 280 000	4 423 000	4 435 000	4 496 000	4 582 000	4 706 000	4 729 185	4 833 386	5 115 316
Germany	46 090 000	46 570 000	:	41 321 000	41 738 000	42 302 000	42 928 000	43 431 000	43 851 000	44 403 000	45 071 000
Hungary	2 889 000	3 214 000	3 262 000	3 055 000	3 013 720	2 984 060	2 967 810	2 986 030	3 040 732	3 107 695	3 196 856
Austria	4 157 000	4 205 000	4 246 000	4 285 000	4 360 000	4 441 000	4 513 000	4 584 000	4 641 308	4 694 921	4 748 048
Poland	12 339 000	13 384 000	14 589 000	16 080 000	16 495 000	17 240 000	18 125 000	18 744 000	19 389 446	20 003 863	20 723 423
Romania	3 364 000	3 221 000	3 541 000	4 027 000	4 245 000	4 320 000	4 335 000	4 487 000	4 696 000	4 908 000	5 155 000
Slovakia	1 303 700	1 333 700	1 433 900	1 544 900	1 589 000	1 669 100	1 749 300	1 824 200	1 879 800	1 949 100	2 034 574
Finland	2 430 000	2 506 000	2 570 000	2 700 000	2 777 000	2 877 000	2 978 000	3 037 000	3 105 834	3 172 735	3 234 860
Sweden	4 154 000	4 202 000	4 258 000	4 279 000	4 299 950	4 334 390	4 400 550	4 446 349	4 494 661	4 584 711	4 668 262

Source: Eurostat

There is interesting issue regarding the minimum budget cost for transport for people living in rural areas which was already investigated by number of studies [45] .

Automobilization

Automobilization development issues include a wide range of factors that need to be monitored and evaluated for their impact on society. The increase in the number of cars and their intensive use is on the one hand negative, in the form of a negative impact on the environment and, on the other, positively affects the development of the economy, employment and influence the way people live.

Increased use of passenger cars is most pronounced in densely populated areas, causing difficulties in the environmental sustainability of the environment, which means that it acts predominantly as a negative factor that degrades the environment of predominantly cities. In this context, it is necessary to establish an effective level of cooperation between individual car and mass passenger transport, which in many cases is a complex task for transport planners. Different measures, however, can effectively influence the division of the transport work, especially during work journeys, that is, journeys that are regularly repeated throughout the day.

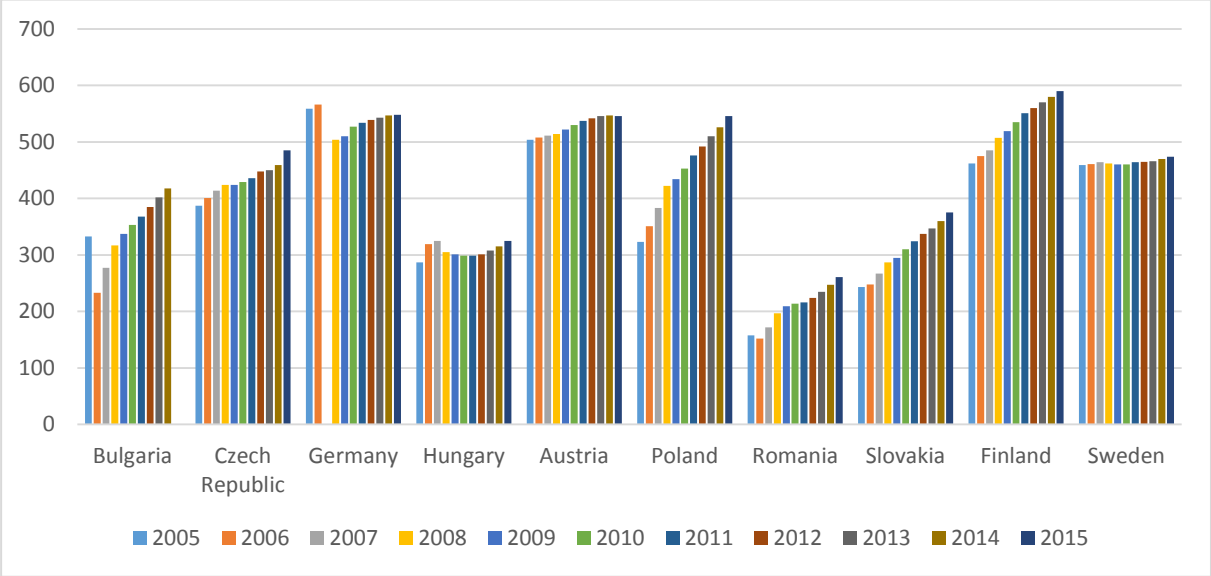

Figure 8 Automobilization in selected EU countries in the period 2005-2015 [6]

Table 8 Automobilization in selected EU countries in the period 2005-2015 [6]

Year / Country	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Bulgaria	333	233	277	317	337	353	368	385	402	418	:
Czech Republic	387	401	414	424	424	429	436	448	450	459	485
Germany	559	566	:	504	510	527	534	539	543	547	548
Hungary	287	319	325	305	301	299	299	301	308	315	325
Austria	504	508	511	514	522	530	537	542	546	547	546
Poland	323	351	383	422	434	453	476	492	510	526	546
Romania	158	152	172	197	209	214	216	224	235	247	261
Slovakia	243	248	267	287	295	310	324	337	347	360	375
Finland	462	475	485	507	519	535	551	560	570	580	590
Sweden	459	461	464	462	460	460	464	465	466	470	474

2. Urbanization and suburbanization

The process of urbanization, that is, the movement of the population from rural to the urban settlements and from the smaller settlements to the larger ones, peaked in the Slovakia in the early 90s of the last century. The migration of the rural population to the cities in this period was related to the centrally planned economy of the former Czechoslovak Socialist Republic, but mainly to the housing development directed at the main settlement centres where the main investment stocks and job opportunities were concentrated. [8]

The following subchapters describes the situation in particular countries based on the available data.

Slovakia

With abolition of central planning, the migration patterns of the population began to change. The current migratory processes of the population can be characterized as compaction of the population into certain municipalities located in the background and the distance to the centres of gravity. This fact can best be documented on the example of the capital of the Slovakia – Bratislava. [7]

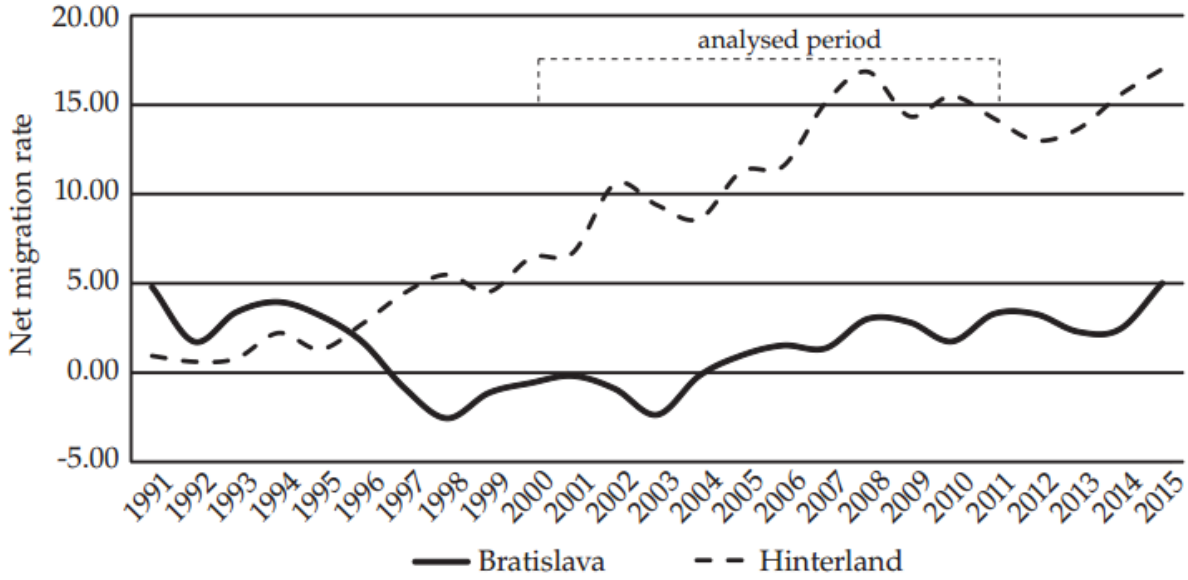

Figure 9 Population development in Bratislava and the surrounding area [7]

Suburbanization is a process of change in population deployment. Most often it is defined as the process of moving people to their suburbs or surrounding rural communities. However, this process should be seen not only as a change in population distribution and spatial structure of suburban areas but also as a change in the way of life of „suburban" inhabitants. While most countries in Central and Eastern Europe are experiencing declines in cities, the trend in the developed countries of Western Europe is exactly the opposite. The reason is to move people from the town to the countryside, respectively, in Western Europe the opposite. [9]

In the Slovakia are markant very strong trend urbanization and also suburbanization. The urbanization is present mainly in big cities as Bratislava where people are moving from East Slovakia to West Slovakia. Together with this trend there is also strong suburbanization that means people from cities are moving from towns anc cities to the close villages. For instance the Bratislava region has strong position from the perspective of number of job places. This fact causes the attraction of people from other parts of Slovakia. But due to fact there are higher cost of living in comparison to average of Slovakia, the migrant are searching for cheaper condition of living. The incoming people are settleing in counties around the city of Bratislava. Therefore the population in these counties has the increasing tendency, see Fig. Another importat finding constists in fact that the villages or towns with the highest increase of populatin are located very close to Bratislava, see Fig.10.

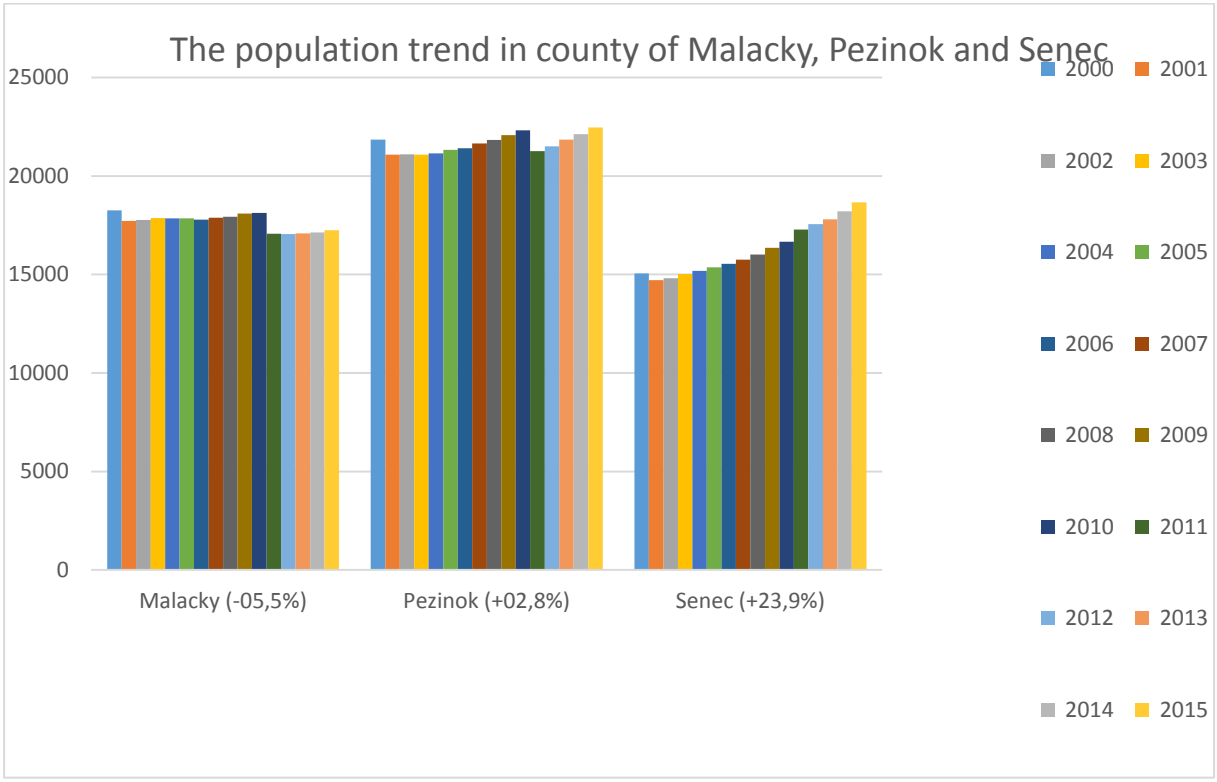

Figure 10 Demographic development in County towns Malacky, Pezinok, and Senec 2000 – 2015

source: Slovak statistics office

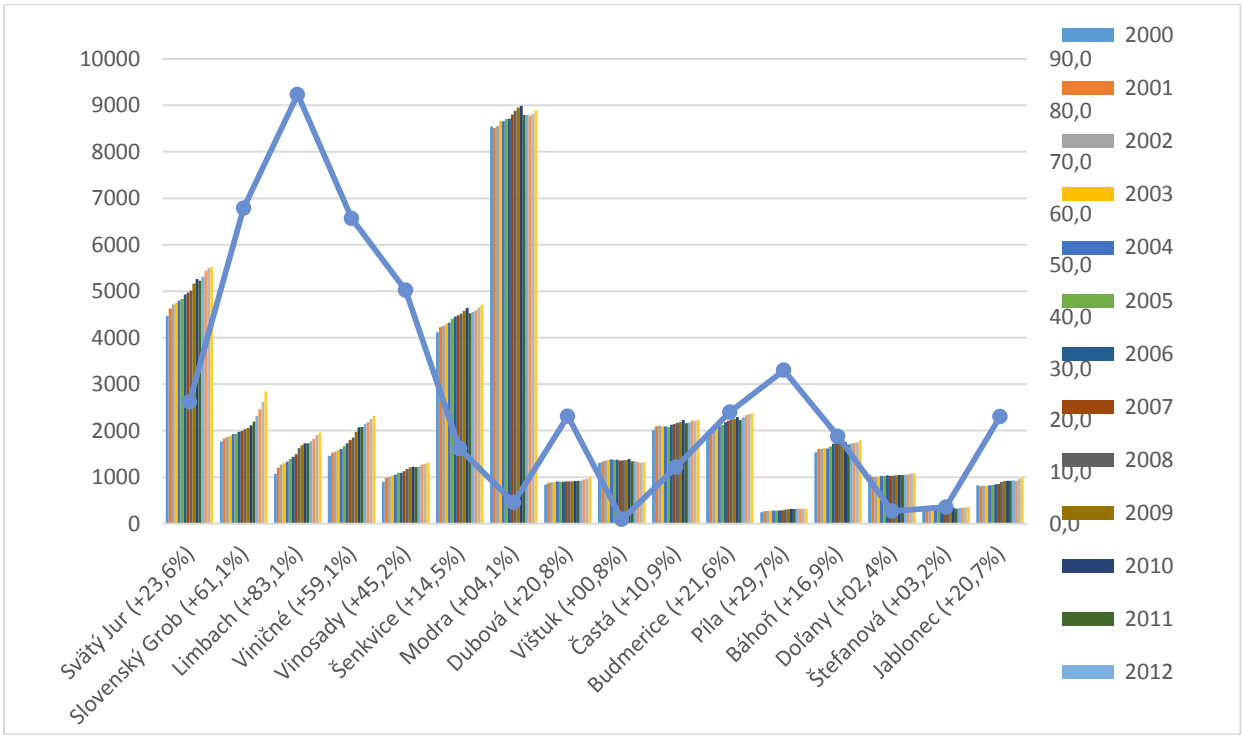

Figure 11 The population trend of cities and villages around the Bratislava grouped by distance from Bratislava [10]

source: Slovak statistics office

The same problem is in Zilina county, see Table 9. The Rajec valley is one of the suburban directions from city of Zilina. The demographic statistics shows the increasing the number of population of villages where are moving mainly people from Zilina.

Table. 9 Comparison of the population trend of villages and towns in Rajec valley (yellow colour are marked villages in 20 km distance from Zilina)

town/village	2009	2010	2011	2012	2013	2014	2015	2016
Rajecké Teplice	2 938	2 938	2 868	2 909	2 932	2 948	2 978	2 985
Rajec	6 069	6 067	5 874	5 864	5 889	5 881	5 850	5 824
Lietavská Lúčka	1 790	1 792	1 751	1 760	1 763	1 774	1 779	1 823
Porúbka	455	461	440	440	453	466	481	494
Konská	1 458	1 477	1 459	1 483	1 478	1 505	1 514	1 542
Zbyňov	870	876	829	834	838	835	844	857
Kľače	369	366	376	386	387	391	400	398

source: Slovak statistics office

However, there are also other cases, where the authors describe that people are moving from rural to urban settlements. This is due in particular to low numbers, respectively no job opportunities, lack of services, no or very poor quality of public transport, and thus the overall lower quality of life. Young people will not return to college after leaving for college, so the villages are slowly going away. One example is the village of Driečna in the east of Slovakia. Currently, there are 4 inhabitants living in the village, but 500 people lived there 50 years ago. Because of the waning numbers of inhabitants, they have cancelled business or school over time. [12]

Situation in rural areas.

There is difference between the Western and Eastern part. In Eastern Slovakia [12] the population has the decreasing trend, which is caused the migration of young people to areas with jobs. Therefore also some rural areas in Presov or Kosice region have the problem with low public transport service. On the opposite, there is Bratislava region which has the increasing trend of population. There are rural settlements which will count with increasing population due to attraction of Bratislava. There are many examples of rural areas with increasing population in last year which are very close to the important city or town [35].

Czech Republic

In the Czech Republic, the situation is similar to Slovakia. For example, in České Budějovice every year the population fall by about 300 inhabitants. On the other hand, hundreds of people will come to the nearby satellite villages each year. This is also a problem for schools or parking. Similar problems exist, for example, in the Plzeň Region, Olomouc or Prague.

The authors of the study "Spatial mobility of commuters – commuting" from the Faculty of Natural Sciences of Charles University in Prague describe demographic and socioeconomic developments in 5 municipalities in the Czech Republic. The study shows that there has been a significant increase in population in the last 10 years, in some cases up to three and a half times. The reason is a good transport connection between these municipalities and Prague. Such developments result, for example, in parking problems in the capital of the Czech Republic – Prague. Based on this, 62 locations were selected to provide parking facilities, from where the inhabitants of the surrounding cities and villages could continue by public transport. [13,14]

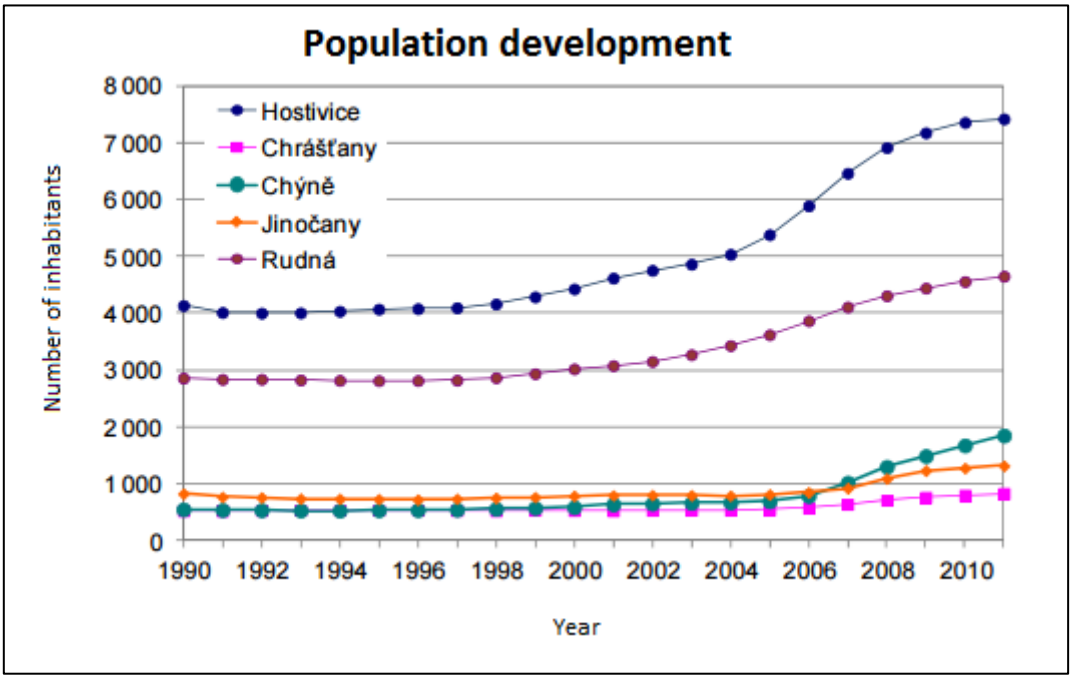

Figure 12 Population development in 5 municipalities in Czech Republic
source: South Bohemia region

The statistical examples of Region South Bohemia

The South Bohemian region has of 637 834 people. The density is 3,4 persons/km². It is region with lowest population density in Czech republic. The region has 623 villages and towns,53 are towns. The settlements is shown in Fig.13.

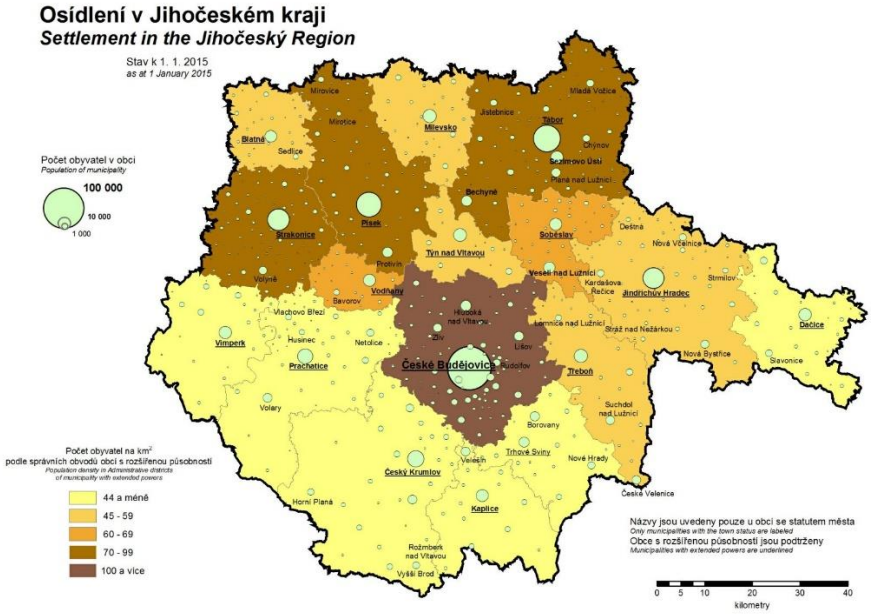

Fig.13 The settlement in South Bohemia region

source: Czech statistics office

The most population density is in regional capital Ceske Budejovice and then in counties capital as Strakonice, Písek, Tábor. The lowest density is in county towns which lay in the border areas (Prachatice, Český Krumlov).

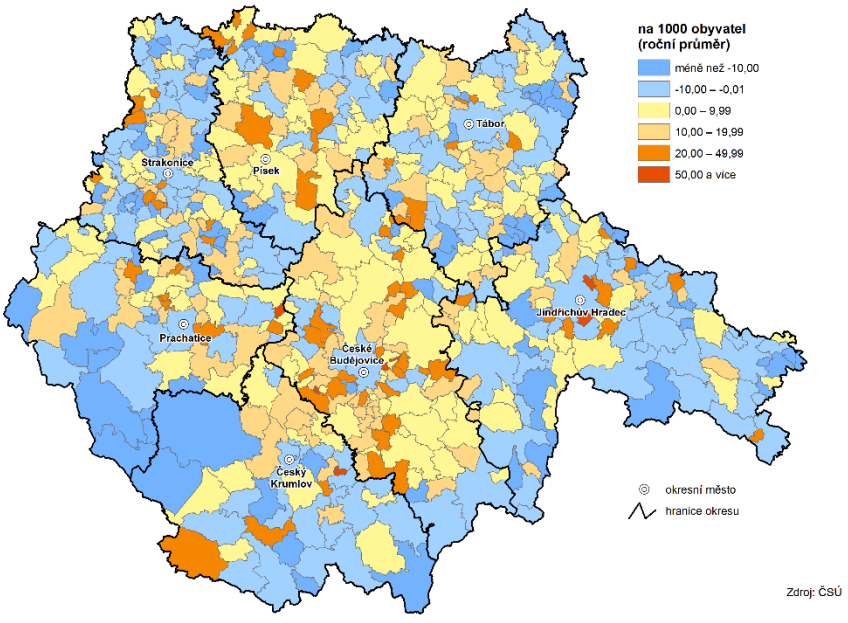

Fig. 14 The total increasing/decreasing of population during 2011 -2016 in South Bohemia region

source: Czech statistics office

The increasing o pupulation diferes from area to area but in general there are increasing of pupulation mainly near the cities or towns with job places. On the contrary the situation is different in border areas.
The following examples in Fig. 15 shows the statistics of county of Český Krumlov.

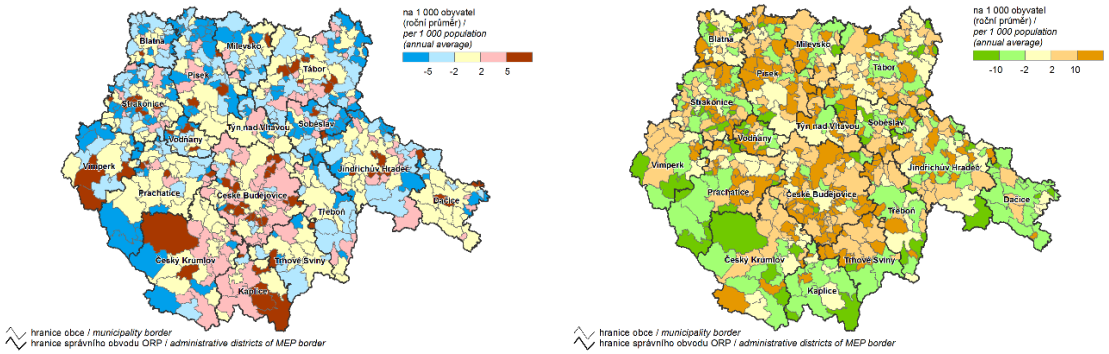

Fig. 15 The natural cahnge of population (left) The migration change in county Cesky krumlov(right)

source: Czech statistics office

The reason are various but one of them is better standard of living, environment also the improvement of infrastructure mainly from EU funding. Another fact is also the unemployment rate which is in this area very low, see Fig.16.

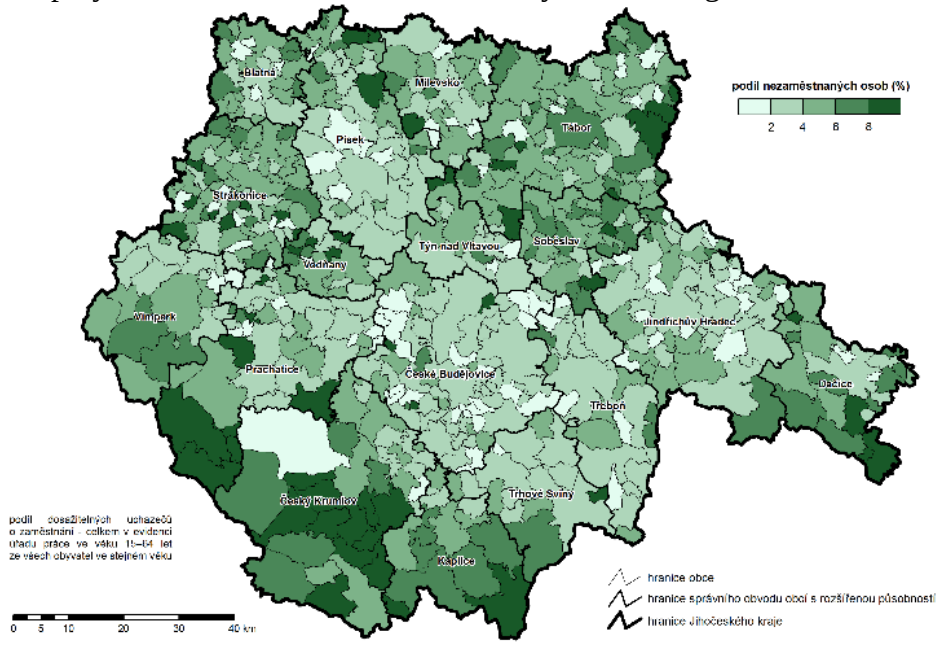

Fig. 16 The map of unemployment rate in South Bohemia source: Czech statistics office

Poland

Suburbanization also relates to the Poland. Adam Radzimski, Mical Beim and Bogusz Modrzewski in their study "Are Cities in Poland Ready for Sustainability? Poznan Case Study" describes changes over the last 20 years. The city of Poznan is one of the examples of the suburbanization process and therefore the decrease of the number of inhabitants of the inner city accompanied by the growth of the whole metropolitan area population. Many new lands is used without connection to the existing settlement structure, which makes the provision of public transport services increasingly difficult. This is the reason that private cars are in most cases the only means of transport that ensures a rapid transfer between the satellite dwelling and the inner city. [15]

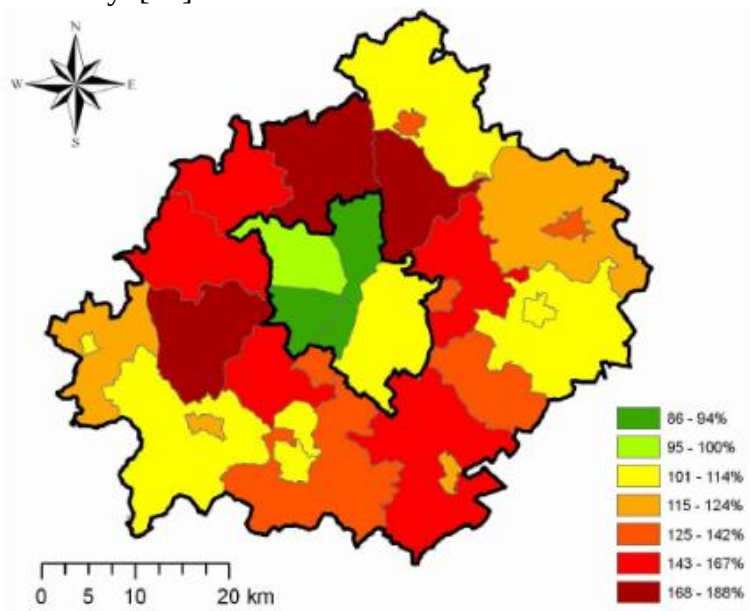

Figure 17 The development of Population Change in the Poznań Metropolitan Area in 1990 – 2008 [15]

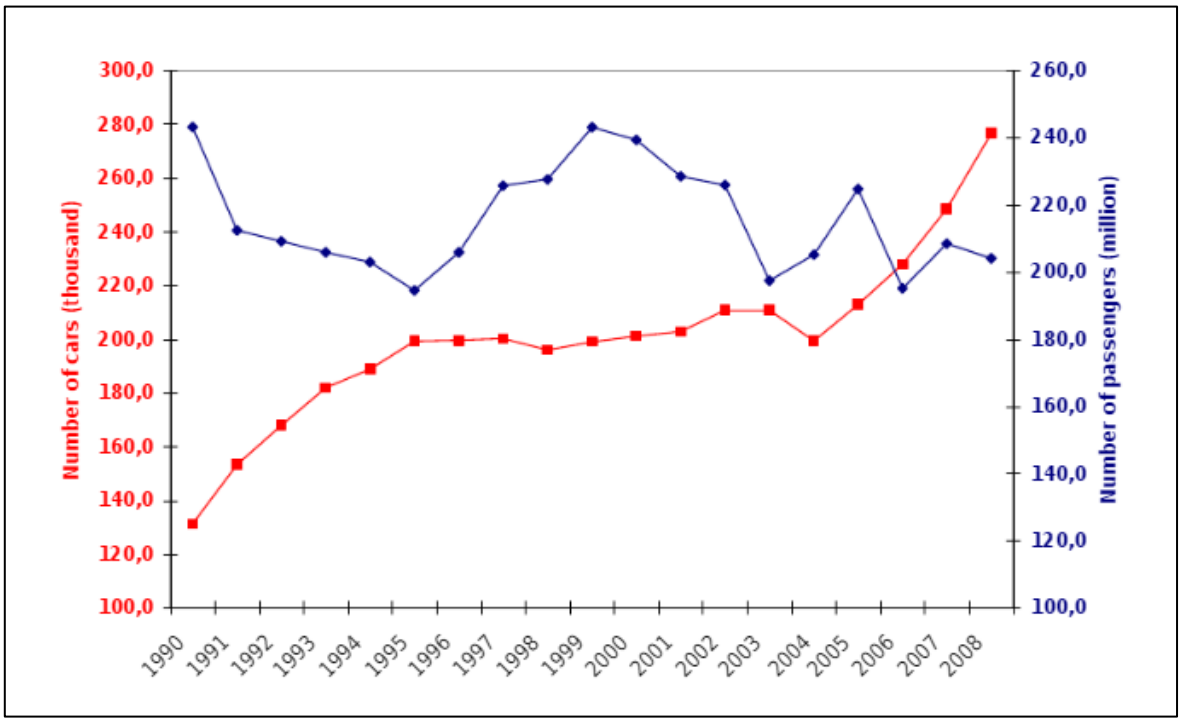

Figure 18 The development of the number of passenger cars and the number of passengers transported by public transport in Poznań [15]

The interesting from Polish statistcs shows the following figures.

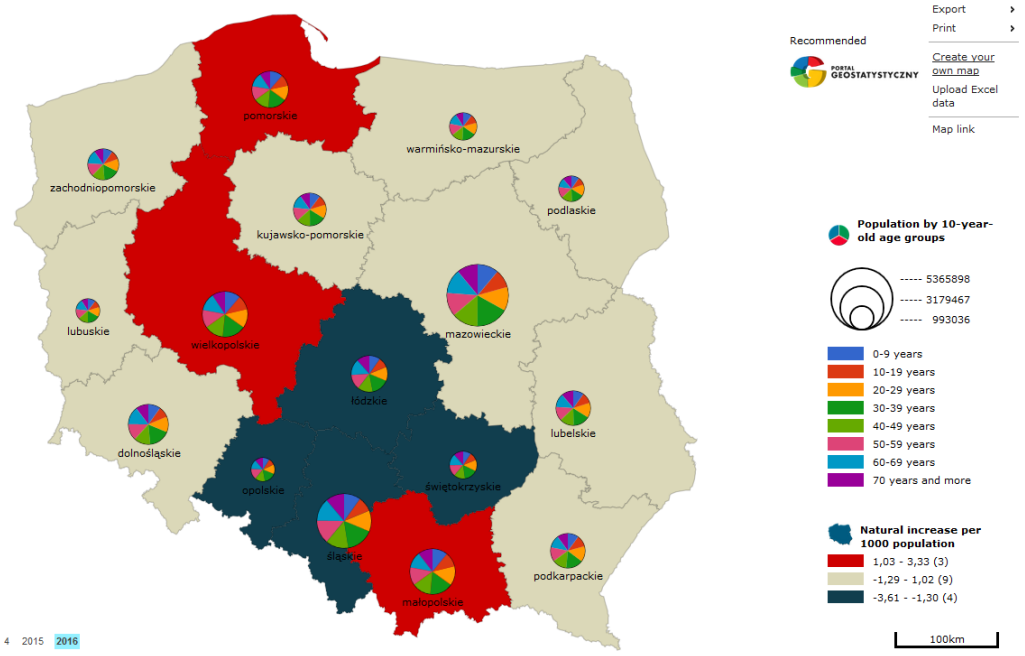

Fig. 19 The comparison of population of 10 age groups within Poland

Source: Polish Central Statistical office

The comparison of population in rural and urban areas shows that mainly in industrial parts and region people are living in the cities. On the contrary the areas with agroculture are characterised mainly with population in rural areas, see Fig. 20.

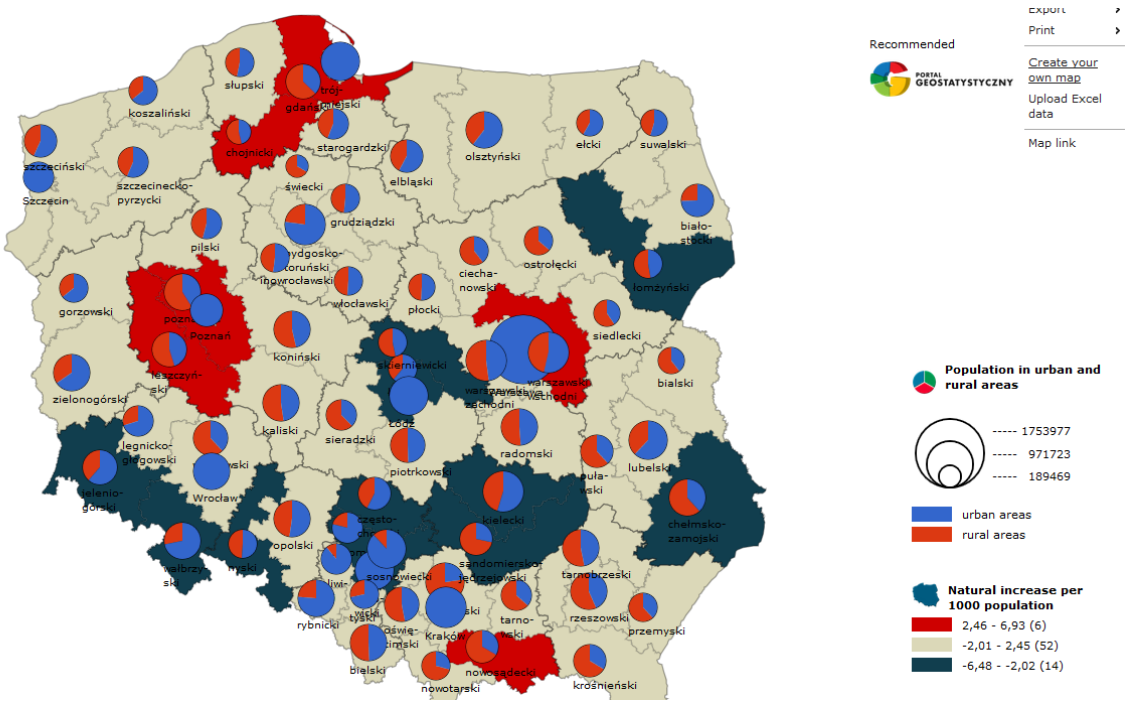

Fig. 20 The comparison of population in urban and rural areas

Source: Polish Central Statistical office

The highest statistics of unemployment rate is mainly in North and East Poland. The lowest unemployment rate is in voivodship Mazowiecke.

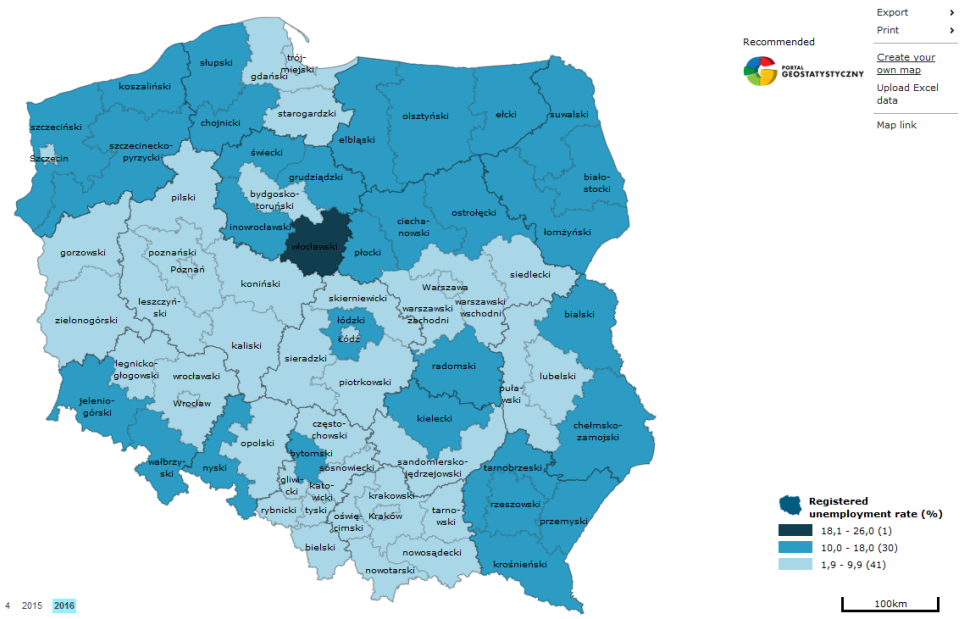

Fig.21 The comparison of unemployment rate in Poland

Source: Polish Central Statistical office

Hungary

Since the mid-1990s, population decline has occurred in Budapest, with more than 10,000 people per year. In 2008, approximately 1.7 million people lived in the capital of Hungary, which was down 16% compared to 1990.

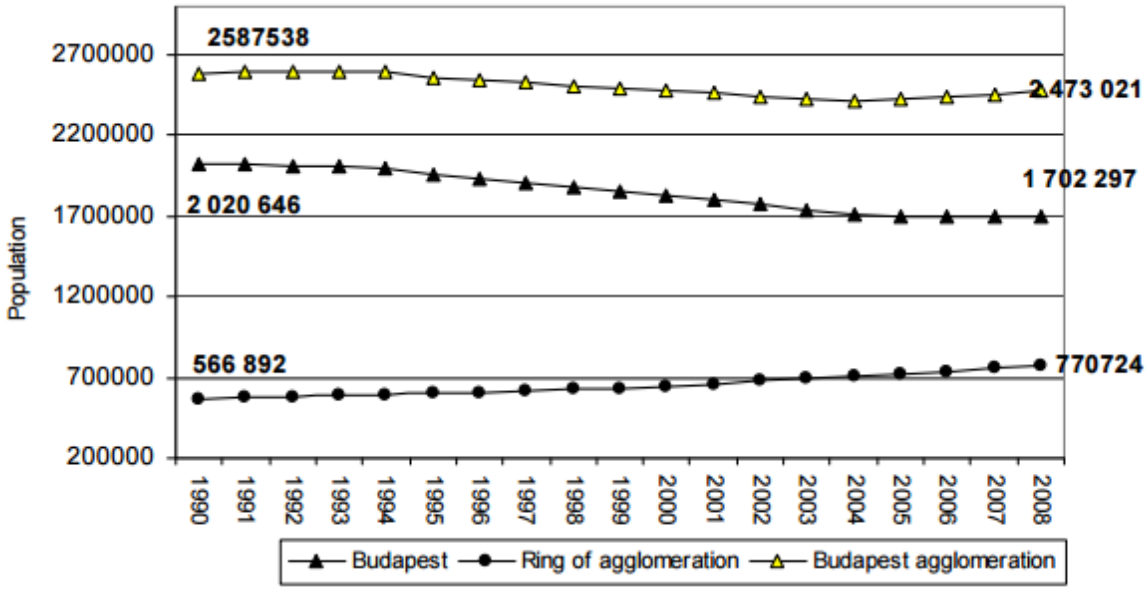

Figure 22 The population development in Budapest and Budapest agglomeration [16]

In Budapest, suburbanization has also changed transport behaviour in a wider agglomeration for several years since 1990. The number of passenger cars in 2008 reached 886,000 vehicles, or 33 % of all Hungarian passenger cars. In Budapest, 594,000 vehicles (67%) and 289,000 (in the suburbs) vehicles were registered. Compared to 1990 the total number of vehicles increased by 15 % in Budapest and up to 121 % in the agglomeration. [16]

Such a development, however, is not only in large cities. Gábor Pirisi and András Trócsányi in their study have been concerned with reducing the number of inhabitants of small cities in Hungary. They focused on Hungarian cities with less than 30,000 inhabitants. The data on the population were taken from the national counting and information database administered by the Hungarian Central Statistical Office. In total, 259 places were surveyed in detail from 1870 to 2011. Up to 62% of small cities lost each year about twentieth and 27% of small cities lost a tenth of their population each year during the decade between 2001 and 2011 (Fig. 16). [17]

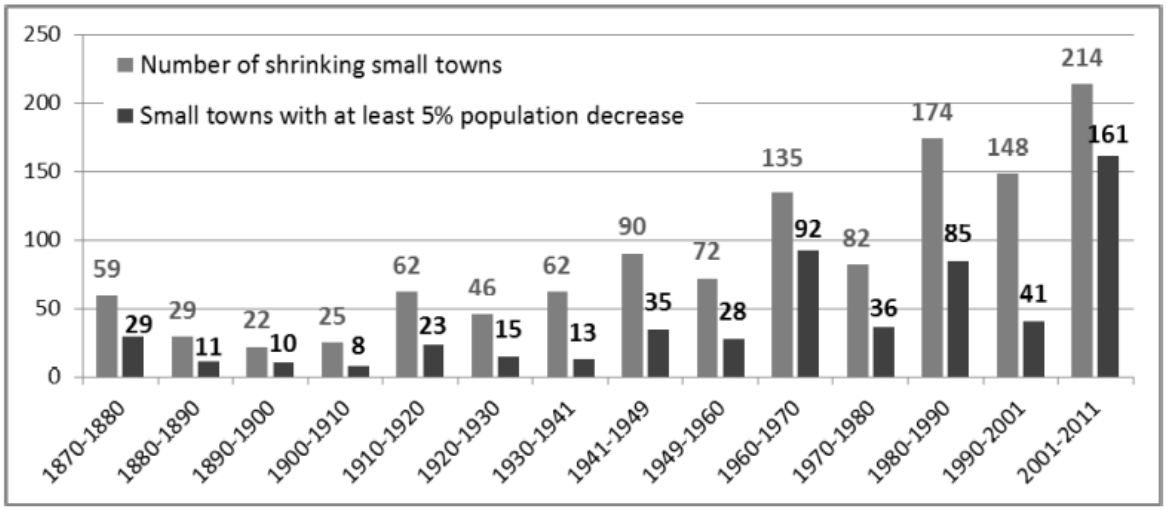

Figure 23 Comparison of reducing the number of inhabitants in small Hungarian cities [17]

In Fig. 16 it can be seen that population growth has become exceptional. Growing small cities or those with a stagnant population are located only on the edge of the agglomerations, in the Balaton region and in the economically dynamic northwest region (Fig. 17). In the south-east of Hungary, the demographic situation is much worse than the average, which shows a faster aging population, very low birth rates, and intra-regional emigration to surrounding villages. [17]

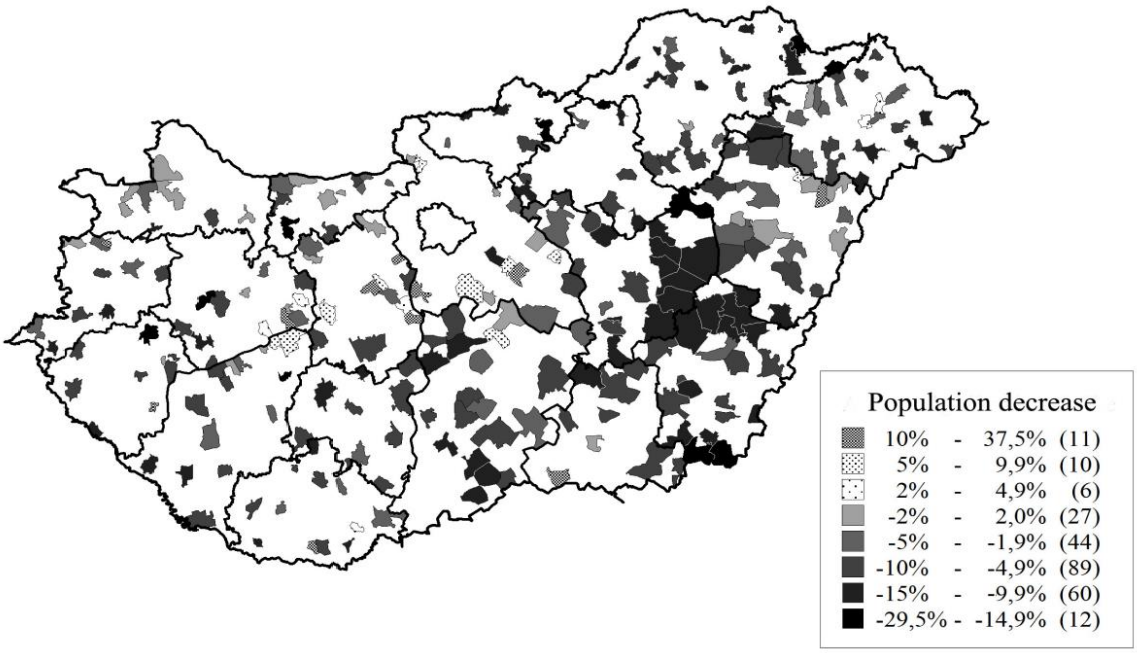

Figure 24 Population change in different regions in Hungary [17]

Szabolcs-Szatmár-Bereg County

The interesting data shows the statistics about the demography in mostly rural area Szabolcs-Szatmár-Bereg county from 1870 to 2011. In comparison to first evidence of data in 1870 there was increasing of data about 180 %. But in recent years there is evidence of slightly decreasing of population about 4 % for between 1991-2011. There is higher imigration mainly from Ukraine and Romania, but migration loss in Szabolcs-Szatmár-Bereg represents 3700 people.
The big problem is also unemployment of the group of people in age between 19-64 years which represents 51 % of this group that is the highest in Hungary. In the unemployment rate it represents 9 %.

Tab. 10 The comparison of various demographic characteristics in Szabolcs-Szatmár-Bereg county from 1870 - 2011

Year	Population	Population density, person per km^2	Population as a percentage of the		Period	Actual increase, decrease (-)	Annual average increase, decrease (-) in percentages
			1870 census	previous census			
Present population							
1870	299 441	50,4	100,0	–	–	–	–
1880	288 327	48,6	96,3	96,3	1870–1880	-11 114	-0,34
1890	329 131	55,4	109,9	114,2	1881–1890	40 804	1,33
1900	384 060	64,7	127,7	116,2	1891–1900	53 337	1,51
1910	418 482	70,5	139,8	109,0	1901–1910	34 422	0,86
1920	435 119	73,3	145,3	104,0	1911–1920	16 637	0,39
1930	502 136	84,6	167,7	115,4	1921–1930	67 017	1,44

1941	546 639	92,1	182,6	108,9	1931–1941	44 503	0,85
1949	558 098	94,0	186,4	102,1	1941–1948	11 459	0,26
1960	586 451	98,8	195,8	105,1	1949–1959	28 353	0,45
1970	590 214	99,4	197,1	100,6	1960–1969	3 763	0,06
			Permanent population				
1980	621 047	104,6	207,4	102,9	1970–1979	17 717	0,29
1990	592 933	99,9	198,0	95,5	1980–1989	-28 114	-0,46
2001	586 158	98,7	195,8	98,9	1990–2001	-6 775	-0,10
2011	572 734	96,5	191,3	97,7	2001–2011	-13 424	-0,21
			Resident population				
1980	593 829	100,0	198,3	105,0	1970–1979	28 272	0,49
1990	572 301	96,4	191,1	96,4	1980–1989	-21 528	-0,37
2001	582 256	98,1	194,4	101,7	1990–2001	9 955	0,16
2011	559 272	94,2	186,8	96,1	2001–2011	-22 984	-0,37

Source: Hungarian central statistical offfice

In comparison of the population of districts of Nagykálló and Nyíregyházaa we can see the decreasing trend of population, see tab.11.

Tab. 11 The comparison of population of district Nagykálló and Nyíregyháza between 1970 - 2011

Area	Hectare	Year 2011 population per 1 km^2	Resident population					Year 2011 population per 1 km^2
			1970	1980	1990	2001	2011	
J08 Nagykállói	37 737	83,1	34 835	34 874	32 248	32 526	30 403	80,6
J10 Nyíregyházi	80 960	204,8	132 213	157 990	162 137	169 091	168 118	207,7

Source: Hungarian central statistical office

Considering the public transport and especially rail passenger transport we can see the relationship between traffic and particular region, tab.12. For the Northern Great Plain (Észak-Alföld) region it is 13,2 millions passengers per year 2015.

Table. 12 THE TOP TEN MOST TRAFFICKED REGION PAIRS IN DOMESTIC RAIL PASSENGER TRANSPORT (2015)

Range	Get on region	Get off region	Passengers in million
1.	Közép-Magyarország	Közép-Magyarország	60,3
2.	Észak-Alföld	Észak-Alföld	13,2
3.	Nyugat-Dunántúl	Nyugat-Dunántúl	9,7
4.	Közép-Dunántúl	Közép-Magyarország	7,2
5.	Észak-Magyarország	Észak-Magyarország	7,1
6.	Dél-Alföld	Dél-Alföld	5,6
7.	Közép-Magyarország	Közép-Dunántúl	5,4
8.	Közép-Dunántúl	Közép-Dunántúl	4,8
9.	Dél-Dunántúl	Dél-Dunántúl	3,9
10.	Észak-Alföld	Közép-Magyarország	2,7

Source: Hungarian central statistical office

Germany

At the beginning of the twentieth century, Germany had a total fertility rate (TFR) of approximately 4.2 children per woman (with a replacement fertility rate of 2.9 children at that time). The life expectancy of someone born during this time was less than 45 years. The number of births exceeded the number of deaths by an average of 10.4 per 1,000 residents; the natural balance in 1900 was +760,000. By the middle of the 1950s the birth rate had decreased to the new replacement fertility rate of 2.1 children per woman. This phase was followed by the "baby boom" until the end of the 1960s with peak levels of more than 2.5 children per woman.

The second demographic transition began in Germany at the beginning of the 1970s. It introduced the long-term trend to a total fertility rate of 1.4 children or less; this level has not been surpassed since 1991. 1971 was the last year in which the number of births exceeded the number of deaths. Since then there has been a negative natural balance. The population growth since then has been dependent upon the level of net immigration. If immigration decreases, as it did since the middle of the 1990s, or if there is net emigration, as was the case during the economic crises at the beginning of the 1970s and 1980s, the population in Germany shrinks. In 2011 the birth deficit grew to -2.3 per 1,000 residents, and the natural balance sunk even further to -190,000 residents. Nonetheless there was not a population decline in that year. After many years with increasing population losses due to low or negative migration balances, the 2011 population in Germany grew slightly for the first time since 2003 due to the strong growth in net migration. [28]

Approximately half the population of Germany lives in the 30 major urban German agglomerations, such as Berlin, Hamburg, Munich (München), and Cologne (Köln) but also in smaller cities including Münster, Freiburg, Leipzig, and Dresden. The gridded cartogram helps to understand the demographic processes and development that occurred there in recent years, revealing some distinct trends of re-urbanisation in some of the most densely populated areas.

Examination of the average annual change in the populations of the selected urban agglomerations highlights the regional differences in these trends. Contrary to the national population decline, which is predicted to continue, 26 out of the 30 major agglomerations show population growth between 2008 and 2013. In 25 of these areas population growth in the city centre is even higher than in its suburban area. This can be seen as evidence of a very recent trend of re-urbanisation in these places.

One particularly notable trend is the dynamics in smaller cities such as Freiburg and Münster, as well as Dresden and Leipzig in East Germany. In addition to high rates of re-urbanisation, the suburban areas often have stagnating or even declining populations.

The Ruhr area agglomerations are distinctively different from the other areas described in the overall summary of trends. The stagnating populations in the centres of Dortmund and Essen are complemented by considerably declining populations in their surrounding areas. [29]

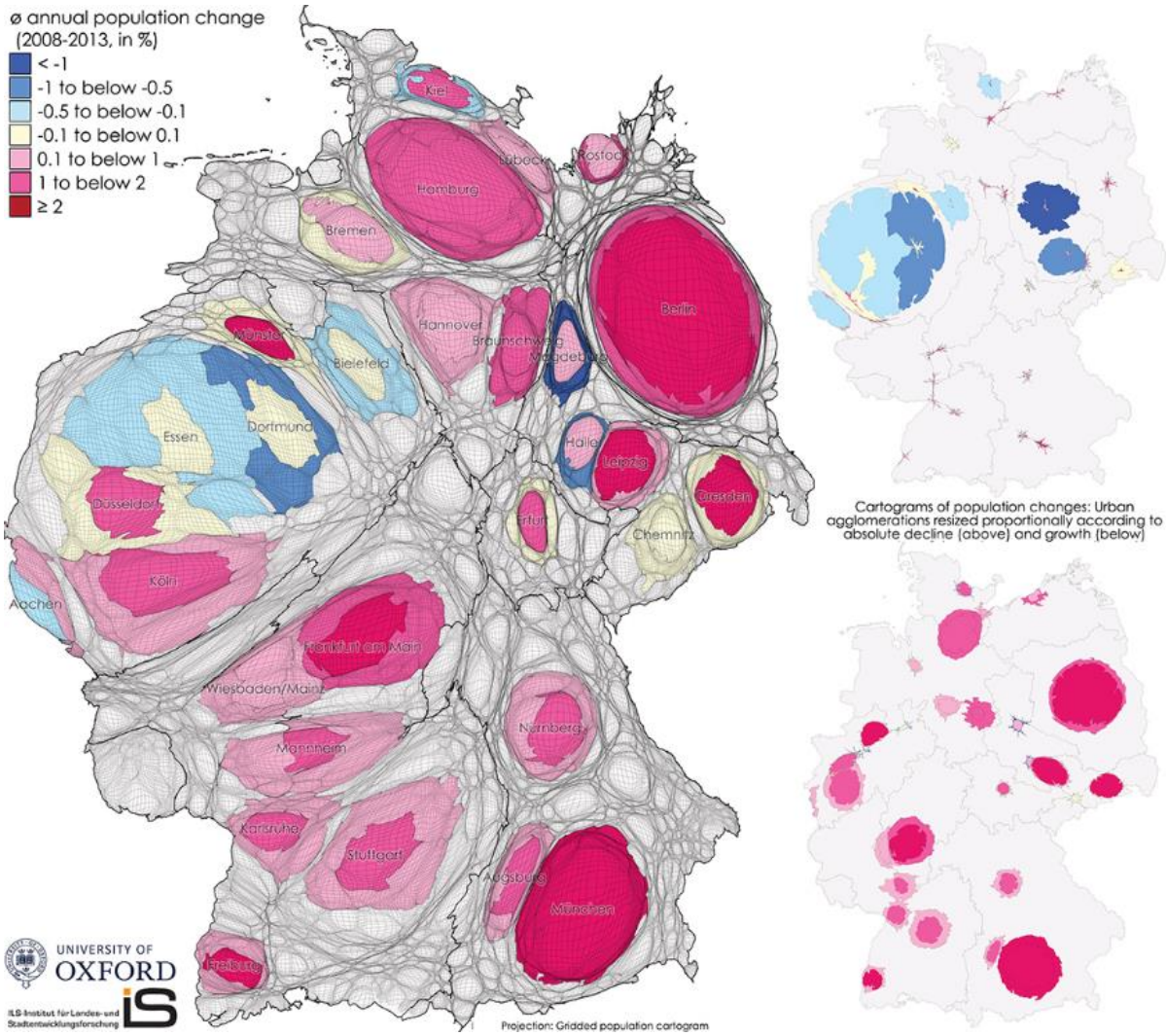

Figure 18 Annual population change in Germany 2008 – 2013 [29]

In Fig. 26 it is possible to see regional demographic changes in the area in Germany.

Despite an influx of 1.2m refugees over the past two years, Germany's population faces near-irreversible decline. According to predictions from the UN in 2015, two in five Germans will be over 60 by 2050 and Europe's oldest country will have shrunk to 75m from 82m. Since the 1970s, more Germans have been dying than are born. Fewer births and longer lives are a problem for most rich countries. But the consequences are more acute for Germany, where birth rates are lower than in Britain and France. [37]

If Germany is a warning for others, its eastern part is a warning for its west. If it were still a country, East Germany would be the oldest in the world. Nearly 30 years after unification the region still suffers the aftershock from the fall of the Berlin Wall in 1989, when millions—mostly young, mostly women—fled for the west. Those who remained had record-low birth rates. "Kids not born in the '90s, also didn't have kids in the 2010s. It's the echo of the echo,"

says Frank Swiaczny from the Federal Institute for Population Research, a think-tank in Wiesbaden. The east's population will shrink from 12.5m in 2016 to 8.7m by 2060, according to government statistics. Saxony-Anhalt, the state to which Bitterfeld-Wolfen belongs, is ahead of the curve. [37]

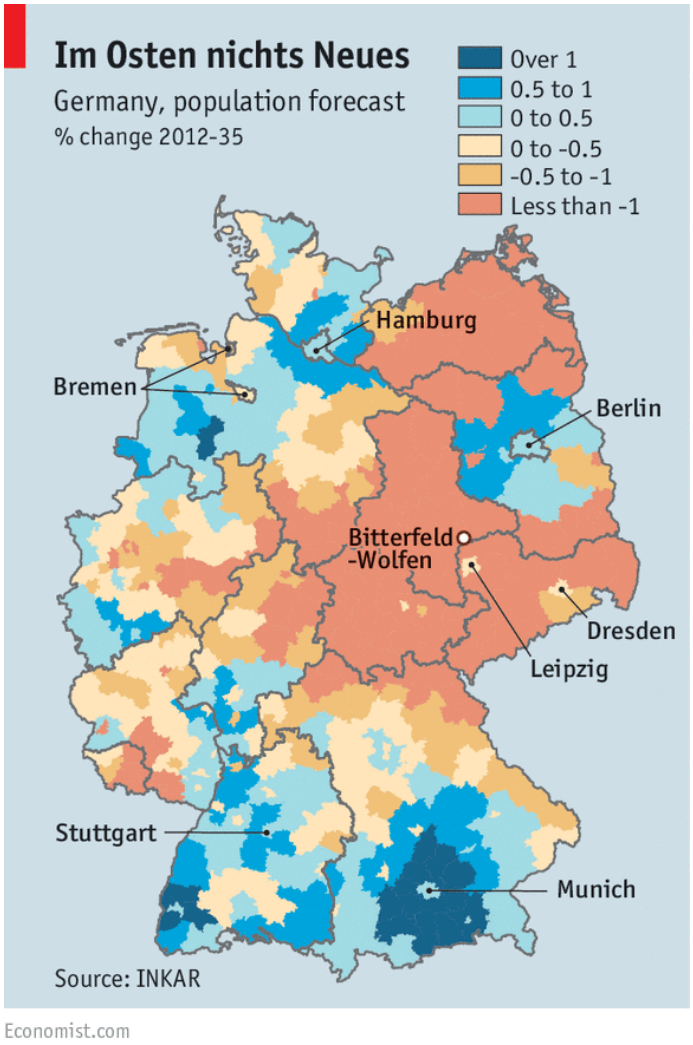

Fig. 27 The Germany population forecast [37]

By 2060, Germany will see a population decline of 15 - 20 % (65 - 70 million inhabitants), according to expert forecasts. The reason will be, in particular, population aging, internationalization, or a change in the way of life. [19]

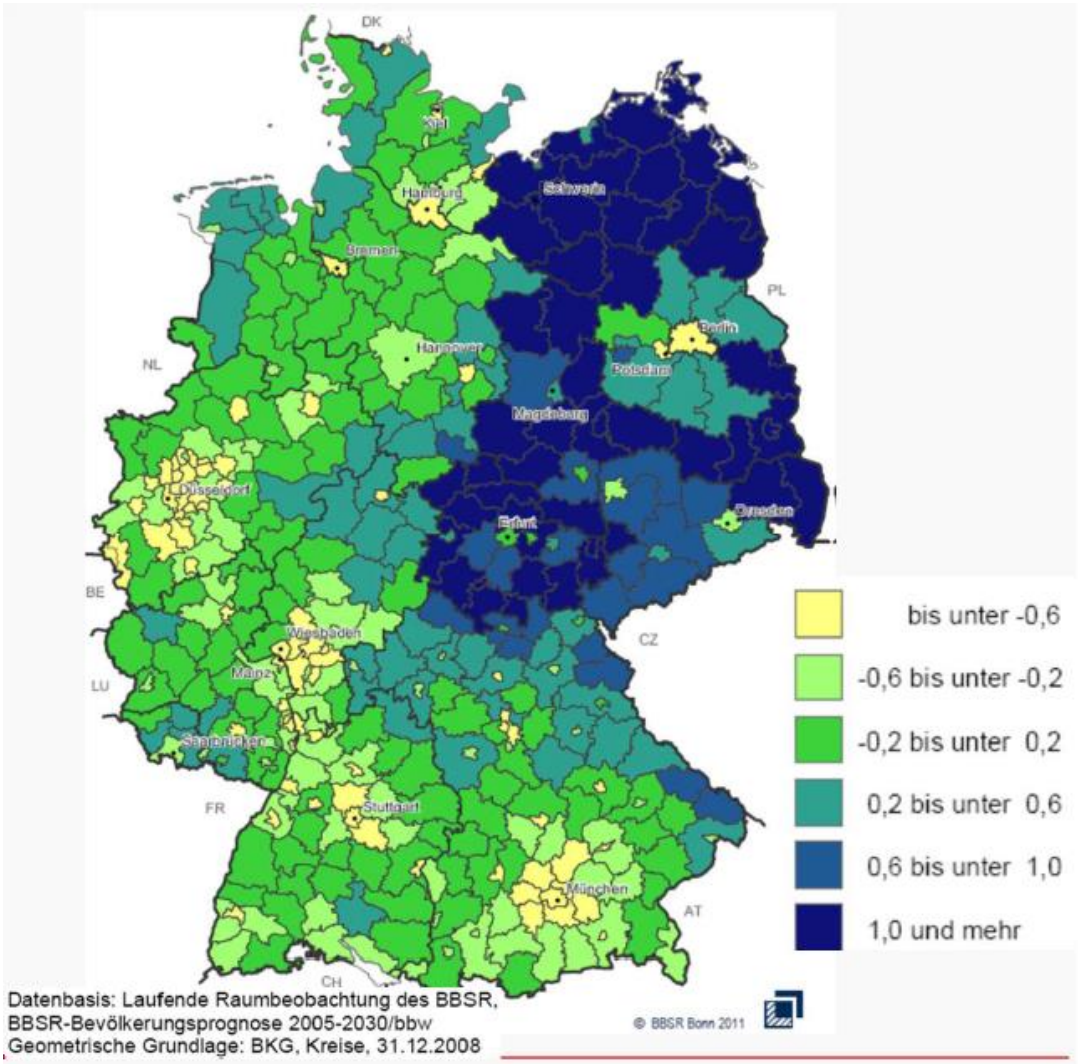

Figure 28 Regional demographic change in space in Germany 2005 – 2030 [19]

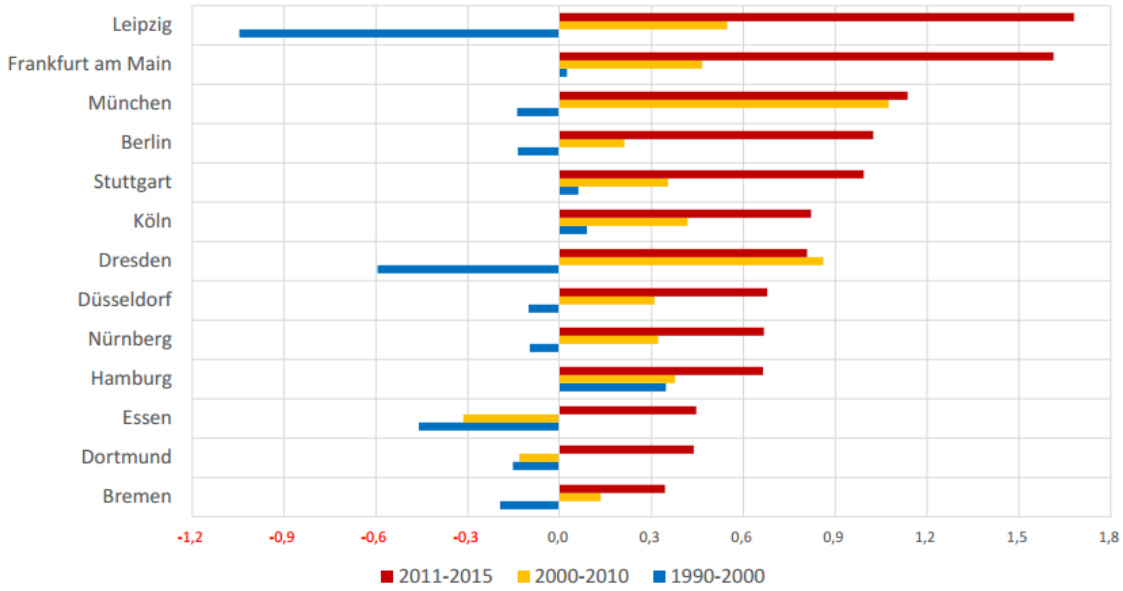

Figure 29 Average annual population growth in % in cities over 500,000 inhabitants in 1990 – 2015 [18]

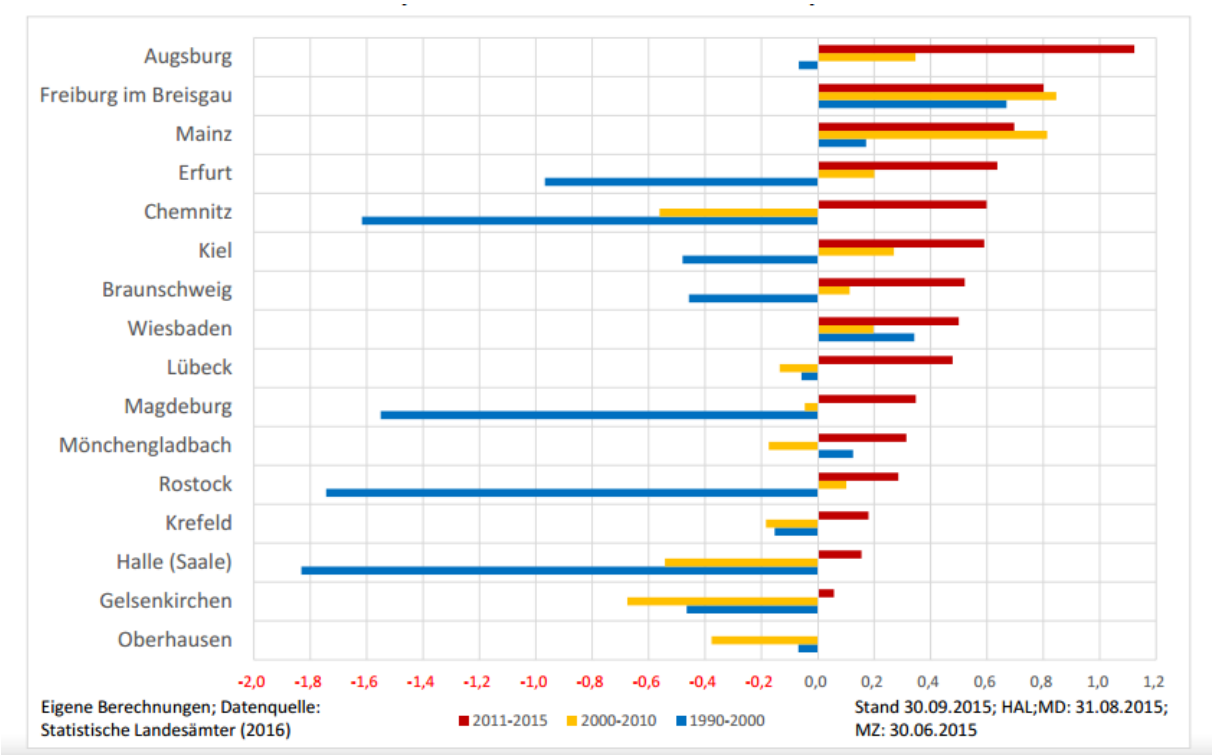

Figure 30 Average annual population growth in % in cities with 200 000 – 300 000 inhabitants in 1990 – 2015 [18]

Of course, even in some German cities there is an unfavorable population development, such as Neubrandenburg in the northeast of Germany (Fig. 31).. Within the Land is a major business and economic centre as well as a regional shopping centre of north-

eastern Germany. In 1990, this city had more than 90,000 inhabitants, in 2013 it was only 63,400 and the forecast for the next years is a further decline in the population. [19]

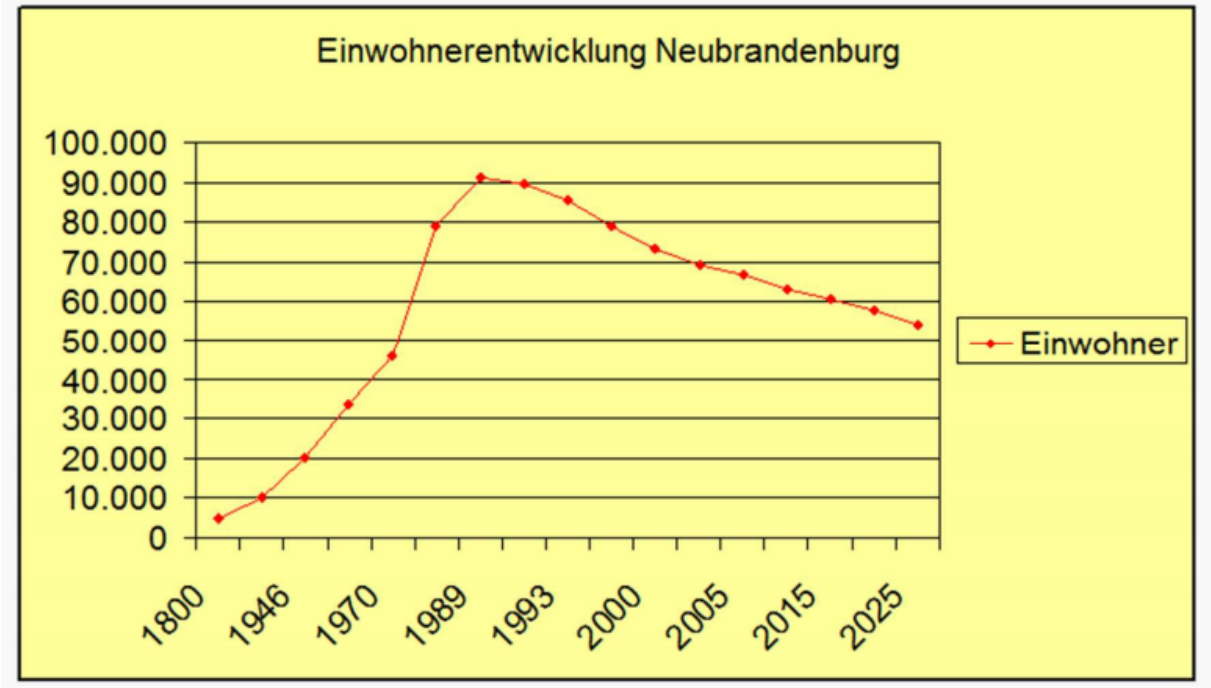

Figure 31 Population development in Neubrandenburg in 1800 – 2025 [19]

There were conducted also some studies which describe the process of social exclusion. Interesting findings regarding the pheriperalisation was conducted in study by (Leibert, Golinski,2017), tab.13.

We can see the difference betwenn former East and West Germany even in comparison of unemployment rate for urban or rural areas. The unemploymwent rate for rural areas is for instance in West Germany 4,5 %, while in East Germany 10,2 %. Also for example the child poverty rate is higher in East Germany rural areas 20,7 % in comparison to rural areas in West Germany 9 %. There are also particular data for Saxony –Anhalt state, so you can see even higher values for some indicators, see Fig. 13.

Tab. 13 The selected indicators of peripheralisation: social exclusion in Germany

	Saxony-Anhalt	Urban districts West	Urban districts East	Rural districts West	Rural districts East	Germany total
Social exclusion						
Unemployment rate	11.5	6.4	11.2	4.5	10.2	6.8
Youth unemployment rate	10.2	5.4	10.8	4.0	9.2	5.9
Long term unemployed per 100 unemployed persons	35.4	36.9	35.3	29.3	36.8	35.6
Underemployment*	16.5	8.6	15.6	6.2	13.8	9.3
Welfare recipients ("Hartz IV") per 100 inhabitants under 65	16.7	8.9	17.6	5.5	13.5	9.5
Child poverty rate	26.8	14.8	28.4	9.0	20.7	15.2
Dependence						
Tax revenue per capita 2012	451€	828€	547€	668€	448€	728€
Gross value added (GVA) 2012	46.8	61.6	48.2	53.4	46.0	57.4
GVA – development 2007-2012	5.7	8.6	11.6	13.1	8.8	9.6
R&D** personnel per 1,000 persons employed	3.5	15.7	8.8	7.9	4.6	12.6
Personnel in skill-intensive enterprise-related services per 100 persons employed	6.0	12.5	12.0	6.6	4.8	10.7
Personnel in creative industries per 100 persons employed 2012	1.6	4.0	4.9	1.7	1.2	3.4
Personnel in skill- and research-intensive industries per 100 persons employed 2012	6.1	12.0	5.9	11.9	7.0	10.9
Personnel in the FIRE*** economy per 100 persons employed 2012	22.2	24.6	25.9	17.9	19.2	23.2
Median income per capita 2012	2,137€	3,038€	2,338€	2,719€	2,069€	2,754€

* Proportion of the workforce employed on the subsidised labour market (e.g. job creation schemes, vocational re-training)

** Research and development

*** Finance, Insurance and Real Estate

Source:[61]

Italy.

Regarding the situation in rural areas in Italy, the National Strategic Plan for Rural Development (NSP) 2007-2013 distinguishes between four macro-typologies of areas: a) Urban conglomerations; b) Intensively farmed rural areas; c) Intermediate rural areas; d)

Rural areas with general development problems. These areas were identified with some modification of the OECD methodology for the classification of areas in urban and rural contexts, which did not allow for sufficient differentiation within the provinces. In Italy the provinces generally show significant differences across the
country. (See Figure 32).

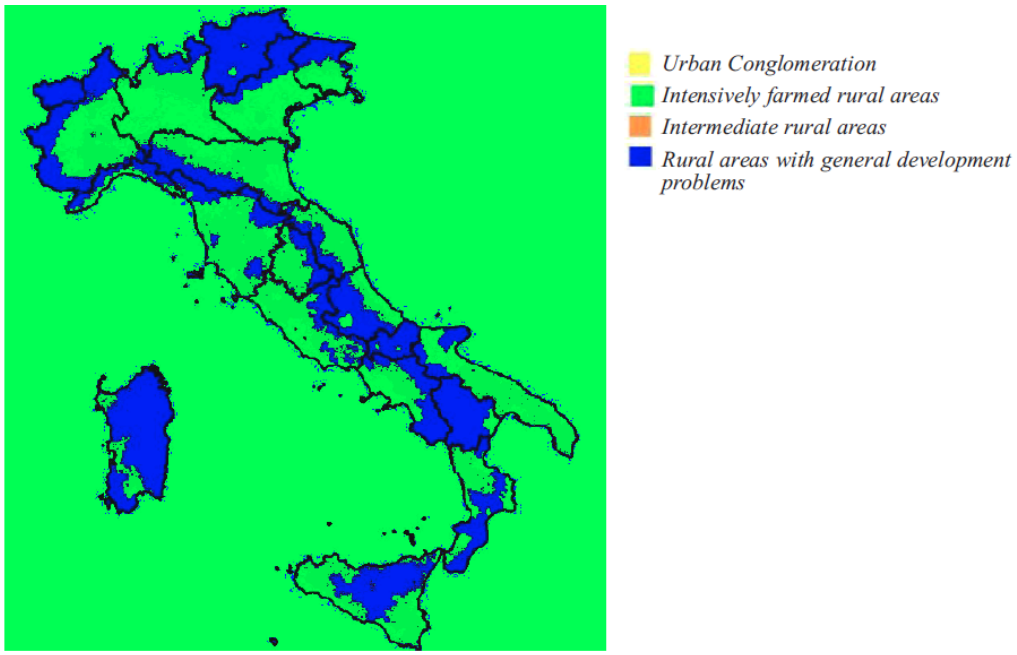

Fig.32 The indication of rural areas in Italy

Source: :[64]

The rural areas therefore appear with worse condition and accessibility to job places, education etc.

Interesting facts show various parameters for region Castelfranco Emilia. The trend of total population has increasing effect about 40 % where in comparison from 1991 to 2011, see tab.14. The increasing trend is laso related to the mobility to work outside of urban area that means mainly in rural areas.

Tab. 14 The various indicators of Castelfranco Emilia between 1991 - 2011

Indicator	1991	2001	2011
Resident population	21 247	25 096	31 656
Incidence of surface centers and inhabited areas	7,1	7,6	8,4
Incidence of resident population in sparse rural areas	18,2	15,7	13,3
Demographic density	207,3	244,8	308,8
Social and material vulnerability index	97,6	97,2	98,6
Incidence of young people out of the labor market and training	5,5	7,4	11,2

Incidence of disadvantaged families	2,3	2,6	3,0
Population aged less than 6 years	4,1	5,6	7,0
Population aged more than 75 years	8,5	9,0	9,6
Incidence of legally separated and divorced persons	2,1	4,4	6,9
Incidence of foreign residents	8,5	33,9	123,1
Foreign employment rate	72,4	67,1	59,2
Foreign school attendance index	16,7	28,0	38,4
Incidence of housing in property	66,0	72,4	73,7
Daily mobility for study or work	67,9	67,8	69,4
Mobility for study or work outside the municipality area	33,5	34,7	37,2
Mobility for work	106,9	130,0	163,6
Mobility for study	75,7	56,3	48,6
Mobility with private means of transport	64,1	71,9	73,3
Mobility with public means of transport	12,5	8,0	9,8
Slow mobility (feet and bike)	19,1	13,4	14,6
Short mobility	85,5	77,7	78,1
Long mobility	1,6	1,6	4,1

Source: Italian National Institute of Statistics

The similar trend is also in Emilia – Romagna region where the population between 1991 - 2011 has increased about 10 %. But there is the declining trend of population in rural areas about 30 %.

Tab. 15 The various indicators of Emilia – Romagna Region between 1991 - 2011

	Emilia-Romagna Region		
Indicators	**1991**	**2001**	**2011**
Resident population	**3 910 247**	**3 983 738**	**4 342 135**
Incidence of surface centers and inhabited areas	**6,1**	**6,5**	**7,3**
Incidence of resident population in sparse rural areas	**17,8**	**15,7**	**13,1**
Demographic density	**127,9**	**152,4**	**193,4**
Social and material vulnerability index	**96,60**	**97,30**	**98,60**
Incidence of young people out of the labor market and training	**4,20**	**5,80**	**8,30**
Incidence of disadvantaged families	**2,60**	**3,00**	**3,50**
Population aged less than 6 years	**3,5**	**4,7**	**5,6**
Population aged more than 75 years	**10,6**	**11,2**	**12,0**
Incidence of legally separated and divorced persons	**2,0**	**4,7**	**6,5**
Incidence of foreign residents	**7,0**	**39,1**	**104,1**
Foreign employment rate	**73,2**	**68,5**	**61,1**
Foreign school attendance index	**16,7**	**31,7**	**40,3**
Incidence of housing in property	**64,9**	**71,2**	**72,2**

Daily mobility for study or work	**67,3**	**67,3**	**68,9**
Mobility for study or work outside the municipality area	**23,3**	**24,5**	**26,2**
Mobility for work	**55,1**	**64,8**	**79,7**
Mobility for study	**45,4**	**33,7**	**29,1**
Mobility with private means	**61,6**	**67,6**	**69,0**
Mobility with public means	**13,0**	**8,8**	**10,2**
Slow mobility (feet and bike)	**24,2**	**16,0**	**18,5**
Short mobility	**92,7**	**83,0**	**84,4**
Long mobility	**1,5**	**1,6**	**3,6**

Source: Italian National Institute of Statistics

The comparison in national scale shows table 16. Here we can see that the population in rural areas for whole Italy is lower than in discussed regions.

Tab. 16 The various indicators of Emilia – Romagna, Castelfranco Region with average in Italy

Indicators	**Castelfranco Emilia**	**Emilia-Romagna region**	**Italy**
Resident population	31 656	4 342 135	59 433 744
Incidence of surface centers and inhabited areas	8,4	7,3	6,4
Incidence of resident population in sparse rural areas	13,3	13,1	9,0
Demographic density	308,8	193,4	196,8
Social and material vulnerability index	98,6	98,60	99,30
Incidence of young people out of the labor market and training	11,2	8,30	12,30
Incidence of disadvantaged families	3,0	3,50	3,00
Population aged less than 6 years	7,0	5,6	5,6
Population aged more than 75 years	9,6	12,0	10,4
Incidence of legally separated and divorced persons	6,9	6,5	5,4
Incidence of foreign residents	123,1	104,1	67,8
Foreign employment rate	59,2	61,1	58,9
Foreign school attendance index	38,4	40,3	39,5
Incidence of housing in property	73,7	72,2	72,5
Daily mobility for study or work	69,4	68,9	61,4
Mobility for study or work outside the municipality area	37,2	26,2	24,2
Mobility for work	163,6	79,7	85,7
Mobility for study	48,6	29,1	35,2
Mobility with private means	73,3	69,0	64,3
Mobility with public means	9,8	10,2	13,4
Slow mobility (feet and bike)	14,6	18,5	19,1
Short mobility	78,1	84,4	81,4

Long mobility	4,1	3,6	5,0

Source: Italian National Institute of Statistics

Conclusion of situation in EU.

Consequences of suburbanization

Suburbanization is one of the possibilities of expanding the city, which has very diverse consequences on many levels. For a given location, it can be beneficial (e.g. economic), on the other hand this phenomenon brings many negative consequences, which can have a lasting and irreversible impact. Therefore, most authors agree that suburbanization is a negative phenomenon.

The negative consequences include:

1. Government and private investment and operating costs – here it is possible to include higher infrastructure costs. These include, in particular, the building of different institutions.
2. Transport costs – for the population, the aggravating factor is a longer travel time and hence the higher costs associated with car traffic. Adverse consequences may also be higher social and environmental costs associated with transport, such as noise, dust, pollution, congestion, etc. For the founders of urban public transport then more expensive and less efficient transport.
3. Negative impact on the protection of natural habitats.
4. Negative impact on quality of life.
5. Social issues, such as emptying the inner city, unequal distribution of jobs and people's homes.
6. In the low populated areas is logically low demand for public transport that lead to low public transport service supply

In addition to the negative consequences, suburbanization also has some positive effects. One of the main positive impacts is the economic side. With the new inhabitants, the economic situation is also coming to the given location, mainly around the strong economical cities. Building sites requires engineering networks, divorces, new roads, and therefore investment in infrastructure, benefiting not only residents but also the potential tertiary sector. [10]

According the Eurostat in 2016, the highest crude rate of natural increase of population was registered in Ireland (7.1 per 1 000 persons), followed by Cyprus (4.7) and Luxembourg (3.6). A total of 13 EU Member States had negative rates of natural change, with deaths outnumbering births the most in Bulgaria (-6.0 per 1 000 persons), Lithuania (-3.7), Romania (-3.5), Croatia and Latvia (both -3.4) and Hungary (-3.2). In relative terms, Luxembourg (16.2 per 1 000 persons), Sweden (11.9), Malta (11.2), Germany (9.4), and Austria (8.7) had the highest crude rates of net migration in 2016, while Lithuania (-10.5 per 1 000 persons), Latvia

(-6.2), Croatia (-5.4) and Romania (-2.7) recorded the largest negative crude net migration rates.

Among the 18 EU Member States where the population increased in 2016, 14 recorded both a natural increase and net migration contributing to their population growth. In Germany, Spain, Poland and Finland, the positive net migration was the sole driver of population growth, as natural population change was negative. Of the 10 EU Member States that reported a reduction in their level of population during 2015, three — Croatia, Latvia and Lithuania — recorded a decline largely as a result of negative net migration (although this was supplemented by a relatively low negative rate of natural population change). Conversely, in Bulgaria, Greece, Hungary, Portugal and Romania the decrease in the level of population was mostly driven by a negative rate of natural population change (supplemented by a relatively low negative rate of net migration). In Estonia and Italy, the decline in the population was solely due to negative natural change, while net migration was positive.

3. The importance of public transport

Providing public transport in low-density areas, which is usually cost-inefficient, has been a challenge for many governments all over the world. In their quest of finding the right approach, governments have tried to combine many aspects within a transport system. Of all these aspects, we distinguish seven “key ingredients” that contribute largely to the success or failure of such a system. The management of these key ingredients is examined in several successful cases in the Netherlands. The case studies show that the combination of key ingredients is crucial for achieving success. Each low-density area can have its own optimal combination, depending on the wishes of the stakeholders and the circumstances of the system. However, it appears that the presence of three ingredients is crucial for success: the presence of financial means, cooperation between stakeholders and flexible supply of scheduled and on-demand transports. [50]

According the UITP statistics [52] the use of public transport in the EU reached its highest level since 2000, with a total of 57.9 billion journeys made in 2014 according to UITP's new Statistics Brief, 'Local public transport in the European Union'. But we can say i tis mainly in and around the urban areas. 2014 was the first year of distinct growth in demand for public transport after years of stable demand following the start of the economic crisis in 2008. The highest total demand in 2014 for bus, tram, metro and suburban rail was recorded in Germany (10.9bn journeys), UK (7.7bn) and France (7.6bn). Between 2013 and 2014, ‘growth leaders’ France, Italy, Poland and the UK had a combined increase of 600 million journeys, driving up the total EU figure.

Of the 57.9 billion public transport journeys made in 2014, 55.8% were by bus, 16.1% by metro, 14.5% by tram and 13.6% by suburban rail. The developments mask significant national variations, however, which are quite closely linked to national employment figures. 17 EU countries saw higher ridership in 2014 compared to 2010 but only seven had sustained growth: Austria, France, Germany, Lithuania, Malta, Sweden and the UK. Bulgaria was the only country where ridership dropped every year since 2000. Encouragingly, countries such

as Spain, Ireland and Italy that have been impacted by the crisis, saw a return to growth in 2014.

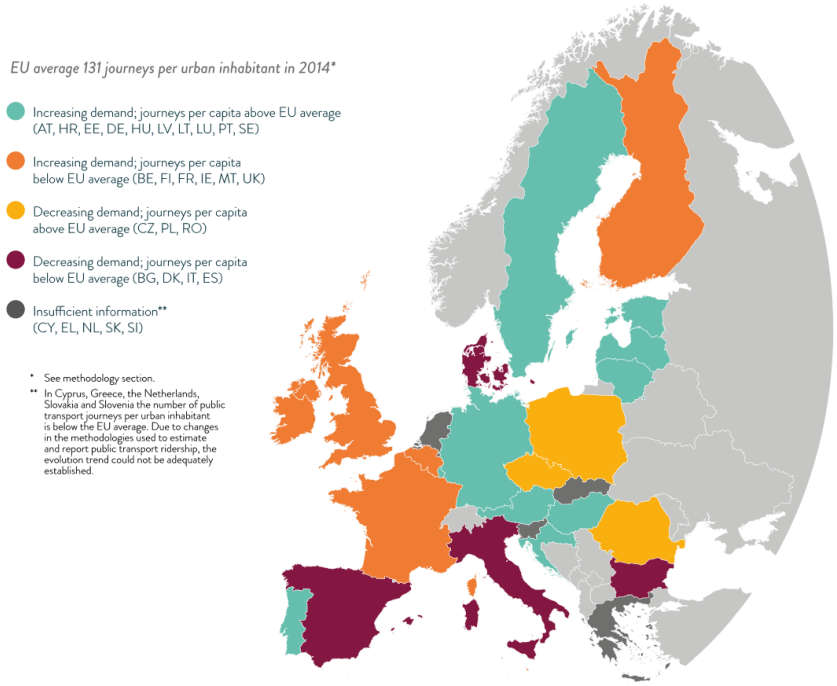

Fig. 33 EU-28 Public transport journeys by bus, tram and metro per urban inhabitant in 2014 and evolution trend in the previous 5 years. [52]

In EU capital cities, the average annual percentage growth in demand (2010-2014) was highest in Brussels; demand per capita is approximately 2.5 times higher in capital cities than the national average.

In general there are various approaches regarding the public transport organisations. In many countries the local or regional public transport is organised by municipalities or their companies, regional or county government which subsidies the service. The advanced for integrated organisation of public transport represents the integrated public transport systems where all regional and urban transport systems are organised by one company so called integrator or organizator (in Germany, Austria the Public transport unions so called Verkersverbunds).

For instance also the Czech republic has the good experiences in launching the Integrated public transport systems. In Slovakia are meanwhile only 2, some in preparation step. But what is important from legislative framwork is recommendation to have the Public Transport service plan [60]. In Slovakia it is obliged for eachtown,city or region. This plan determines the requierements of public transport supply based on the transport demand, mainly on the changing of socio demographic characteristics.

Very similar approach have also in Germany. For instance in Saxony Anhalt in Public transport plan for 2010 -2025 [59] is also stated goal and the level of public transport service considering the future forecast. The public transport timetable is planned on the headway interval (so called taktplan). The plan also stated to goals in updating the transport infrastructure and maximum travel time to reach important towns, cities in order to get to work or to schools.

New challenges of Public transport

Public transport is facing a number of challenges and opportunities that result from changes occurring within the sector itself, as well as from external trends affecting its wider socio-economic environment. Growing urbanisation leads to an increasing demand for transport, which requires a corresponding increase in mass transit supply in order to absorb it. Cities have multiple modal choices at their disposal, most often proposed in a combination – conventional or automated metro, light rail or tramway, bus or BRT, or waterborne – plus other less conventional modes such as cable car, tram-train or monorail to meet specific needs. Within this range, cities can choose the most appropriate modes and take advantage of potential spill-overs, through coordination and prioritisation. Cities with long-established public transport systems, particularly ageing rail infrastructure and rolling stock now need rehabilitation and automation to improve their operational efficiency and capacity. Besides challenges linked to quantitative growth, public transport must make significant qualitative improvements in order to become more attractive. Customers expect the same kind of lifestyle services and connectivity from public transport vehicles and stations as they already have in their own environment and living space. Such services build on basic requirements, which include comfort, security and cleanliness. The notion of quality in public transport should also be created through operational excellence, which includes enhanced frequency, punctuality and reliability of the service thanks to optimised network design and service performance. Likewise, smart ticketing and integrated travel information contribute to making public transport customer/user-friendly, while facilitating accessibility for all citizens. All these tools offer a huge potential to attract new public transport customers and consequently increase revenues.

The world is changing fast and urban areas are springing up everywhere, driven by the growth of cities of all sizes. Combined with rapid economic growth and the emergence of a large middle class in emerging countries, these trends are shifting the world's centre of gravity to the South-East. Globally, some 1,000 cities of more than 500,000 inhabitants are already facing major mobility problems, due to the near impossibility of providing adequate infrastructure to keep pace with the ever increasing popularity of the private car. In the meantime, in Western countries, car use seems to have reached a ceiling. Young people are apparently now more interested in all the latest mobility solutions than in car ownership. In urban and rural areas, this is leading to new mobility behaviour. [31] But what in the case of rural areas?

The statistics shows the different trends in different rural areas, so we would like present some good examples that can be take for inspiration.

SouthMoravian region.

Interesting results provides the study (Stastna et al.,2015) focused on the Integrated public transport in South Moravian region. he public transport in southern Moravia is ensured by the Integrated Transport System of the South Moravian Region. This joint venture company involves 21 state-owned, communal and private companies in unified tariff and time schedule, operated from one place with mutual continuity of transits. It covers 672 of 673 communes in the region (both urban and rural) and additional 55 communes in neighboring regions including small overlaps to Slovakia and Austria. It operates on the area of 8,117 km^2 with 1,221,212 inhabitants (2010). There are also examples of villages with small population and depopulated trend. The system is under permanent checking and adapting the routes, schedule and other characteristics according to the needs. The system consists of 331 transits, of it 25 railway lines, 11 tramway lines, 13 trolleybus lines, 79 bus lines of urban transport in 10 cities and towns (including Brno) and 193 regional bus lines altogether with about 3500 stops. Railway and tramway lines outbalance in radial directions, whereas buses mostly on the tangential ones. The system generates more than 20,000 daily connections. It operates with 1300 vehicles or their combinations. The average number of public transport connection is according the study 27. The main output from the time accessibiilty showed that all villages or town are in max.40 minutes from closest urban center. The output from theis case study shows that the rural areas can have profit on the PT offer which is based on the integration.

Mittelthüringen

Another interesting example is related to the Public transport union Mittelthüringen. The Verkehrsverbund Mittelthüringen (VMT) [52] is a consortium of 13 transport companies with the aim of offering regional local transport as a simple, environmentally friendly and inexpensive mobility solution. The territory of the VMT includes the cities of Erfurt, Weimar, Jena and Gera as well as the counties of Gotha, Weimarer Land and the Saale-Holzland-Kreis. In this case also the passenger from rural areas are benefiting from one public transport system.

Some studies [40] found out that the rural communities face a range of challenges associated with accessibility and connectivity which apply in both the physical and virtual sphere. Constraints in rural transport infrastructure and services are often caused by limitations in the development and resilience of technological infrastructures. In this context there is significant disparity between urban and rural communities.
The rural inhabitants are more likely use and need the cars. It is mainly caused by the accessibility of other forms of transport mode. The statistic (The Association of German Transport Companies Statistics 2015) shows and confirms the data about modal split in various types of settlements, see Fig. 29. This statistic provide the interesting information about the linking of sociodemographics changes and demand for transport [43]

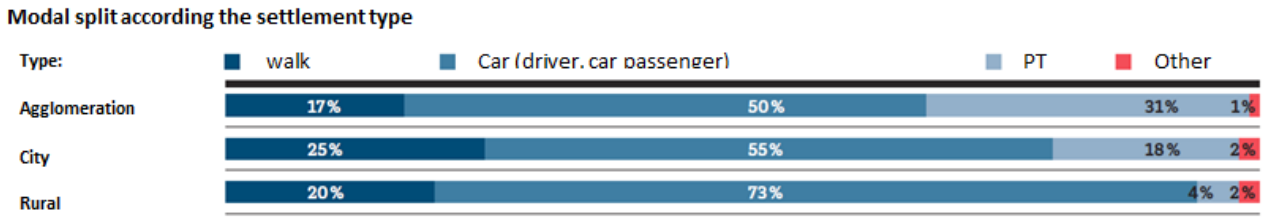

Fig. 34 The modal split according the settlement type

There is correlation between ridership in good served rural areas and public transport service. But in some location is need to combine the other form of transport, for instance Park and Ride or Bike and Ride [44]. Due to fact that the demand in low densed rural areas can not be fully supply by common public transport services, the new approaches are searching. There canbe also use the bikesharing system as one of the solution for mobility in so called last mile, but meanwhile it is mainly system for urban environment.

The new demand patters and forms of public transport.

The shrinking regions or rural areas are facing also problems with mobility. But there is evidence of various mobility solutions in many countries which have already testing the new way of public transport services. From the analysis of current status in particular countries is clear that nowadays we are facing the changes in travel demand.

First group is related to people who are moving to the economically strong cities or areas from rural areas with increasing population. This can be evaluated as increased travel demand also for public transport. The demand can be expressed as the function between population changes during years and the distance from the important city or economically strong area, see Fig. 35.

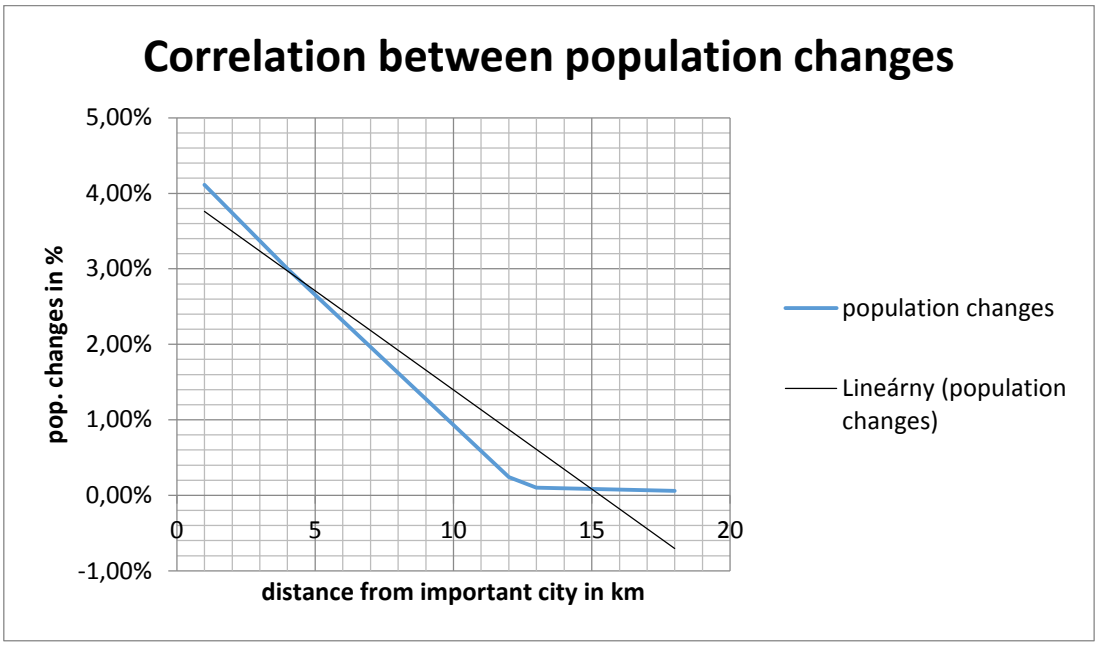

Fig. 35 The correlation between population changes in villages and the distance from economically stron city

By examining the correlation coefficient of population changes of villages or towns and their distances from important city the results pointed on the negative linear correlation with value (-0,95). This is very typical case for many German, Polish, Slovak, Czech or Hungarian rural areas.This means that the villages that are closer to the city have also increasing of population then the villages wchih are far way.

Second group of travel demand is characterised by low populated areas where people are not able to provide adequate demand for regular public transport operation.

In order to solve this we can see various approaches. First consists in development of regular operation based on the short and regular interval supported by integrated pubkic transport organisation. This is mainly for rural areas where the population is increasing. The population in these rural areas can benefited from the proximity of economically strong cities.

The second approach is suitable for less populated areas consists in creation of good condition for development either the public transport service on demand so called Demand responsive Transport (DRT) or combination of individual transport (cars, bikes) and PT. For rural areas with low transport demand are also suitable various forms of. Some studies, for instance (Chang et. Al,2015) already tested the propensity of such kind transport in rural area.

The following text presents some interesting cases and examples of such kind of approaches.

Czech republic

In some rural regions (Orlické hory, Podhorlicko) [36] is already in operation the On Demand Bus service. This was caused by irregular demand from the site of inhabitants. Therefore this public transport line have been transformed into line on demand basis(on the phone call). In the timetable is this PT connections indicated with „R“.

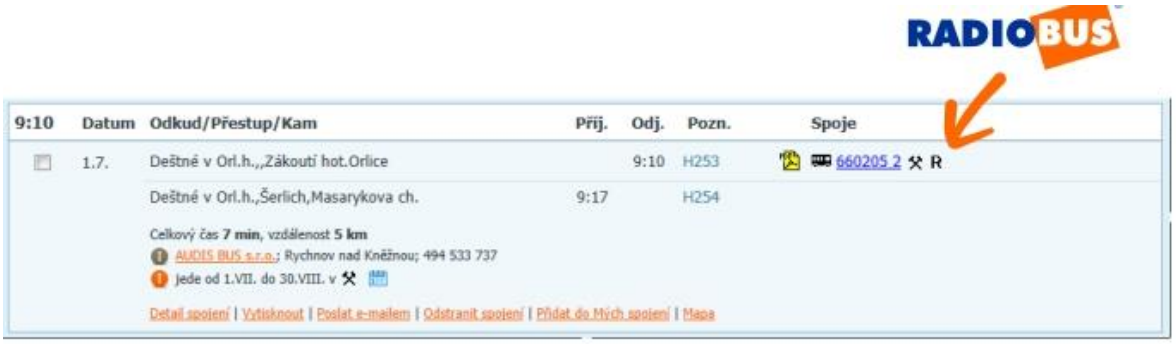

Fig. 35 Indication of On demand bus service in online timetable

Other similar service is in plan close to Brno. [37]

Germany

For instance the Germany has various experiences with irregular or on demand public transport.

- Taxibus Köln - Anruf-Sammel-Taxi (AST) Köln/Dormagen, Langenfeld, Rheinisch-Bergischer Kreis, Rhein-Sieg-Kreis, Bonn, Kreis Euskirchen, Rhein-Erft-Kreis
- Anruf-Linien-Bus Verkehrsgesellschaft Meißen (around Dresden)
- Elbe-Elster region authority organizes DRT in Herzberg, Sonnewalde, Umland und Finsterwalde Neu im Angebot: Anruf-Linienbus
- Hohne village
- Hof city (Bavaria) stadtwerke-hof and vb-bachstein
- Rostock: REBUS = Regional Bus Rostock
- Braunschweig (Nieder Sachsen).

There is various mobility approaches, for instance in Verkerverbund Rottweil where is the operation of the On demand Bus service /Dial a BUS. The operation of such kind of system requires also various financial sources.

The county of Verden provides the investment grant to cover the cost of the bus service. Other funding is realized by administrative district of Verden and the subsidy funds of the Zweckverband Verkehrsverbund Bremen-Lower Saxony (ZVBN) and a grant by the LNVG. The Dial a BUS Niedernwöhren in the county Schaumburg receives a grant from the municipality of Niedernwöhren from annual grant. The citizens bus in the town of Rehburg-Loccum in the District of Nienburg / Weser is subsidized by the city. The citizen bus in the

administrative district Emsland is co-financed by the county Emsland. In the district of Rotenburg (Wümme), the citizen 's bus is operated with grant from region, the county and the municipalities, in the county.

On the contrary in some countries as Albania, Bulgaria, Romania, Montenegro are presented the collective for of public transport based on the basis of collective taxi or so called Marschrutka, Maxitaxi. This service is operated on the free market without any regulation, but just on the irregular base.

United Kingdom
Also in UK have in operation On demand bus operation serving the rural communities. For instance the CallConnect (Lincolnshire), Ring'n'Ride serving the passenger in Great Manchester, Nippy Bus (Somerset), Scarborough Dial A Ride (North Yorkshire). [54-56]

France
In France are also demand responsive transport mainlz for disabled or passenger with mobilitz problems. There are also service based transport on demand in Romans and Bourg-de-Péage. [57]

Poland
The first ever demand responsive transport scheme in Poland - called Tele-Bus - is operated since 2007 in Krakow by MPK, [58] but it serve mainly in the city and surrounding.

Italy

Also in Italy are some examples of testing the Demand responsive transport in cities as Rome, Milan, Genoa, Florence, as well as in several mid- to small-size towns such as Alessandria, Aosta, Cremona, Livorno, Mantova, Parma, Empoli, Siena, Sarzana. But this service is mainly focus on urban enviroment.

The new travel patterns in rural areas

It is clear that the socio demographic changes mentioned above generate the new demand of specific passenger groups. It is also important to evaluate the various types of rural areas and the minimum transport needs for them.

There are also some approaches [41] which focused on the minimum transport needs rural households. Some institution [42] already classified also such kind of areas as following:
urban (sparse);

- urban (less sparse);
- rural town/town and fringe (sparse);
- rural town/town and fringe (less sparse);
- village (sparse);

- village (less sparse);
- dispersed/hamlet and dispersed (sparse); and
- dispersed/hamlet and dispersed (less sparse).

Each of mentioned areas can generate the various types of travel groups but in general we can group them in following groups:

- inhabitants in rural areas without ownership of individual means of transport (.ie. cars),
- inhabitants with specific mobility needs (disabled, handicapped, etc.)
- inhabitants in low densed/populated areas which need to commute on daily basis (school children students, commuters, etc.).,
- inhabitants who travel irregular (pensioners, etc.),
- tourists which consider particular rural areas interested from any reason and they need to transport,

These groups require the different transport supply, mainly based on the specific demand [47]. The high dependency on cars is mainly caused in rural areas with now adequate public transport service or information about service.

The lack of efficient passenger information systems in rural areas may reduce the use of public transport and increase car ownership. Therefore, a sophisticated passenger information system, which can take into account the above mentioned problems, is required. It is a challenge to provide accurate, current information on arrival and departure times particularly in rural areas. Passengers from suburban, rural and remote areas need more reliable and sophisticated travel information compared to urban areas; because, unlike in urban areas, passengers in rural areas are provided with very limited transport facilities, generally make longer journeys. There is also call for new annovative form of public transport service based on the demand basis or combination of individual transport and public transport.

4. Conclusions

This working paper has focused on the problematic of the new travel patterns resulting from changes in socio-demography. We can see that especially in rural areas with low densed population is the solving of this issue very action with regarding of providing the public transport supply. Adequate transport supply can be successful if we know travel behaviour needs in particular areas. In general travel behaviour focuses mainly on issues such as when and where peoples travel and how people use the transportation. In general the public transport is used by general public. The service should be universal and offered for any passenger. But in reality there is difference between urban and rural areas. The urban areas are characterised by high density, but the rural areas are characterised low density which caused

also the lower demand. And the demand is linked to the transport supply what means that in rural with very low densed areas is public transport supply very low.

Therefore there is the research challenge to find out the relationship among various parameters and public transport supply. On this basis it is possible to obtain the concrete idea of how people react to changes in transport systems and policies. Generally, travel behaviour depends on three main factors, which include other variables (Table 14).

Table 14 The main factors affecting travel behaviour of the population

Travel Components	**External factors: Policy, economic, physical environment while people are travelling**	**Internal factors: Characteristics of travellers**
Trip purpose (Activity choice) Travel mode choice Travel time Travel cost Travel distance Trip frequency	Built environment Infrastructure Transit service quality Transport policy Economic situation Geography/Morphology	Income Car ownership Possession of drivers‘ licence Working status Gender Age group Household composition Level of education Attitudes Personality type Volume of passenger Trip purpose

Future planning and policy interventions are crucial in addressing the new challenges deriving from the key drivers. To meet the traveller needs of an ageing population the transport system needs to be adapted to cope with the reduced physical and cognitive capabilities of elderly. Transport policy measures are supposed to increasingly address the characteristics and the needs of the future population in order to support both private and collective mobility of elderly as long as possible.

An important issue is related to the organisation of public transport. The good experiences proved that one of the good approaches is integration of public transport systems, which will have positive effect mainly for rural areas.

As urbanization and suburbanization continue to be a relevant phenomenon, urban and suburban transport networks must be properly planned to face an increasing number of people that will travel in and across urban and suburban centres. Measures to tackle congestion, air pollution and noise will be applied more and more in metropolitan and urban areas, but in

rural areas is crucial to solve the basic transport offer or suplly. Therefore public transport has to be properly planned and subsidised in order to satisfy the potential increase in demand.

There can be also important to integrate the soft mode of transport (i.e. walking and cycling) in enhancing the mobility to and from rural areas or in combination with new public transport service.

Awareness campaigns and training on environmental issues, already proved to be cost-effective, should become a major priority for policy makers.

Future transport planning should take account of the possibility for the transport systems to be severely affected by extreme weather conditions and disruptive events in order to develop some resilience to these aspects and to prevent major damage from services and network interruptions.

It is up to all policy levels (European, national and local) to take into account all the challenges deriving from expected trends and exploiting all the potential in order to satisfy future traveller needs and to drive the changes on a sustainable track. It si important also start to solve the problem of suitable public transport service or sustainable transport in rural areas.

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