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**Jan Fidrmuc (Brunel University and ISA, ÚV SR)**

**Kristína Gardoňová (ISA, ÚV SR)**

**Martin Hulényi (ISA, ÚV SR)**

**Alexandra Lešková (Economic University in Bratislava and ISA, ÚV SR)**

**Veronika Zlaczká (ISA, ÚV SR)**

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# Mind the Gap: Macroeconomic Analysis of the Investment gap in Slovak regions\*

Jan Fidrmuc<sup>†</sup>, Kristína Gardoňová<sup>‡</sup>, Martin Hulényi<sup>§</sup>, Alexandra Lešková<sup>\*\*</sup> and Veronika Zlaczka<sup>††</sup>

## Abstract

In order to set the priorities for state aid programs, the European Structural and Investment Funds, as well as other social and economic policies of a country, it is crucial to know the current state of the economy, and the gap that separates it from the desired state. In this analysis, we evaluate the relative performance of the Slovak Republic in eleven areas: Socio-economic situation, Demography, Agriculture, Environment, Transport, Digital economy, Education, Tourism, Healthcare, Research and Development and Crime. We perform this assessment for Slovakia at the national as well as at the regional (NUTS 2) level. Slovakia and its regions are compared with two weighted averages of selected European regions: first, regions which are at similar level of economic development as Slovak regions as identified using the synthetic control method (SCM), and, second, selected regions of Western and Northern European countries, chosen so as to constitute a benchmark, which Slovakia should aim to achieve in the long run.

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<sup>†</sup> Correspondent author. Department of Economics and Finance, Brunel University London; Institute for Strategy and Analysis (ISA), Government Office of the Slovak Republic; University of Social and Administrative Affairs, Havířov; CESifo Munich; Rimini Center for Economic Analysis (RCEA); and Global Labor Organization (GLO). Email: jan.fidrmuc@brunel.ac.uk or jan@fidrmuc.net. Phone: + 44-1895-266-528, Web: <http://www.fidrmuc.net/>.

<sup>‡</sup> Institute for Strategy and Analysis (ISA), Government Office of the Slovak Republic, Email: kristina.gardonova@vlada.gov.sk.

<sup>§</sup> Institute for Strategy and Analysis (ISA), Government Office of the Slovak Republic, Email: martin.hulenyi@vlada.gov.sk.

<sup>\*\*</sup> Institute for Strategy and Analysis (ISA), Government Office of the Slovak Republic; Department of Public Administration and Regional Development, University of Economics, Bratislava, Email: alexandra.leskova@euba.sk.

<sup>††</sup> Institute for Strategy and Analysis (ISA), Government Office of the Slovak Republic, Email: veronika.zlaczka@vlada.gov.sk

## 1 Introduction

In order to set the priorities for state aid programs, the European Structural and Investment Funds, as well as other social and economic policies of a country, it is crucial to know the current state of the economy, and the gap that separates it from the desired state. Knowing that the country is approaching the desired state or, on the contrary, is very distant from it, should have an impact on the priorities of public investment. Likewise, it is also important to know the rate at which the country has progressed towards achieving set targets. Such knowledge can be used to evaluate past policies and to formulate plans and strategies for the future alike.

In this analysis, we aim to develop a methodological framework for analyzing a country's standing by means of measuring its relative rather than absolute performance. Our analysis proceeds in two steps. First, we select a suitable benchmark. We perform this step at the regional (NUTS 2) level for the 4 Slovak regions as well as for Slovakia as a whole. The benchmarks are two weighted averages of other EU NUTS 2 regions: a weighted average of regions at similar level of economic development, chosen by means of the synthetic control method (SCM), and a weighted average of regions from developed countries of Western and Northern Europe. The former serves to assess how Slovak regions are performing relative to what could be referred to as their peer regions, while the latter is used to assess their distance from an ideal, long-term, target. We evaluate performance in eleven areas: Socio-economic situation, Demography, Agriculture, Environment, Transport, Digital economy, Education, Tourism, Healthcare, Research and Development, and Crime.

In the next section, we offer a short overview of the available literature that inspired our approach. Section 3 explains our methodology and data sources. Section 4 discusses the results of the evaluation. In the final section, we offer a summary of our results.

## 2 Literature review

In our analysis, we follow the so-called Finnish model. The Finnish approach focuses on evaluating and monitoring performance of a country's economy over time with respect to a number of indicators. To this end, Statistics Finland and the Finnish Prime Minister's Office developed and regularly publish the so-called *Findicator*, assessing Finland's performance with respect to over a hundred indicators. A different, alternative, approach, is pursued by the OECD (2017), which centers on assessing relative rather than absolute values of selected indicators. These are compared to the average of OECD countries. Our approach, which we explain in the next section, combines these two approaches.

*Findicator* has been designed to monitor the level and trends of objective and subjective indicators of quality of life and sustainable growth in Finland. The database of indicators was compiled after consultation with experts and potential users linked to policy decisions, and covers eight areas closely related to prosperity: material living conditions, individual economic activity, healthcare, education, leisure time and social interaction, economic and physical security, public administration and fundamental rights and environmental issues (Finland Statistics, 2014).

Following the *Findicator*, Vapaavuori et al. (2013) analyzed the long-term challenges and opportunities of the country, and outlined a common vision of the Finnish government. This document also identified the key to sustainable growth by 2030, which is the result of an analysis of assumptions and strengths in the context of requirements and objectives of the government to create a good place for living a meaningful and valuable life based on economic growth and well-being. Vapaavuori et al. (2013) identified key priorities for the future development of Finland, including: favorable business environment for all types of businesses, employment, education, community life and participation. In terms of supporting the development of the business environment, Finland sees opportunities

especially in the growth of medium-sized businesses, support of start-ups and the setting of appropriate incentives for all types of businesses.

On the other hand, the challenge is to remove legislative barriers to the entry of new businesses. The labor market, education and social security system must create a solid foundation on which each individual can contribute to socially sustainable development of a country. It is also necessary to pay special attention to young people and to prevent social exclusion in this group. In view of the changes that working life brings about, reforms of working life are also needed in the context of the boom of digital economy.

The key sources of growth and prosperity in the future include a high standard of education and competence. In order for the education system to meet the future labor market needs, it will be necessary to ensure its continuity and development. It is also necessary to maintain and deepen trust between citizens and various actors in the society. In the digital economy, division of labor between citizens, local authorities and the government must be revised and predefined. Every individual must have equal opportunities from education to public services.

OECD (2017), in its analytical report published every two years, captures the state and development of the socio-economic situation and prosperity in 41 countries based on 50 subjective and objective indicators that cover the present state and resources for the future. The OECD approach to the measurement of well-being is based on recommendations of Stiglitz et al. (2010) and on inputs provided by the national statistical offices. Three assumptions underlie the analysis: people, individuals are in the center of evaluation, with focus on households and their living conditions and subjective assessment of their well-being. The emphasis is on assessing welfare (both objective and subjective). The distribution of welfare outcomes among the population is perceived as an important element that shapes the well-being of a society, including disparities related to age, gender, education and income. The evaluation also included the Slovak Republic. The results point to the fact that the performance of the Slovakia depends on the observed dimension. Material conditions, quality of the environment and governance are areas where gaps exist and need to be given increased attention.

Slovak performance falls short of the OECD average in terms of net household income, long-term unemployment, life expectancy, as well as, subjective evaluation of health. On the other hand, education and skills of the adult population or the personal safety exceed the OECD average. A favorable trend can also be seen with respect to the number of murders. The study, in particular, points to many inequalities that contribute to deepening gaps between the successes and opportunities of an individual across various dimensions of well-being.

An alternative to assessing the relative standing are quantitative calculations of the investment needed to achieve a predetermined desired state. An example of this approach is Woetzel et al. (2016), who calculate the global infrastructure gap. The authors find that between 2016 and 2030, the world needs to invest around 3.8% of GDP or an average of USD 3.3 trillion a year to support the expected magnitude of growth.

Dauderstadt (2015) compares and evaluates 11 proposals and institutional measures intended to close the European investment gap. Their analysis shows that the differences between the proposals are remarkable, but most of them share a common emphasis on saving, financing, institutional arrangements and the areas in which they invest. Most proposals aim to mobilize between EUR 100 billion and EUR 300 billion of private capital annually through the use of funds from the EU budget, the government budget, the European Investment Bank (EIB) or new public investment funds. This capital is to be transferred to long-term projects, covering in particular infrastructure and energy. The study highlights the shortcomings and possible risks of these measures, in form of the unwillingness of private investors to engage in these projects, delays in the impact of the investment on economic growth and the shortcomings in the regional attribution priorities. On the other hand, it emphasizes the fact that, despite these inadequacies and possible risks, the measure will support growth and

employment to the extent that the demand creates demand and at the same time there should be secondary and multiplier effects on consumption.

### 3 Methodology and data

In our analysis, we assess the socio-economic development of Slovakia as a whole as well as of its individual regions (at the NUTS 2 level). We begin with the evaluation at the regional level, from which we then deduce the assessment for the whole country. For each Slovak NUTS 2 region, we have created two weighted averages of selected EU NUTS 2 regions for the purpose of comparison. The first weighted average, the so-called "clone", is composed of EU regions that currently are at a similar level of socio-economic development as their Slovak counterparts. The second weighted average, which we refer to as the "target", represents the level which the Slovak regions should aspire to achieve in the future. While the clone is unique for each Slovak region, the target is the same for all regions.

The regions forming the clones of Slovak NUTS 2 regions were selected by using the synthetic control method (SCM). The SCM method allows us to construct a weighted average of the regions included in an original pool of observations (in our case, all regions in the EU), which copies the development of per-capita GDP of the selected Slovak region<sup>1</sup>. The composition of the clones of the Slovak NUTS 2 regions is presented in Table 1. As can be seen, the clones are mostly composed of the regions from South Europe and the new member states. Often, these are regions of similar nature as the cloned Slovak region. For example, the clone of Bratislava region consists mainly of other urban regions: Budapest, Prague, Bucharest, Sofia and Bremen. In general, the largest weights are attributed to regions from other countries of the Visegrad Group<sup>2</sup>, Bulgaria and Romania.

The Slovak regions' target value was calculated as the weighted average of Western and Northern European regions, which are similar in size (in terms of population) to Slovak regions (0.6-1.8 million inhabitants). The shares used to calculate the weighted average reflect the number of inhabitants of each region. In order to include also a French region, Bretagne is in the target group despite having a much higher number of inhabitants, 3.29 million, than the Slovak regions. The largest overall weight is given to regions from Germany reflecting the economic importance of this country within the EU.

In order to compare the economic development of Slovak regions with their clones (comparison groups), we rely on relevant data from the Eurostat regional database. These data cover eleven areas: socio-economic situation, demography, agriculture, transport, digital economy, education, tourism, healthcare, research and development.

Some data were missing in the Eurostat database, therefore we retained only the indicators with missing values accounting for less than 30% of the observations. To reduce the number of missing values, we applied imputation. This method creates a new sample from existing data using repeated selection and using the trend for the region concerned to fill the gaps. For example, Fig. 1 shows an imputation of Live bovine animals per 1000 inhabitants of the Belgian region of Antwerp. In this figure, black dots indicate the available data, while red lines show the ranges of imputed values replacing the missing data in repeated simulations. As you can see, the average of multiple simulations (red points) can constitute a relatively accurate estimate of the missing data point.

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<sup>1</sup> See the detailed discussion of the SCM in Appendix C.

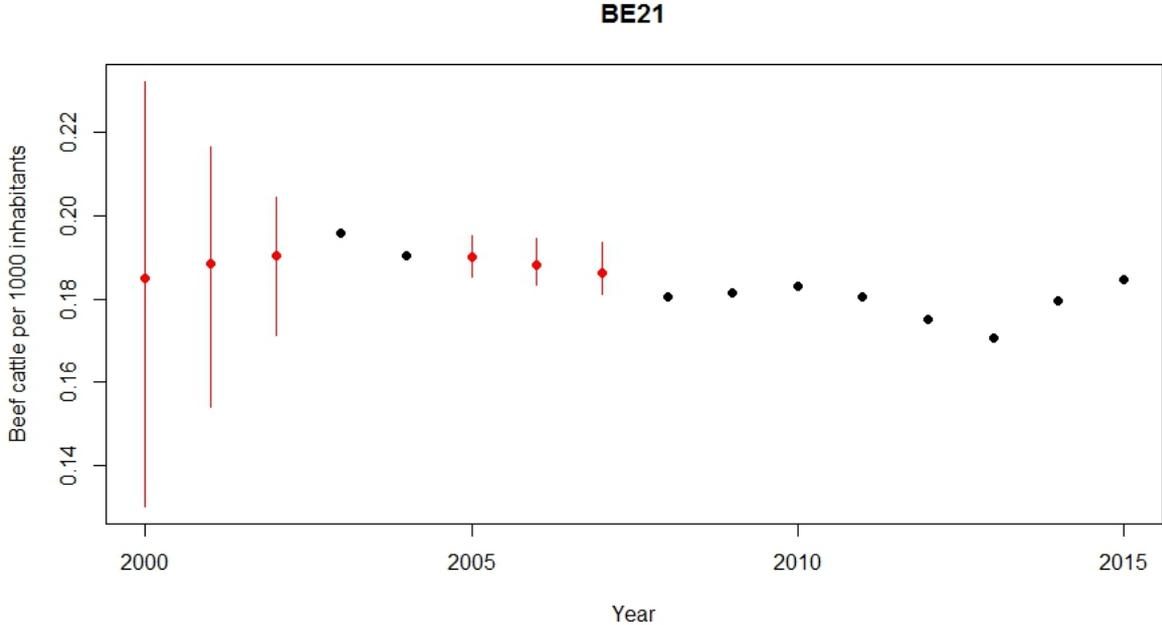
<sup>2</sup> This group includes the Czech Republic, Hungary, Poland, and Slovakia.

**Tab. 1 The composition of the clones and target for Slovak Regions**

Slovak Region	Group	
	Region name	Share
Bratislava Region	Közép-Magyarország (HU)	54 %
	Bremen (DE)	17,3 %
	Praha (CZ)	10 %
	South Aegean (EL)	8,3 %
	București – Ilfov (RO)	5,8 %
	Yugoiztochen (BG)	2,2 %
	Śląskie (PL)	0,5 %
	Yugozapaden (BG)	0,1 %
	Åland (FI)	0,1 %
	Sud-Est (RO)	0,1 %
	Vest (RO)	0,1 %
Western Slovakia	Dolnośląskie (PL)	50,7 %
	Moravskoslezsko (CZ)	23,3 %
	Sud – Muntenia (RO)	19,3 %
	Dytiki Makedonia (EL)	3,8 %
	Castilla-La Mancha (ES)	1,8 %
Central Slovakia	Świętokrzyskie (PL)	43,3 %
	Yugoiztochen (BG)	27,6 %
	București – Ilfov (RO)	14,5 %
	Cantabria (ES)	4,9 %
	Moravskoslezsko (CZ)	4,5 %
	Sud-Est (RO)	3,3 %
	Vorarlberg (AT)	0,3 %
	Střední Čechy (CZ)	0,3 %
	Śląskie (PL)	0,3 %
Eastern Slovakia	Észak-Magyarország (HU)	37,5 %
	Severoiztochen (BG)	36,1 %
	Dolnośląskie (PL)	20,6 %
	Canarias (ES)	3,9 %
	Andalucía (ES)	1,8 %
Target group	Bretagne (FR)	17,66 %
	Västsverige (SE)	10,37 %
	Tübingen (DE)	9,75 %
	Antwerpen (BE)	9,67 %
	Liguria (IT)	8,54 %
	Oberösterreich (AT)	7,68 %
	Länsi-Suomi (FI)	7,39 %
	Midtjylland (DK)	6,88 %
	Utrecht (NL)	6,74 %
	Kassel (DE)	6,57 %
	Oberpfalz (DE)	5,9 %
Trier (DE)	2,84 %	

Source: Own calculations based on statistical data of Cambridge Econometrics Regional Database

**Fig.1 Imputation of missing values for region Antwerp**



Source: Own calculations based on Eurostat data

However, if the entire series was missing for a particular region or there was only one available data point, imputation was not possible. Overall, we have reduced the share of missing values to 14% by using this method.

Finally, we compute the ratios of Slovak regions’ values with respect to a broad range of indicators to the weighted average of the comparison group (clone) and the target group (target). If higher values of a given variable indicate worse outcomes (for example, the number of victims in road accidents), we calculated the ratio of the target and the comparison group to the value of the Slovak regions, that is, we inverted the ratio. The reason for this is to maintain the same intuition in interpreting the results - the higher the value, the more favorable situation for the Slovak regions. The following section describes these results.

**4 Results**

We present the results of our calculations in two sets of graphs. The first set of graphs are in *Appendix A: Analysis of the situation in 2015*, broken down by region. These charts refer to year 2015, the last year for which data is available. The gray unit line represents the situation when the development of the Slovak region is the same as that of the comparison or target group. The blue and orange n-gon then show the Slovak values in relation to the target or comparison group of regions respectively. If the ratio of the Slovak region and the target group (blue n-gon) is greater than 1 for a particular indicator, the corresponding n-gon lies outside the gray n-gon. This means that the Slovak values exceed those of the target group. The same rule applies to the comparison group (orange n-gon). Conversely, if the blue (orange) n-gon lies inside the gray n-gon, it means that the Slovak values are worse than the values of the target (comparison) group.

The second set of graphs can be found in *Appendix B: Analysis of selected indicators*, where we compare the development in four Slovak regions over the last 15 years, for each variable separately. The variables are divided into nine areas identical to those listed in Appendix A. The development in

Slovak regions is compared with the comparison group or target group, which are represented by the gray unit line. The ratio of the Slovak region to the comparison or target group is then depicted by the color-coded lines representing the four regions and Slovakia as a whole. If the Slovak region achieves better results than the comparison or target group, the color-coded line indicating this region will be above the grey unit line.

For most variables, the higher the value of the region, the better the result. However, for some variables, such as *Victims of road accidents*, or *At-risk-of poverty rate*, low values indicate favorable outcomes. To ensure consistent interpretation of the graphs, we have inverted those variables. The graphs depicting inverted indicators are denoted by an asterisk.



## 4.1 Socio-economic situation

The most commonly used indicator of the economic situation of a region is GDP per capita. We use *GDP per capita in current market prices*. In section 1.B we report the development of this indicator, as well as, other related variables selected for our analysis. We observe steady improvement in this indicator in all regions over the period covered by our data, and since 2006, all regions show better results than the comparison group. Bratislava region has a significant lead. Compared to the target group, all regions are significantly lagging behind, but *GDP per capita at current market prices* is close to the unit line for the Bratislava region. Other regions, including the average for Slovakia, are deeply below the average level of the target group.

The other two sets of socio-economic indicator graphs show inverted values. Naturally, we would want to see low values of the *Severe material deprivation rate*, and *At-risk-of poverty and social exclusion rate*. For the variable *Severe material deprivation rate*, we only have data for the Bratislava region and Western Slovakia. We see that the Western Slovakia region is doing very well, reaching more than 2 times the values of the comparison group (as we have inverted this indicator, it means that this corresponds to half of the value in the comparison group). On the contrary, the situation in Bratislava region has been deteriorating since 2009 as the *Severe material deprivation rate* is increasing. Looking at the graph of the target group, we can see that the situation in all Slovak regions, as well as in Slovakia as a whole, is improving.

The rate of population at risk of poverty or social exclusion as % of population, in the graphs labeled as *At risk of poverty rate*, has declined in Western, Central and Eastern Slovakia regions. However, similarly to the previous variable, since 2009, the Bratislava region has experienced a significant decay compared to the comparison group: increased numbers of people in the Bratislava region are threatened by poverty or social exclusion. Eastern Slovakia region is performing best in this regard. It has seen the greatest improvement, compared to the comparison group, since the beginning of the period under review.

By comparing the Slovak regions with the target group, we can see similar historical development: until mid-2000s when the Bratislava region briefly overtook the target group.

The spider charts in Section 1.A show that the best performing region is Western Slovakia, which attains 1 to 2 times the values of the comparison group in all the indicators surveyed. However, compared to the target group, this region lags behind in *GDP per capita in current market prices* and *Severe material deprivation rate*. For Central and Eastern Slovakia, some data were missing, but we can see that Central Slovakia currently achieves very good results in the *GDP per capita in current market prices* compared to the target group; and the Eastern Slovakia region managed to reduce *At-risk-of poverty rate*, compared to the comparison group. In this case, the graphs were again inverted to enable better interpretation of results.



## 4.2 Demography

Section 2.B provides an overview of the evolution of selected indicators in the area of demographics compared to the comparison and target groups. With respect to the *Life expectancy* indicator, the region of Eastern Slovakia has been long showing the best results. When comparing the Slovak regions to the comparison group, we can see that despite very small variations, the Eastern Slovakia region has been above the level of the comparison group since the beginning of the period under review, both for men and for women. The *Life expectancy* for men in the Bratislava region and in Western Slovakia, especially in recent years, is close to the comparison group, with the Central Slovakia region slightly lagging behind. Most significant improvement in *Life expectancy of women* can be seen in the Bratislava region since 2010.

Despite the fact that Bratislava region comes closest to the target group, it, all regions, and Slovakia as a whole, continue to lag behind the target group.

The indicator *Live births per 1000 inhabitants* shows larger, but not extraordinary, differences between the Slovak regions and the comparison group. The largest increase is registered in the Bratislava region. Eastern Slovakia has remained above the level of its comparison group throughout the period.

When considering performance relative to the target group, the Bratislava Region has recorded a steady improvement, moving from the lowest level among the Slovak regions to the highest level and currently achieves significantly better results than the target group together with the Eastern Slovakia region. Western Slovakia has been slightly below the target group for a long time, while Slovakia, as a whole, is similar to the target group.

The spider charts for 2015 in Section 2.A show that Western and Central Slovakia regions are lagging behind the target group, even though the distance to reaching the unit line is not huge. Compared to the comparison group the indicator *Live births per 1000 inhabitants* shows that regions of Eastern Slovakia and Bratislava region are doing slightly better than their respective comparison groups in 2015. Overall, the regions of Central and Western Slovakia reach worse results, but it is still necessary to keep in mind that the variations on the scale for this set of graphs are minimal and, therefore the deviations of the real numbers are not significant.



## 4.3 Agriculture

Within the agriculture sector, we focused on six main indicators: *Live bovine animals (per 1000 inhabitants)*, *Production of cow's milk (in tons per 1000 inhabitants)*, *Cereals for the production of grain (per 1 km<sup>2</sup>)*, *Economic accounts for agriculture in basic prices (million euro per capita)*, *Share of farm area to total area of the region (ha)*, *Number of people employed full-time on farms (per inhabitant)*. Looking at charts in Section 3.B, we see that there is a great diversity of results, both between the compared Slovak regions and in relation to the target group.

Regions of Western and Eastern Slovakia focus on cattle breeding. In the graph *Live bovine animals*, we can see that all four Slovak regions have very good results compared to the comparison group. However, all regions of Slovakia lag very behind the target group, even the Bratislava region is able to breed only one tenth of the number of *Live bovine animals* of the target group.

*Production of cow's milk* in the Western Slovakia region reaches 2.5 times the value of production of dairy products in the comparison group, with above-average developments, with the exception of short-term output declines in 2003 and 2008. Short-term declines in dairy production in Western Slovakia were offset by increased production in the Central Slovakia region. The Central Slovakia region holds a similar level of production as the comparison group. Since 2000, the region of Eastern Slovakia has recorded an increase in production and is currently approaching the comparison group. Bratislava region has long-term better results than the comparison group.

The target group chart shows the relative backwardness of the development of Slovak regions and Slovakia as a whole. On average, Slovakia achieves about one third of *Production of cow's milk* compared to the target group. The lowest values are recorded in the Bratislava region, on the other hand, the Western Slovakia region is closest to the target group.

The indicator *Cereals for the production of grain* show better results for the Slovak regions. The regions of Bratislava and Western Slovakia have long-term better results than the comparison group, which is not surprising given the nature of the geological base and the flat surface on which the regions are located. The regions of Central and Eastern Slovakia, on the other hand, lag significantly behind the comparison group.

In comparison with the target group, Western Slovakia region is the best performer; it is known for the cultivation of agricultural crops and in the past it reached up to 2 times the value of *Cereals for the production of grain* of the target group level. In the long run, due to the different geographic profile, the region of Central Slovakia is below the target group level. In all regions, but more noticeably in the Eastern Slovakia region, we are recording a decline in the trend of the indicator of *Cereals for the production of grain*. Bratislava region stays the worst performer when looking at the target group graph, which may reflect its urban nature.

In graphs showing *Economic accounts for agriculture in basic prices in million euro per inhabitant*, we can see a favorable development in the Bratislava region and Western Slovakia region compared to the comparison group. On the other hand, Central Slovakia and Eastern Slovakia do not even reach half the level of their respective comparison groups. Compared with the target group, the most favorable situation is in the Western Slovakia region. Other regions do not reach the target group level.

The indicator *Share of farm area to total area of the region* shows the most favorable results for the regions of Central and Western Slovakia compared to the comparison and target groups. Eastern Slovakia and the Bratislava region are performing worse in comparison with both groups. However, it is worth pointing out that in the last two years of the analyzed period the Bratislava region has achieved better results than the target group. A survey conducted by Eurostat pointed to the fact that, while the number of agro-farms in Slovakia is low, the Slovak Republic was ranked third in the average farm size. The average agricultural area thus reaches 80.7 ha.

*Number of people employed full-time on farms from total population* has been developing below the relevant comparison groups of all Slovak regions. Values for this indicator range from 0.2 to 0.5. Compared with the target group, the situation is more favorable. Central and Western Slovakia are better than the target group; on the other hand, Eastern Slovakia and the Bratislava region have not reached the level of the target group.

From the graphs in Section 3.A, we can see that the worst among the Slovak regions is the region of Central Slovakia, which has a lower ratio to the comparison and target group than other Slovak regions. The best situation in the agricultural area is in Western Slovakia, where most of the indicators exceed their comparison and target groups.



## 4.4 Environment

In the field of environmental issues, we found available and relevant data for three indicators: *Generated waste at 1000 tons per capita*, *Recycled waste at 1000 tons per capita* and *Cooling degree days*, which means the number of days when the temperature is above a certain threshold, with air-conditioning of buildings having an impact on energy consumption.

Eurostat records data on the number of Heating degree days, the territorial coverage of waste disposal services or the abstraction of fresh water on the territory of the individual regions, however these data are largely unavailable. Similarly, we do not have access to data that is relevant to the environment, such as air pollution, at regional level.

In order to interpret the results in a consistent manner, we inverted the indicators *Generated waste at 1000 tons per capita* and *Cooling degree days*, i.e. values for a given region that are greater than 1 represent values more favorable than the ones of comparative or target group. By analogy, values lower than 1 represent a worse situation than in comparison or target group.

The development of individual indicators is shown in the charts in Section 4.B. The graphs of the comparison and target group of the indicator *Generated waste at 1000 tons per capita* show that Eastern Slovakia achieves the best results, which means that it has the lowest amount of waste produced per inhabitant.

Both charts share the same trend curve, with a significant improvement seen from 2013 in the case of the Eastern Slovakia region as well as other regions, with the exception of the Western Slovakia region with respect to the comparison group. In the beginning of the monitored period, the Central Slovakia region was below the level of the comparison group, but it caught it up by 2002. Slovakia as a whole is above average in terms of the *Generated waste at 1000 tons per capita* as it exceeds its target group by 1.5 to 2 times. The worst among Slovak regions is the Bratislava region, although it still achieves better results than the target or comparison group.

The indicator *Recycled waste at 1000 tons per capita* is directly linked to the indicator *Generated waste at 1000 tons per capita*. The indicator *Recycled waste at 1000 tons per capita* has no longer been inverted, as our goal is to have as much recycled waste as possible from the waste already produced. Data for the Western Slovakia and Central Slovakia regions for the years 2000 and 2001 were omitted on purpose due to the extremely high reported values. At the present time, we cannot explain why these regions have reached values of 10 to 15 times their comparison groups, but we suppose that this was related to trying to meet the EU accession criteria. We can see that after 2004, these values have stabilized at just below the unit line relative to the comparison group. Apart from the Central Slovakia region, no other Slovak region has exceeded its comparison group. Hence, we can state that the Slovak regions are lagging behind in sorting and recycling of waste. We see this also in the development of the target group chart, where all regions, including Slovakia as a whole, reach extremely low values, around one tenth of the target group's value.

The *Cooling degree days*' variable is very unlikely to be affected, as the increase in the need to air-condition the buildings is also due to global warming, but we have intentionally inverted this variable, as the regions want to spend as little energy on air-conditioning in the summer as possible. On the graphs of both the comparison and the target group, it can be seen that the highest values are achieved in the regions of Eastern and Central Slovakia. In these regions, therefore, there are fewer air-conditioned days than in their respective comparison or target groups. We can see that the Bratislava region and the Western Slovakia region have similar values as the comparison groups, with the

situation in the Bratislava region in the last year under review being positive in the context of reducing energy consumption.

We can assume that there are more new buildings in the West of Slovakia, while other regions still use older premises whose construction does not require air-conditioning; in addition, they have a mountainous relief, where temperatures do not reach high values in the summer, as it is in the case of the lowlands of Bratislava or Western Slovakia regions. This indicator has been included in the environmental field only as a matter of curiosity, rather than with the aim of setting some goals in order to reduce the number of *Cooling degree days* in Slovakia.

As illustrated in Part 4.A, the best values among the environmental indicators in the last year of the analyzed period were recorded by the Central Slovakia Region, which outperformed its comparison group in all three indicators. The region has 2.5 times exceeded its target group in the indicator *Generated waste at 1000 tons per capita*, however, this does not hold for the remaining indicators, especially *Recycled Waste at 1000 tons per capita*, where the Central Slovakia region, as well as other Slovak regions, have very poor results compared to the target group.

One possible reason is the inclusion of the regions of Western and Northern Europe in the target group, where waste has been recycled for longer period of time than in Slovakia and people's awareness of waste sorting is higher. The Western Slovakia region showed the worst environmental performance in 2015, which lags behind all its benchmarks, and has only outpaced its target group in the indicator *Generated waste at 1000 tons per capita*. We can say that, within the environmental field, more specifically the waste management, we still have a lot to catch up with.



## 4.5 Transport

The transport sector was monitored using four indicators, namely *Injured in road accidents (per million inhabitants)*, *Victims in road accidents (per million inhabitants)*, *Motorways (per km<sup>2</sup>)*, *Other roads - excluding motorways (per km<sup>2</sup>)*. In order to better interpret the results, we have inverted indicators *Injured in road accidents* and *Victims in road accidents*, i.e. values for a given region that are greater than 1 represent more favorable outcomes than the ones in comparison or target group. By analogy, values lower than 1 represent a worse situation than in comparison or target group.

The development of individual indicators is shown in Section 5.B. Favorable developments for Slovakia and its regions appear with respect to *Injured in road accidents*. From 2011 onwards, all Slovak regions reached levels above the comparison group, with a significant lead of Bratislava region. Significantly good values, over the whole analyzed period, have been achieved by the indicator as compared to the target groups for individual regions and for Slovakia as a whole, and since 2008 the situation has been improving further. Some decline can be seen between 2012 - 2013, however, all regions remain still significantly above the target group.

All Slovak regions reach values around 1 in relation to the comparison group for the indicator *Victims in road accidents*, however, a positive trend can be seen. Since 2008, all regions stayed mainly above the unit line, with the Bratislava region recording the worst results. The best situation has been recorded for Eastern Slovakia. The situation is different when the performance is compared to the target group. The regions were well below the target group during the reporting period, although the Bratislava Region and Eastern Slovakia achieved more favorable values in certain years. In 2015, only the Bratislava region was situated just above 1, the values of other regions, including Slovakia's average, were lower but very close to 1.

As can be seen in the development chart of the *Motorways per km<sup>2</sup>*, in the first five years of the sample period, the Bratislava Region and Western Slovakia reached values above the relevant comparison groups, which may be a consequence of the large-scale highways network building in this period. The situation has changed after 2004, when the values for the Bratislava region became lower than the comparison group and the trend was maintained throughout the monitored period. The regions of Central and Eastern Slovakia showed lower values over the whole period compared to the comparison group. The results for the development of a highway network with a target group point to unfavorable results for the Slovak regions and Slovakia as a whole, with the exception of the Bratislava region.

In the monitored period 2000 – 2015, the indicator *Other roads - excluding motorways* remained close to the values achieved in the comparison groups for all Slovak regions. However, only the Western Slovakia region remained consistently above its clone level. It is worth noting the development in 2000 – 2004, when all Slovak regions exceeded the values of their comparison groups. The downward trend does not mean that the Slovak regions have reduced the length of the road network but reflects the faster construction of motorways in comparison groups. Compared to the target group, the Slovak regions are lagging behind in the long run. Only in 2013 there was a slight improvement.

The spider charts in Section 5.A report the situation in 2015 in each region of Slovakia. The most favorable situation regarding the comparison group is in the regions of Western and Central Slovakia, with respect to all indicators with the exception of *Motorways (per km<sup>2</sup>)*. The Bratislava region and Eastern Slovakia partially lag behind in the indicator *Other roads - excluding motorways (per km<sup>2</sup>)*. Compared to the target group, there were fewer injuries in traffic accidents per million inhabitants, but these regions fall behind in the indicator *Other roads - excluding motorways (per km<sup>2</sup>)*.



## 4.6 Digital economy

The field of Digital economy has been assessed on the basis of three indicators: *Households with access to the internet at home (% of households)*, *Individuals who used the internet for interaction with public authorities (% of individuals who used internet within the last year)*, and *Individuals who used the internet for interaction with public authorities (% of individuals)*.

The development of individual indicators is shown in the charts in section 6.B. The values of the indicator *Households with access to the internet at home* show a decreasing trend in the reference period 2008 – 2015, compared to the countries in the comparison group. All regions, however, reached values above 1 with the exception of Bratislava region in 2014 – 2015. As shown in the chart of the analyzed indicator when compared to the target group, all regions were below the target group level but are approaching this level (Bratislava region even slightly exceeded the target group level in 2012). Apparently contradictory developments with respect to the comparison and target groups reflects the fact that the Slovak regions are close to the level reached in the target group, but they move slower than the regions with a similar level of economic development.

Almost the same development was recorded for the variables *Individuals who used the internet for interaction with public authorities (% of individuals who used internet within the last year)* and *Individuals who used the internet for interaction with public authorities (% of individuals)*. The indicators outlined above show that compared to the comparison group, Western and Central Slovakia reached values above 1 with Western Slovakia reaching 3 times higher values than its respective comparison group. The values of the indicators reached by all regions and Slovakia were markedly below the target group level. In the last years of the analyzed time period, they have significantly diverged from the target group, which points out the scope for building and improving digital tools, as well as the awareness among people about the possibility of using virtual communication with public

authorities. It remains an open question of whether this situation reflects the absence of the necessary digital infrastructure in Slovakia, or a low level of civic activism.

It can be seen from the spider charts in Section 6.A that no region of Slovakia has reached the level of the target group. Western, Central and Eastern Slovakia regions have reached a higher value in the indicator *Households with access to the internet at home* than their relevant comparison groups. Bratislava region is lagging behind in all indicators. Central Slovakia is considered to be the best performer in the category of Digital Economy since it outperforms its comparison group in all selected indicators.



## 4.7 Education

The level of education and training is captured by the indicator *Early leavers from education and training*, in categories: males, females and the total population. The development of individual indicators is shown in the charts in Section 7.B. The values were, also in this case, inverted for reasons of uniform interpretability of results. Higher values in the charts thus mean less early school leaving. For the Bratislava region, there are no data for the category - males, so it has not been possible to compare the results among genders for this region.

Above average development of the values of the analyzed indicators has been recorded for all three categories compared to the comparison and target groups for all regions as well as for Slovakia as a whole. As can be seen from the graphs for individual categories for the comparison and target groups, Western Slovakia has performed best. There is no significant difference in the trend between males and females in school drop-outs. Both, males and females, in the Western Slovakia region dropped school 3 to 4 times less early than males and females in the comparison groups.

The region of Eastern Slovakia is a bit worse off, although it still shows positive values compared to the comparison group. This is the least developed part of Slovakia, with many households living in adverse socio-economic conditions. However, we can see that at the beginning of the monitored period, women in the region of Eastern Slovakia were leaving school early 7 times less often than now.

When looking at the charts with respect to the target group, the region of Western Slovakia stands out again, but only until 2013 when it converged with the other Slovak regions. Again, there is no significant difference in the trend between genders. Perhaps, in the case of the Central Slovakia region, men are experiencing somewhat better results, especially at the beginning of the period under review, but this difference gradually disappears.

It is a peculiar that the worst results compared with both, comparison group and target group, achieves the region of Bratislava in the category of females. We may believe that the middle-sized city affects women worse than other Slovak regions, and therefore women terminate school attendance early. However, the values for the Bratislava region are still better than its respective comparison group, exceeding it almost twice, and they approach the target group.

We can see in the spider charts in Section 7.A that the region of Western Slovakia displays the best results in the category of Education. The Western Slovakia region overtook the comparison group 3 fold and the target group 2 fold. However, due to the lack of data for the Bratislava region, we cannot reach a clear conclusion. The region of Central Slovakia also shows above-average results with respect to the comparison group in all selected indicators and same results as the target group, as the two lines overwrite each other. The region of Eastern Slovakia performs worse, in 2015, than the target group, in all indicators.



## 4.8 Tourism

The following indicators evaluating the field of tourism were selected: *Arrivals of residents at tourist accommodation establishments (per thousand inhabitants)*, *Arrivals at tourist accommodation establishments (per thousand inhabitants)*, *Nights spent at tourist accommodation establishments (per thousand inhabitants)*, *Total nights spent by non-residents at tourist accommodation establishments (per thousand inhabitants)*, *Total nights spent by residents at tourist accommodation establishments (per thousand inhabitants)*. The review of the development of these indicators is presented in Section 8.B.

The development of the indicator *Arrivals of residents at tourist accommodation establishments* showed most favorable development for Central Slovakia region, which has long been above the comparison group level. Recreational centers, the Tatras, which are largely spread over the territory of Central Slovakia, are popular tourist destinations of the Slovak population and surely contribute to the positive development. On the other hand, the development compared to the target group, is significantly lower than 1, which means that all Slovak regions are lagging behind the target group.

*Arrivals at tourist accommodation establishments* in the region of Bratislava, Western Slovakia and Eastern Slovakia hovers around half of the value attained by the comparison group. The exception is Central Slovakia, where the values of the analyzed indicator reached values above 1 in the first decade of the monitored period, and thereafter remained around the unit line from 2011 onwards. Compared to the target group, all Slovak regions are significantly lagging behind with Bratislava region catching up with the target group from 2013 onwards.

Long time development of *Nights spent at tourist accommodation establishments* shows stable results for Western and Central Slovakia reaching the same values as their respective comparison groups and Eastern Slovakia and Bratislava region significantly lagging behind. All Slovak regions and Slovakia as a whole attain value far below the target unit line with a slight improvement in 2015.

Favorable long-run development has been recorded for Western Slovakia in the indicator *Total nights spent by non-residents at tourist accommodation establishments*. It was the only region exceeding the level of the comparison group throughout the whole period under review. Most of the remaining regions stayed around the value 0.3. In the first decade, the region of Bratislava has converged to the target group and since 2011 it has exceeded the values of the target group. This favorable development is also attributed to the fact that Bratislava is the capital city, and thus plays an administrative, political, economic and cultural role, moreover it is a seat to various national and international institutions.

The last indicator, *Total nights spent by residents at tourist accommodation establishments*, shows quite positive results for the comparison group, especially for Central Slovakia for abovementioned reasons of sought touristic destination also by Slovaks, however, looking at the target group we see that all Slovak regions attain only 0.005 times the level of the target group. These are very bad results, showing that Slovak residents, compared with the target group, do not use the home-country touristic opportunities and potential.

The spider web charts for Tourism in Section 8.A for year 2015, point to the fact that all the regions of Slovakia and Slovakia as a whole, did not reach the level of the target group in any of the four indicators monitored. The only exception is the Bratislava region, whose values exceeded the target group level in the indicator *Total nights spent by non-residents at tourist accommodation establishments*. The most favorable development compared with the comparison group was achieved by Central Slovakia, whose values exceeded the comparison group in 3 indicators: *Arrivals at tourist accommodation establishments*, *Arrivals of residents at tourist accommodation establishments* and *Total nights spent by residents at tourist accommodation establishments*.



## 4.9 Healthcare

In the Healthcare sector, 3 indicators were selected: *Crude death rate – except for natural death (% of population)*, *Medical doctors (per 100 000 inhabitants)*, *Pharmacists (per 1 000 inhabitants)*. The variable *Crude death rate – except for natural death (% of population)*, has been purposely inverted, so that higher values indicate more favorable results. Section 9.B provides an overview of the development of individual indicators.

The Eastern Slovakia region maintains the best results in *Crude death rate – except for natural death (% of population)*. In the first decade of the observed period, the region had very similar results to the comparison group. From 2012 onwards, it has even exceeded it 1.1 times. The Western Slovak region started to converge to the level of the comparison group in 2011, and is currently achieving a positive result regarding the comparison group. Bratislava and Central Slovakia were significantly lagging behind the comparison group, but only the Bratislava region managed to improve its position in the given indicator in 2013 and currently it has exceeded the values of the comparison group. The target group chart shows that until 2012 all Slovak regions were below the target group. In 2012, the situation improved in all regions and all, except for Central Slovakia, reached the level of the target group.

In all Slovak regions, the number of *Medical doctors (per 100,000 inhabitants)* is higher than the average of the comparison group. The only exception is Central Slovakia; whose values oscillate around the value of 1. The most attractive results are achieved by Bratislava region, where the number of *Medical doctors (per 100 000 inhabitants)* was up to 1.6 times the level in the comparison group. Compared to the target group, the situation is again most favorable in the Bratislava region, which reaches almost twice the values attained by the target group. Other regions, including the overall value for Slovakia, are below the level of 1, but the worst situation is in Western Slovakia.

The situation is similar in terms of the indicator *Pharmacists (per 1 000 inhabitants)*, at least for the Bratislava region, which achieves above-average values in this indicator. Although the situation has been changing significantly over the years, it has still been above the average of the comparison group. Among other regions, only the Eastern Slovakia region managed to get above the level of 1. Worst values are shown for Central Slovakia. In comparison with the target group, all regions have managed to get closer to or exceed the unit line. Bratislava region significantly exceeded the target group's average - up to 2.6 times.

On the spider charts in Section 9.A, we can see that in 2015 the region of Central Slovakia is clearly the worst off. The Eastern Slovakia region achieves better values than the comparison and target group in almost all indicators, except for *Medical doctors (per 100 000 inhabitants)*. Western Slovakia also lags behind in the same indicator but also in the number of *Pharmacists (per 1 000 inhabitants)*. Bratislava region achieves the same values as the comparison and target groups in all areas, but it particularly stands out in the number of *Pharmacists (per 1000 inhabitants)*.



## 4.10 Research and Development

Seven indicators were used to assess the category of R&D. Graphs of these indicators can be found in Section 10.B.

The first indicator was *Total R&D personnel and researchers as % of active population*. It can be said that all regions over the years 2000 to 2010 achieved better or the same results as their comparison groups, however, there were relatively more employed people in the field of science and technology in

the Bratislava region. After 2010, individual values began to decline in all regions, and the Western and Eastern Slovakia even fell below the level of the comparison group. If we look at the development of the indicator within the target group, we can see that Bratislava region, as the only one, achieved values better than 1. After 2010, however, the relative number of persons employed in the area decreased in all regions. Similar, yet not identical, indicator is *Total R&D personnel and researchers with tertiary education as % of active population*, which yields worse results than the first monitored indicator. Except for Bratislava region, all other regions are lagging behind their comparison groups as well as the target group. Bratislava region attains 0.4 times the value of the target group, other regions show worse results.

Another indicator is *People with tertiary education as % of active population*. The best values are maintained by the Bratislava region, which is above the level of 1, thus above the average of the comparison group. Other regions have a lower number of university graduates than their comparative groups, but the situation has improved significantly in Eastern Slovakia. Compared to the target group, however, all regions, including the Bratislava region, are well below the desirable value.

Within the indicator *Total Intramural R&D expenditure in all sectors as % of GDP*, expenditure on the business sector, government sector and cumulative for both sectors, was monitored. Cumulative values show significant differences among regions. While all regions have been below the levels of the comparison groups since 2006, investments in R&D started to grow again substantially after 2010, especially in Central Slovakia. These are predominantly private business investments, while government spending on R&D remains low. In the area of *Total Intramural R&D expenditure in private business sector as % of GDP*, all regions except for Central Slovakia, have been below the level of the comparison group in recent years.

Government spending differs considerably across regions. While Bratislava region has been oscillating around the unit line, Eastern Slovakia has improved its position in relation to the comparison group, and reached values of 2.5 times the results of the comparison group. In Western Slovakia, on the contrary, a decreasing volume of government spending on R&D as a % of GDP has been recorded since 2007. Looking at the target group graphs, we can state that the total R&D expenditure in our three indicators is below the level of unit line. The only exception here is the Bratislava region, where government spending on R&D is significant, reaching value of 3 times higher than target group, overall causing Slovakia to get closer to the unit line. However, all regions have a significant lack of private spending on science and research.

*Total R&D personnel and researchers in all sectors as % of population* indicator shows a moderately declining trend in Slovak regions, especially since 2010. The best values are, however, reported in Eastern Slovakia. Compared to the target group, it is possible to see a stable pattern: while the Bratislava region oscillates around 0.7, the other regions reach only 0.3 of the value of the target group.

The spider charts in Section 10.A show that the worst results can be observed in the Western Slovakia region, both relative to the target and comparison groups. The only exception is *Total Intramural R&D expenditure in all sectors as % of GDP*, while the most problematic areas are *Total Intramural R&D expenditure in private business sector as % of GDP* and *Total R&D personnel and researchers as % of active population*. The regions of Central and Eastern Slovakia are closer to their comparison groups and obtain more favorable results. In the case of Central Slovakia, *Total Intramural R&D expenditure in all sectors as % of GDP* and *Total Intramural R&D expenditure in private business sector as % of GDP*, *Total R&D personnel and researchers as % of active population*. On the contrary, the problem is mainly the low volume of government spending on science and research. In the case of Eastern Slovakia, the exact opposite situation is true, while government spending is sufficient here, private research spending on science and research is the lowest. The region of Bratislava achieves the best results, mainly in the area of research and development expenditures as a % of GDP.



## 4.11 Crime

In the field of Crime, we have compared the Slovak regions within four indicators. Their development is shown in graphs in section 11.B. For a better interpretation of the results we have inverted all graphs. The desired development for each indicator in this area is to achieve the lowest value of the number of murders, robberies, burglaries or stolen vehicles. Therefore, when interpreting the graphs, proceed as follows - the higher the value compared with the unit line, the better the result for the Slovak region, the smaller the number of crimes compared to the comparison or the target group.

Slovakia has achieved very good results in all monitored indicators. The Slovak regions have fallen below the unit line, which represents a common development of the indicator with a comparison or a target group, only in two cases – *Number of murders per inhabitant* and *Number of stolen vehicles per inhabitant*. A favorable development can be also seen in the data for violent and criminal activity, which have a decreasing tendency from one year to another and their detection rate is rising. According to statistics, Slovakia, within the V4 countries, is regarded as the safest country.

In the first monitored indicator, *Number of murders per inhabitant*, the best results are achieved by Central and Eastern Slovakia regions. Indicator values are above their comparison and target groups, or more precisely, they oscillate gently around them. The situation in the Bratislava and Western Slovakia regions is worse, which have remained below the level of their respective comparison groups in the last six years, and are even below the level of the target group. Slovakia as a whole has not reached the level of the target group in any year of the analyzed period.

The paradox remains that Bratislava region has very poor results in the monitored indicators, while the region itself is not perceived as dangerous by the inhabitants. One possible explanation is the high concentration of people in that region who come to work there, with the number of permanent residents remaining relatively low compared to the actual population.

Values for the indicator *Number of robberies per inhabitant* gained a very favorable development throughout the whole analyzed period in all regions of the Slovak Republic and Slovakia as a whole for both the comparison as well as the target groups. Within the monitored indicator the leader in Slovakia, in the long run, remains the Western Slovakia region, both with respect to the comparison group and in the target group. The Bratislava region has also recorded a positive development, but compared to the other regions of the Slovak Republic, it is still situated on the tail. As already mentioned, the values of the Bratislava region reflect its urban character and the diversity of its population.

Significantly positive results for Slovak regions are displayed by the indicator. All Slovak regions are situated above the *Burglary to private residential premises per inhabitant* comparison and target groups. Eastern Slovakia recorded 7 times better results than its comparison group and more than 11 times better results than the target group. Again, compared to the target group, the Bratislava region has reached a lower level than other Slovak regions.

The last indicator in the Crime area is the *Number of stolen vehicles per inhabitant*. The Eastern Slovakia region is clearly dominating in this area, reaching values above the comparison group, but in the last years of the monitored period the values of this indicator approach close to the unit line. The values of the Bratislava region are slightly oscillating around the comparison group, and in recent years they are copying its development. In the regions of Western and Central Slovakia, the *Number of stolen vehicles per inhabitant* does not reach the level of the comparison group. On the contrary, a different situation is recorded in the development of the given indicator compared to the target group. Bratislava region is copying the development of the target group and other Slovak regions have markedly outpaced it.

On the Crime spider charts in Section 11.A, we can see that Central Slovakia has achieved the best results in the indicator of *Number of murders per inhabitant* relative to the comparison as well as the target group in 2015. The best results among all regions in *Number of murders per inhabitant* was achieved by Western Slovakia region. Eastern Slovakia has made the most significant development in *Burglary to private objects per inhabitant* and *Number of stolen vehicles per inhabitant*, compared to the comparison as well as the target group. The analyzed indicators pointing to the level and the development of crime reached the lowest values in the Bratislava region, reflecting its urban character.

The positive results in the crime area, in almost all Slovak regions, reflect the current secure situation compared to other European regions.

## 5 Conclusion

In this study we present the results of our analysis of the state and development of selected economic, demographic and social indicators of Slovak regions, compared to a group of regions at a similar level of development as well as relative to a target group consisting of selected regions of Western and Northern Europe. The aim of this study is to identify areas, which need to be upheld, therefore, are suitable for allocation of European Structural and Investment Funds, as well as other public investments.

Our analysis shows that the relative position of Slovak regions is very dependent on the chosen indicator. In the field of Socio-economic development, Slovakia attains good results: its level is improving compared to similar regions and also catches up with the target group of European regions. Similarly, Slovakia is doing well in the area of Demographic development, Healthcare and Education. In the field of Digital economy, Slovakia converges to the target group, but at a slower pace than its comparable regions. In the area of Environment, Slovakia lags behind the target group in recycling of waste per capita.

Despite the positive results in some areas, Slovakia is gradually losing head start, which it enjoyed ten years ago. In addition, Slovakia lags behind in the area of Transport infrastructure, Research and Development, as well as Tourism. In these three areas there are no significant signs that the trend is improving compared with the current situation. In the last monitored area, Crime, Slovakia shows very good results reflecting the low number of murders, robberies or burglaries per inhabitant compared to the comparison groups and the target group.

The results of this analysis can serve to identify the areas in which Slovak regions are lagging behind and which should, therefore, be prioritized in the formation of national economic policies and investment strategies. Priority should be given especially to Transport infrastructure, Research and Development, Digital economy, Environment and better use of the favorable Tourism potential of the Slovak regions.

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## Appendix C: Synthetic control method (SCM)

When assessing performance of any region relative to a set of other regions, the selection of a benchmark is of crucial importance. The SCM solves this issue by assigning weights to the comparator regions, so that the weighted average of a selected key indicator, for instance GDP per capita, copies the development of this indicator for the selected region as closely as possible. This method therefore yields a synthetic clone of the target region.

Consider a balanced panel with  $i=1, \dots, n+1$  regions over a time period  $t$ . We would like to clone the region  $i=1$  using the regions  $i=2, \dots, n+1$ . Let us define  $X$  as a matrix with socio-economic characteristics. We obtain the clone of the observed region as a weighted average of the reference group using the vector  $w_i = w_2, \dots, w_{n+1}$ , which is chosen to minimize the difference between the characteristics of the target region ( $x_1$ ) and the comparison group ( $x_i$ ):

$$\sum_{m=1}^k v_m(x_{1m}) - \sum_{i=2}^{n+1} w_i x_{im}$$

where vector  $v_m$  denotes the importance of indicator  $m$  in relationship to the target variable when measuring the difference between  $x_{1m}$  and  $\sum_{i=2}^{n+1} w_i x_{im}$ .

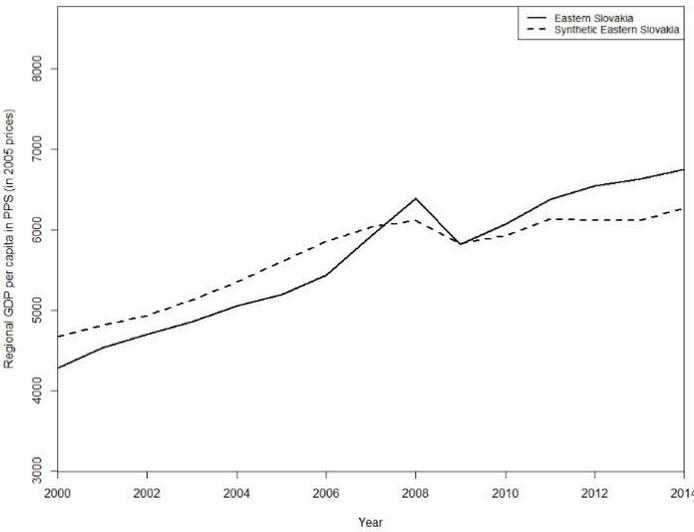
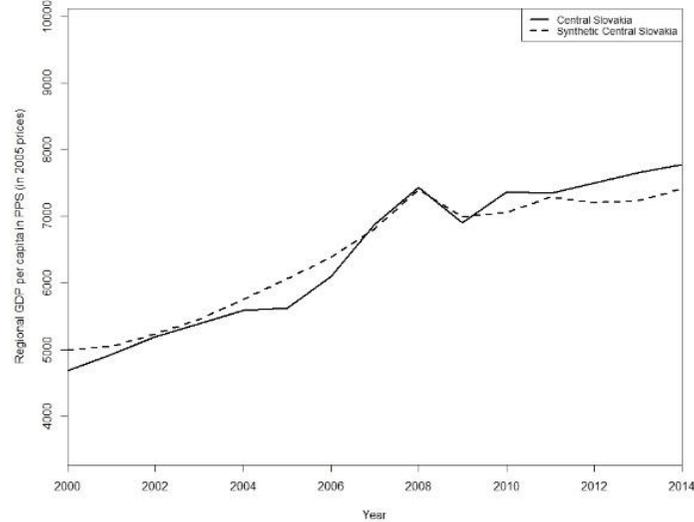
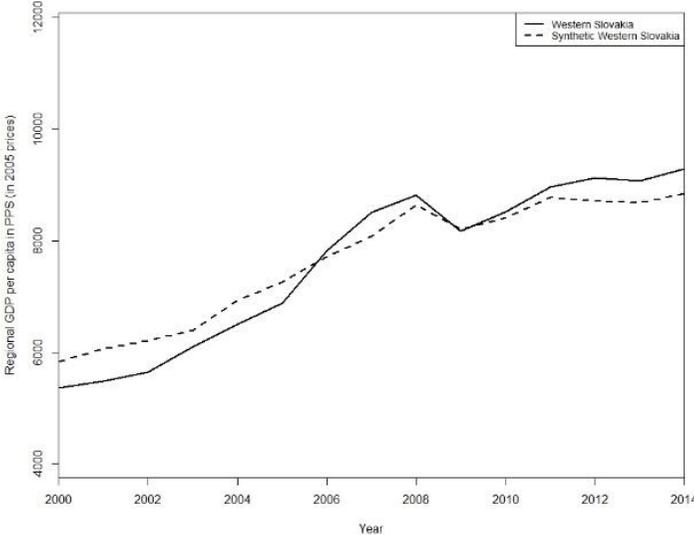
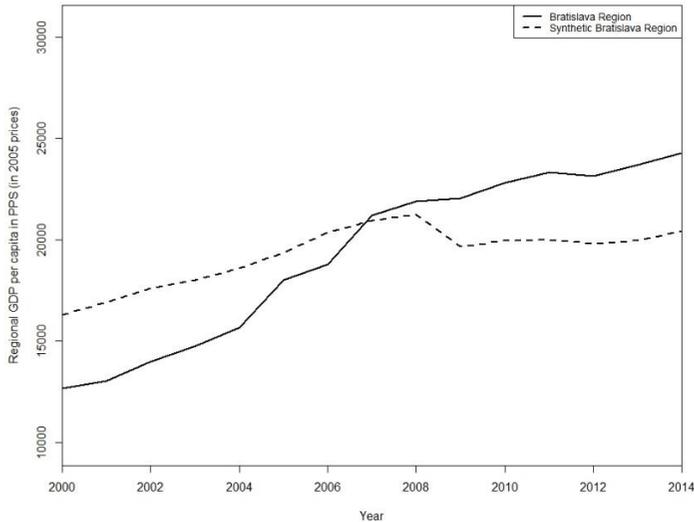
SCM is usually used to examine the effect of a substantial economic shock in the target region that left the other regions unaffected. The time period observed is divided into the period before the shock ( $T_0$ ) and period after the shock ( $T_1$ ). The data from  $T_0$  are used to calculate the clone for the observed region. That enables us to observe the difference in the development between the observed region and its clone in  $T_1$ . In other words, we can therefore calculate the impact of the shock by comparing the observed outcomes in the target region in  $T_1$  with those of the synthetic clone: the clone shows us how the region in question would have developed without the shock. For example, Abadie and Gardeazabal (2003) use SCM to examine how the Basque region in Spain would have developed without the presence terrorist attacks, Campos et al. (2014) look at the impact of accession into the EU on the economic development of the member states and Žúdel (2016) examine the impact of the introduction of Euro in Slovakia.

In our analysis, we apply this method to create clones of the Slovak NUTS 2 regions in order to be able to compare their economic development with other EU regions. Since the Eurostat regional database contains numerous missing values, the condition of a balanced panel was not fulfilled. For this reason, we opted for using the data from Cambridge Econometrics Regional Database, that is complete for the years 2000-2014. The goal was to minimize the difference in GDP per capita between a given Slovak region and the comparison group, in which case we used the population, ratio of gross fixed capital formation on regional GDP and the ratio of gross value added of sectors in a region on the regional gross value added.<sup>3</sup> Furthermore, we excluded the ratio of the gross fixed capital formation on regional GDP for Bratislava region to minimize the difference between Bratislava region and its clone. Due to the same reason, we excluded employment from the characteristics of Central Slovakia.

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<sup>3</sup> The differentiation of the sectors in the Cambridge Econometrics Regional Database is the following: Agriculture, forestry and fishing; Industry less construction; Construction; Wholesale, retail, transport, accommodation & food services, information and communication; Financial & business services

**Fig. 2 Clone regions of the 4 Slovak regions**

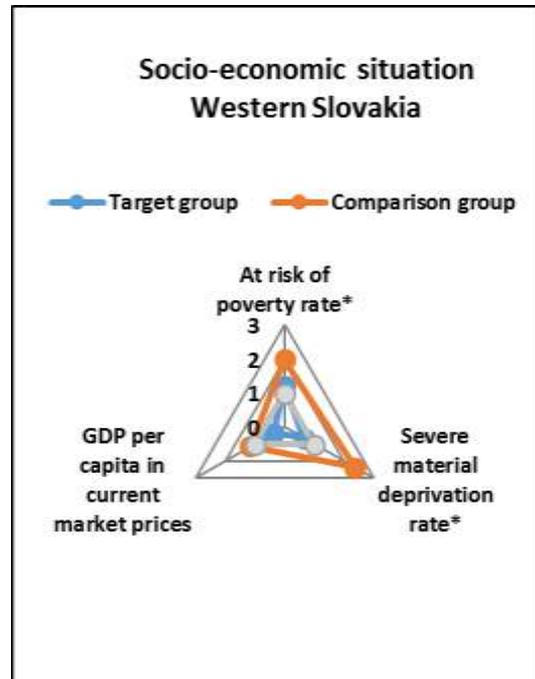
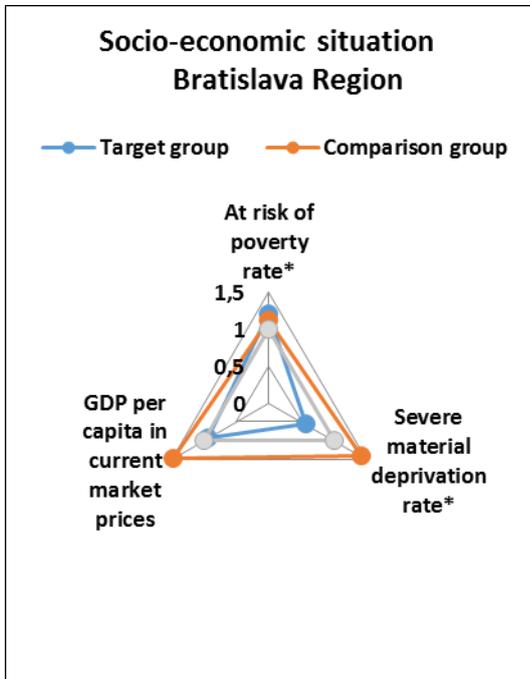


Source: Own calculations

## Appendix II.

### Appendix A: Analysis of the situation in 2015

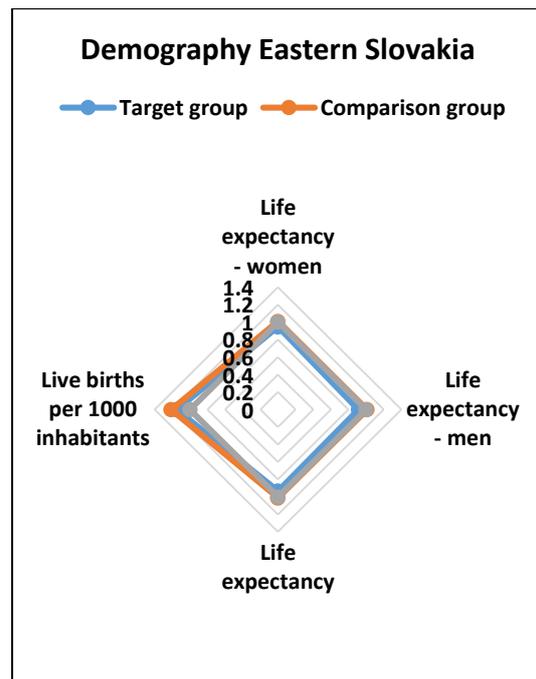
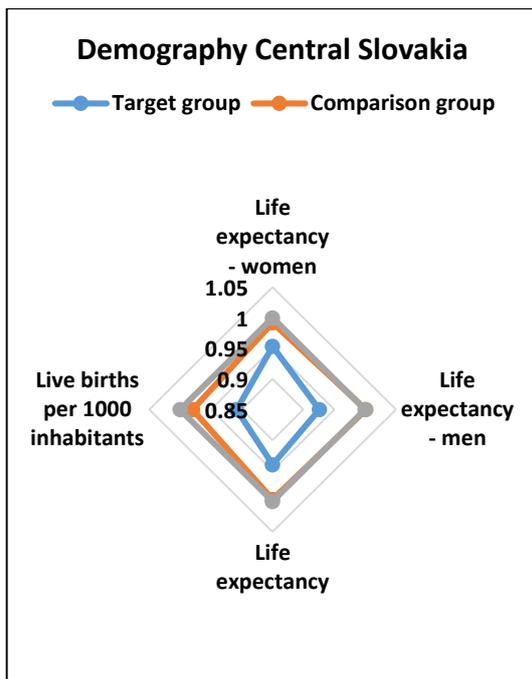
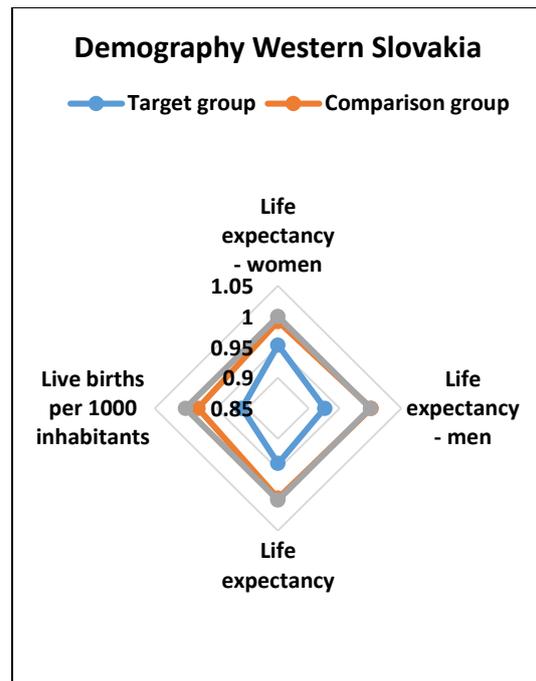
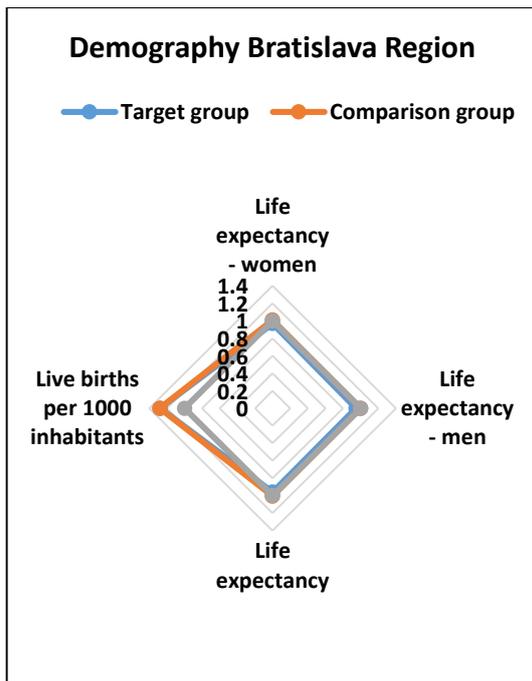
#### 1.A Socio – economic situation in Slovak regions



Source: Own calculation on the basis of data from Eurostat

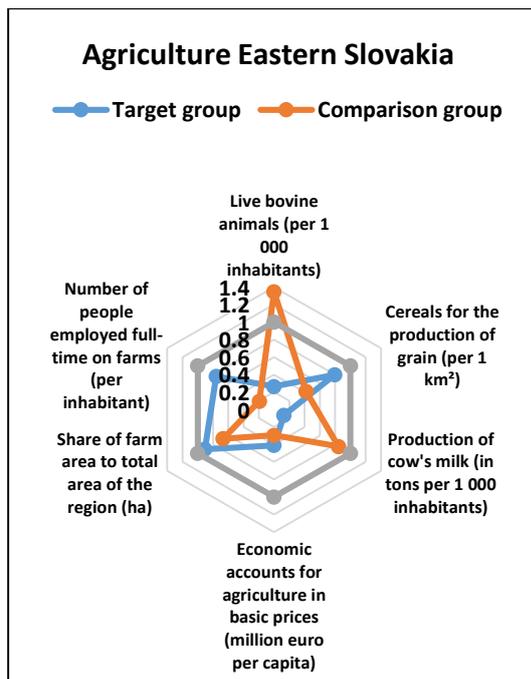
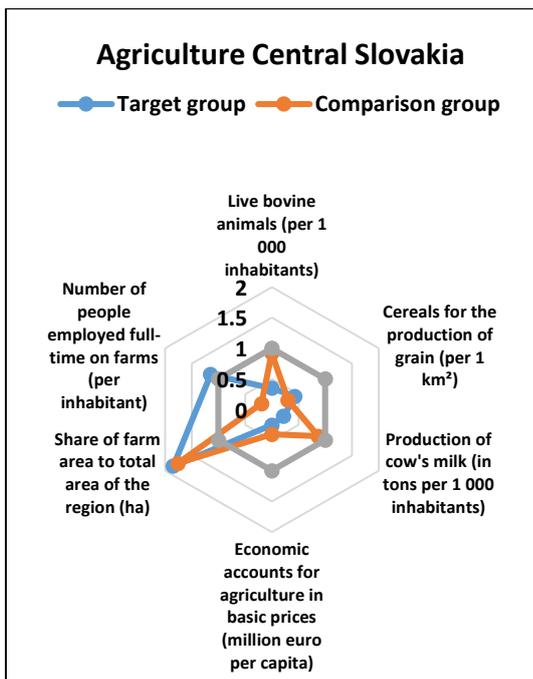
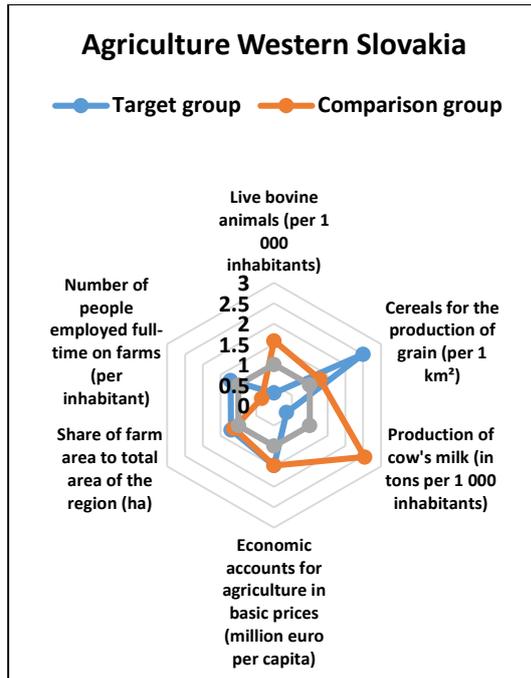
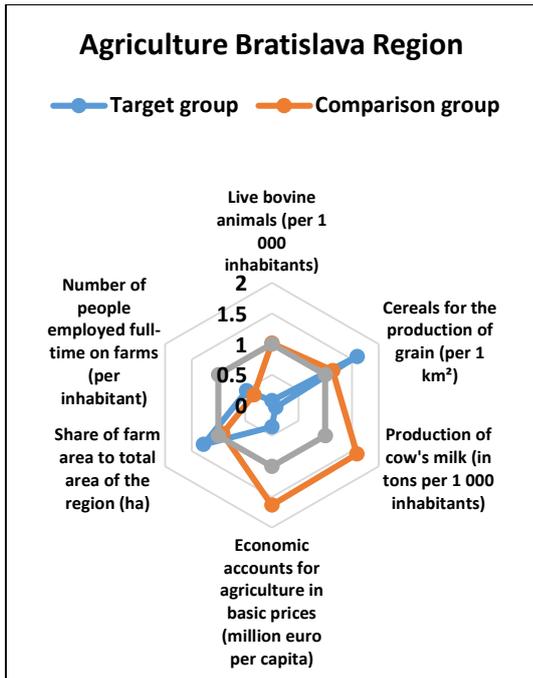
\*inverted values

## 2. A Demographic situation in Slovak regions



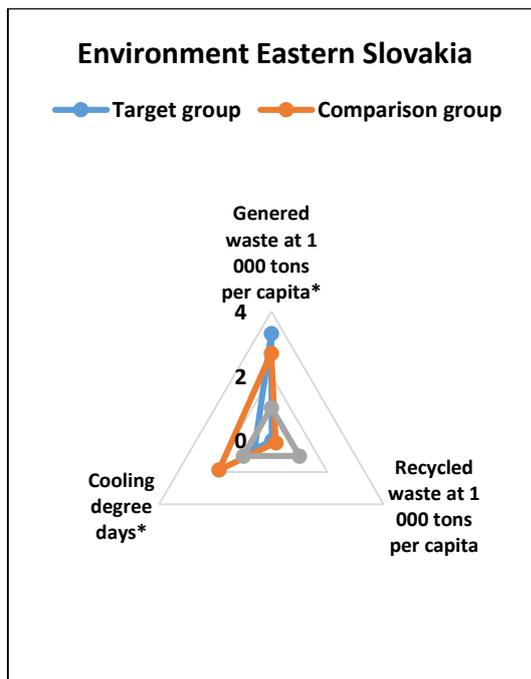
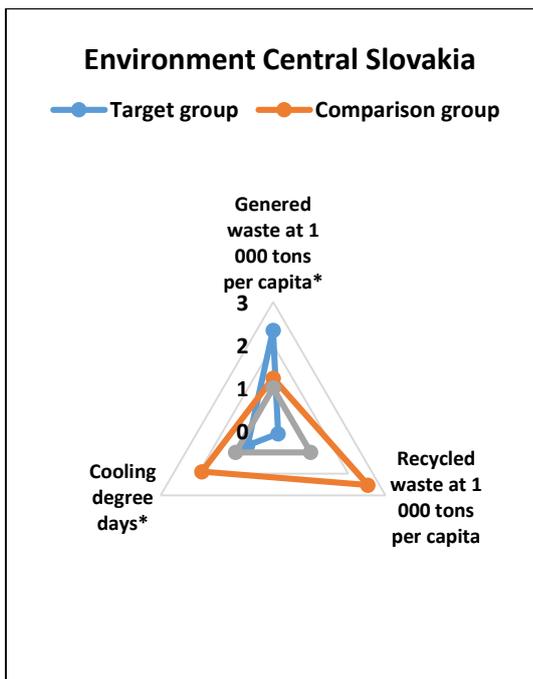
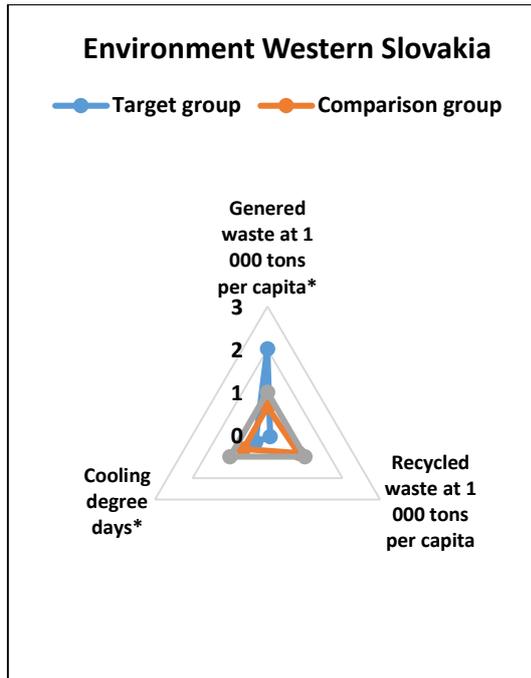
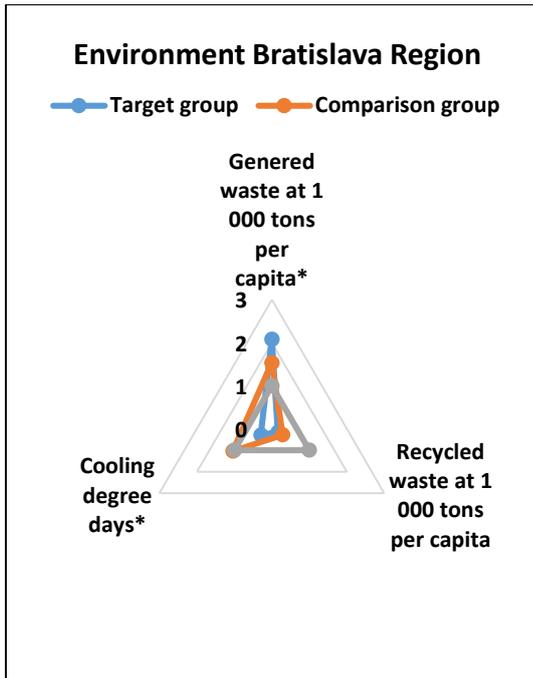
Source: Own calculation on the basis of data from Eurostat

### 3. A Agriculture in Slovak regions



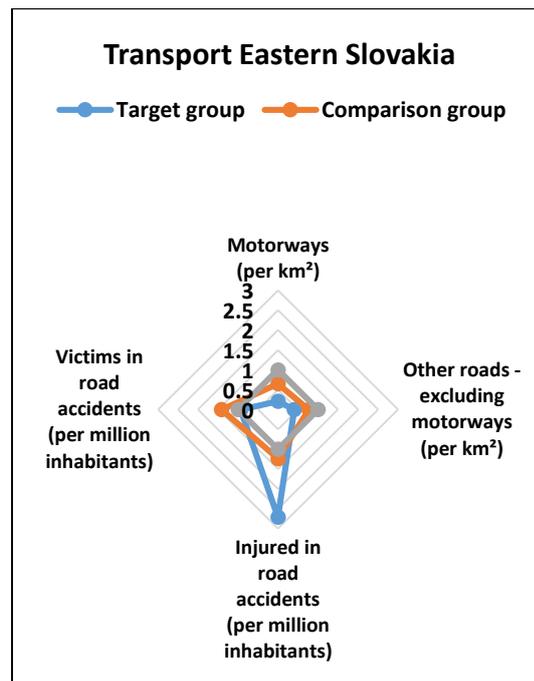
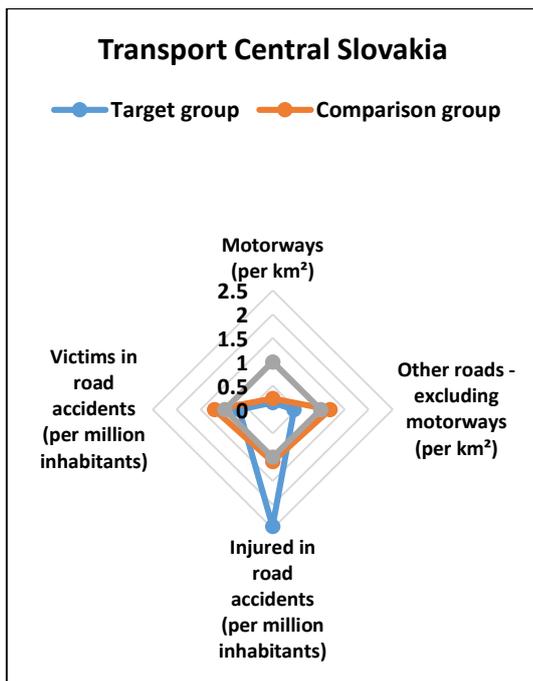
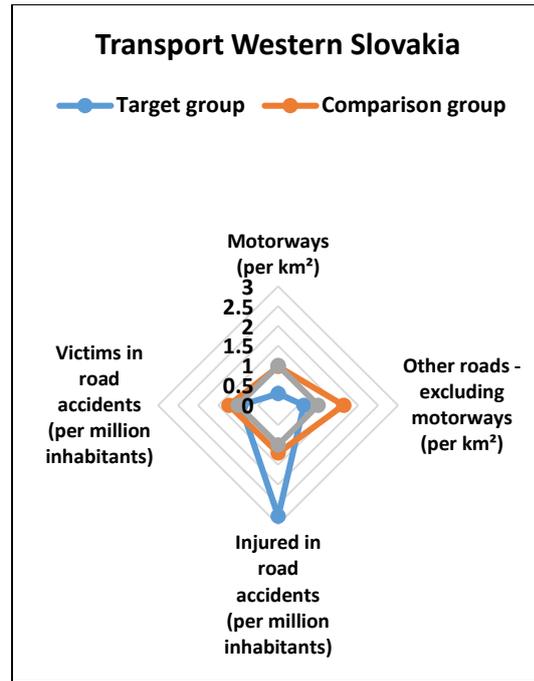
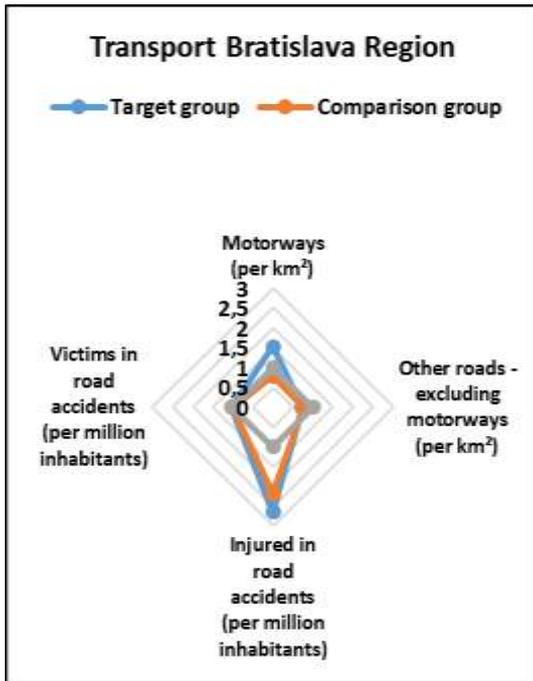
Source: Own calculation on the basis of data from Eurostat

#### 4.A Environment in Slovak regions



Source: Own calculation on the basis of data from Eurostat  
 \*inverted values

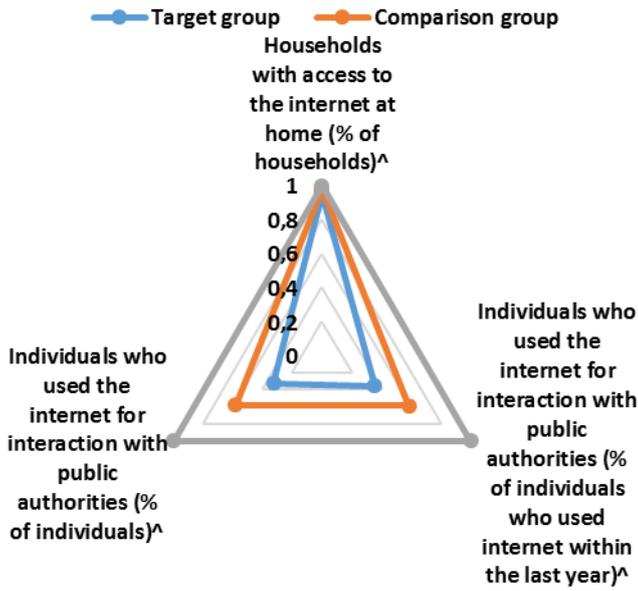
## 5. A Transport in Slovak regions



Source: Own calculation on the basis of data from Eurostat

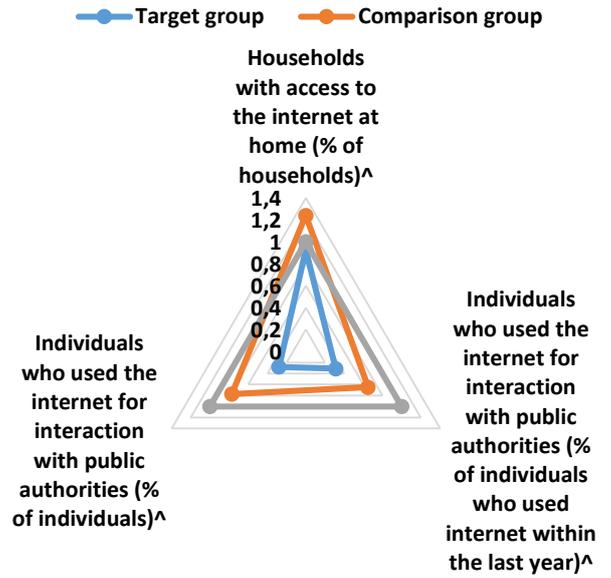
## 6. A Digital Economy in Slovak regions

### Digital Economy Bratislava Region



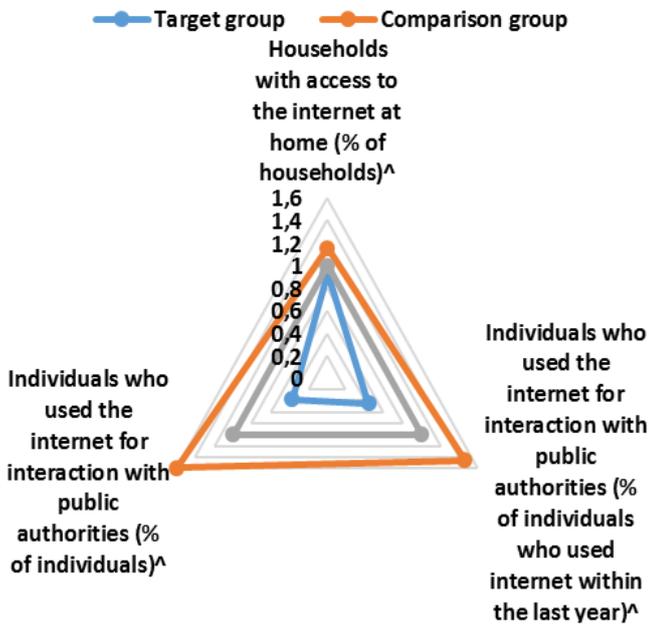
^The population of households consists of all private households having at least one member in the age group 16 to 74 years

### Digital Economy Western Slovakia



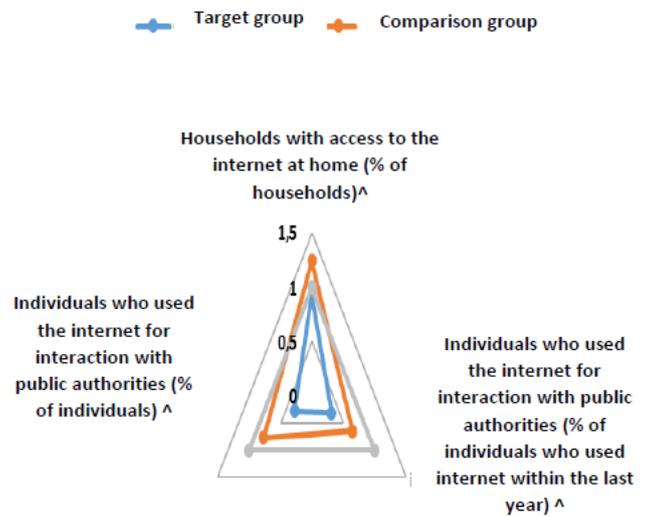
^The population of households consists of all private households having at least one member in the age group 16 to 74 years

### Digital Economy Central Slovakia



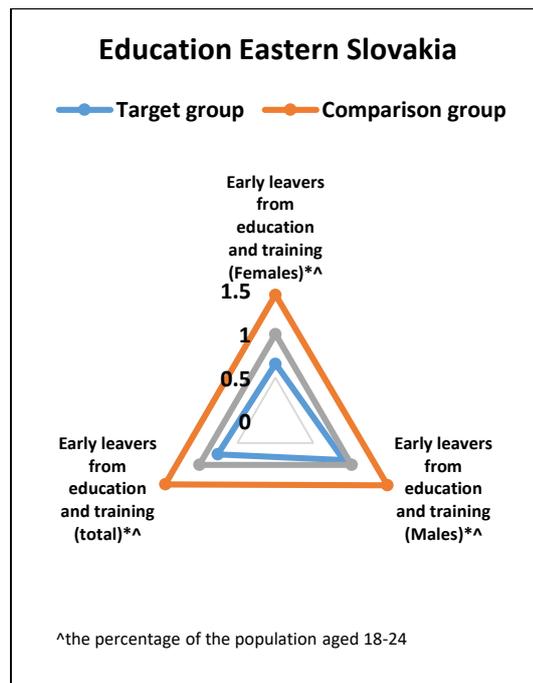
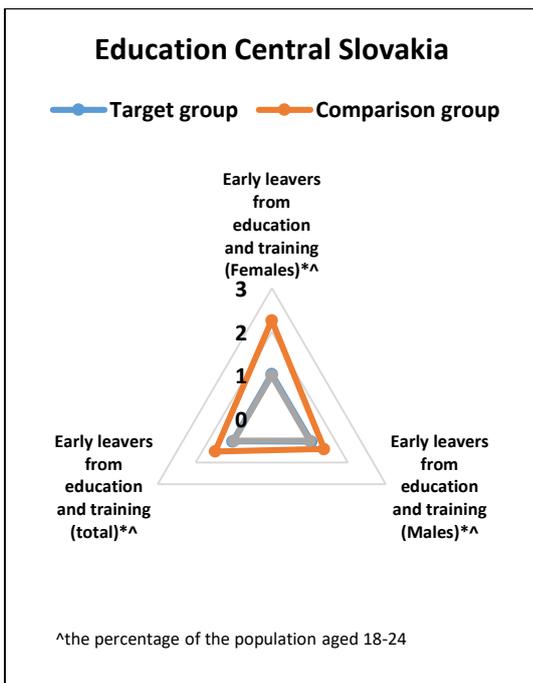
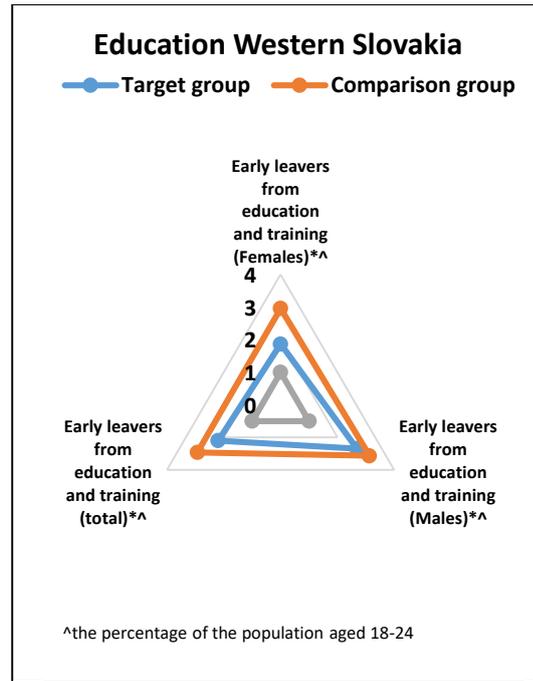
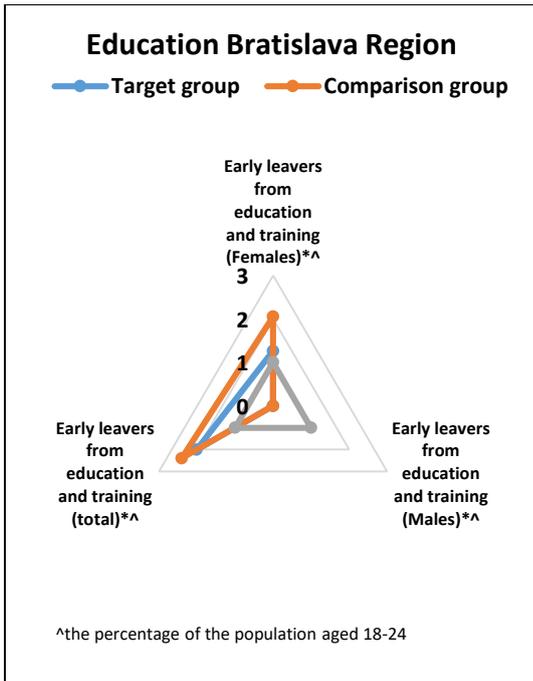
^The population of households consists of all private households having at least one member in the age group 16 to 74 years

### Digital Economy Eastern Slovakia



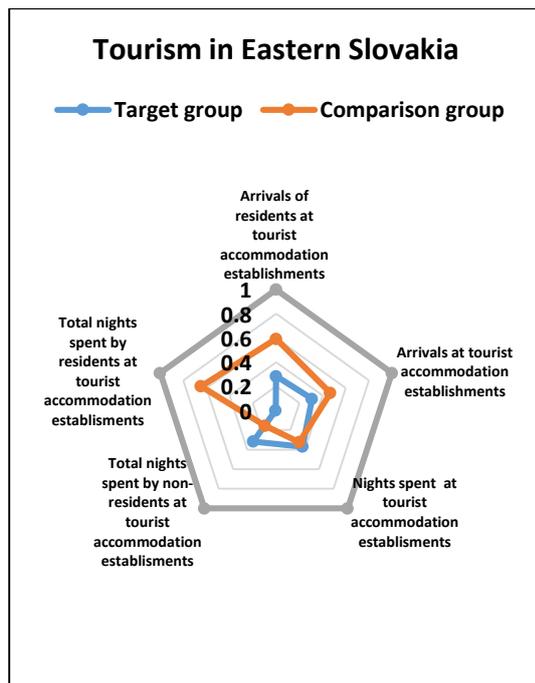
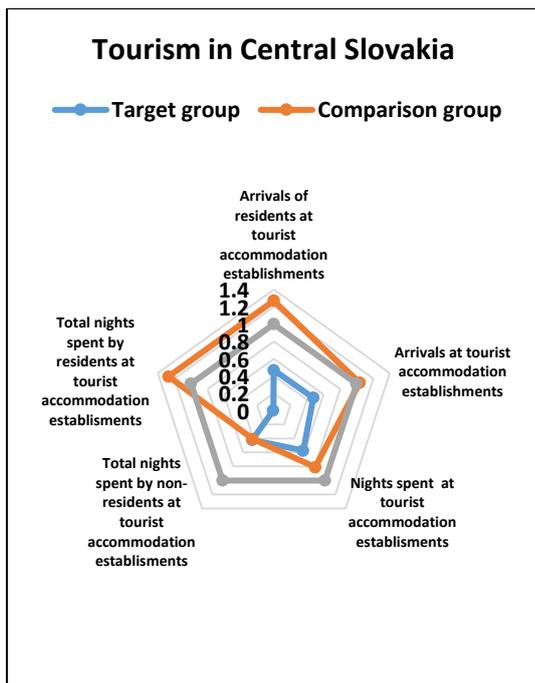
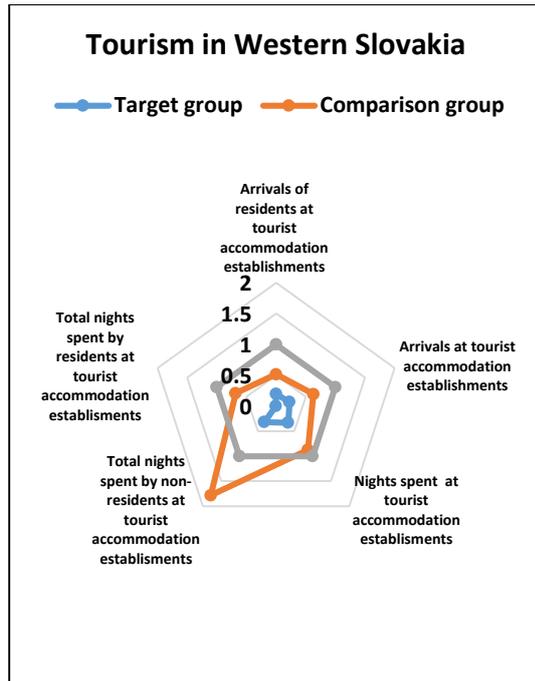
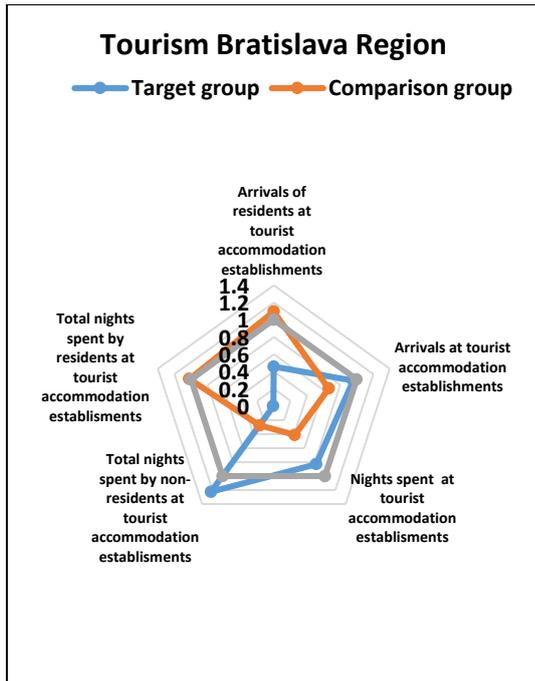
^The population of households consists of all private households having at least one member in the age group 16 to 74 years

## 7.A Education in Slovak regions



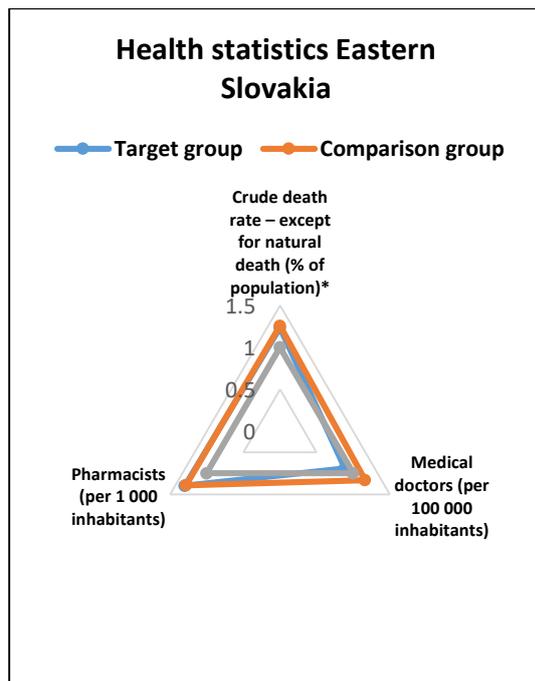
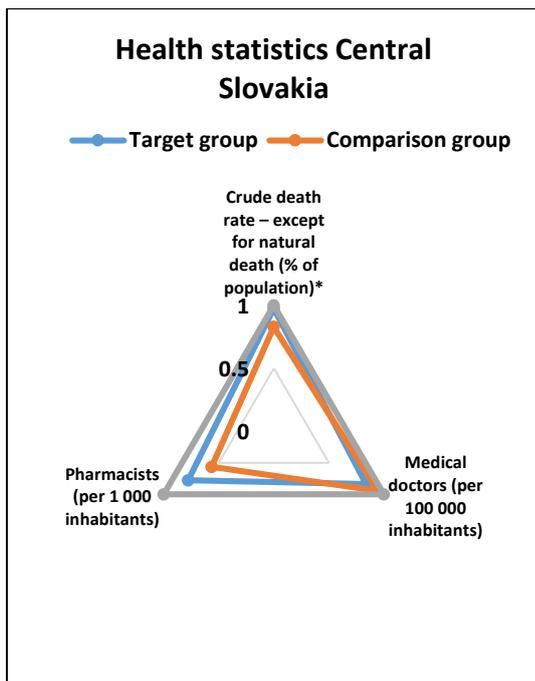
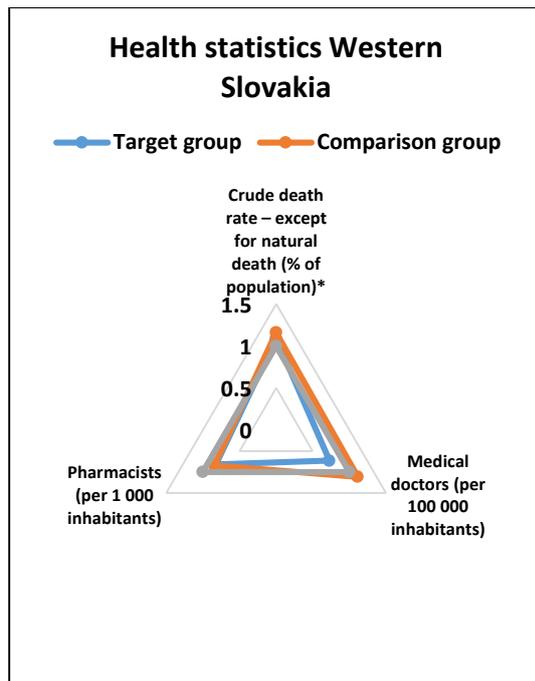
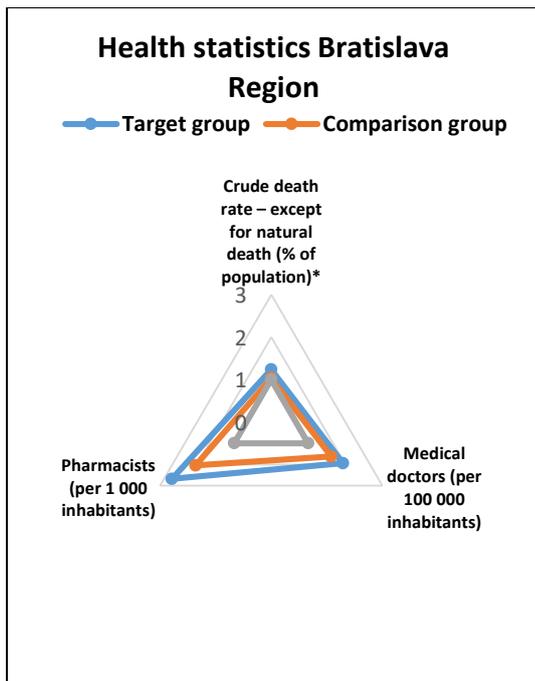
Source: Own calculation on the basis of data from Eurosta  
 \*inverted values

## 8.A Tourism in Slovak regions



Source: Own calculation on the basis of data from Eurostat

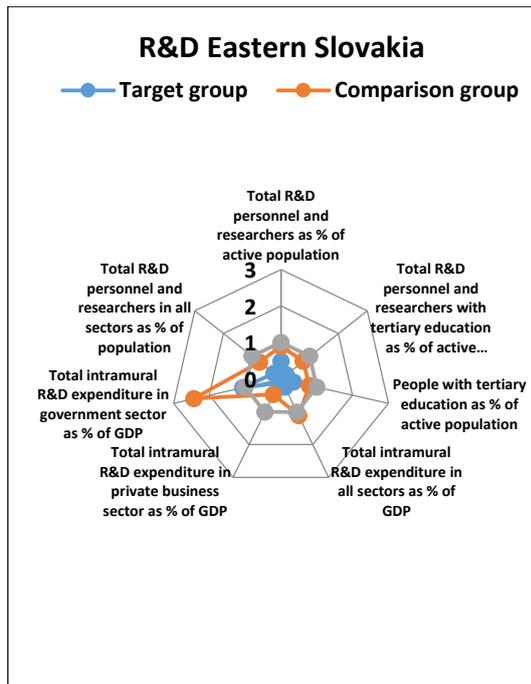
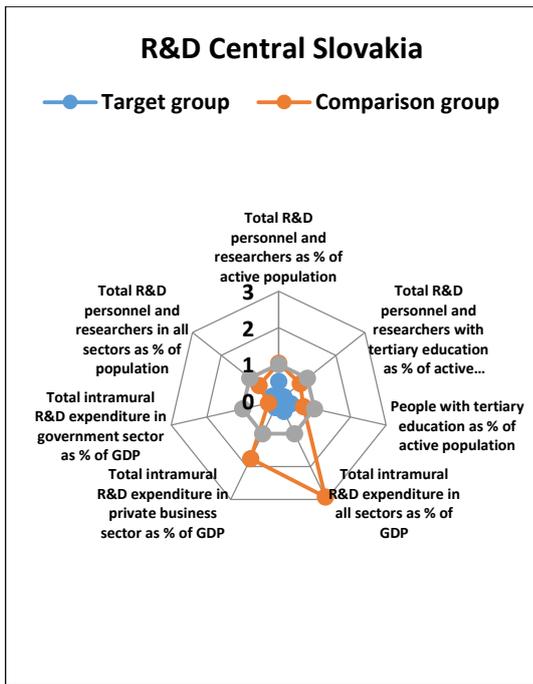
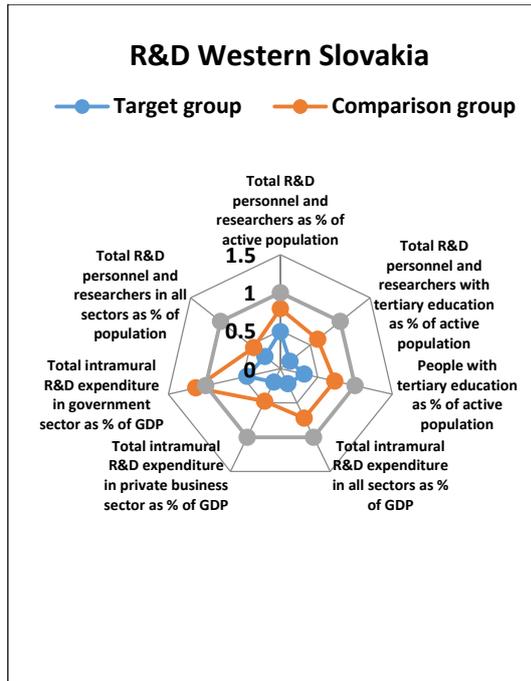
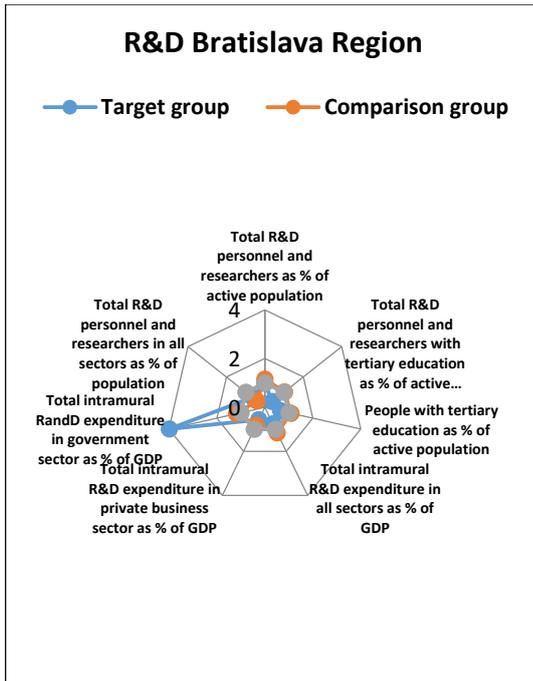
## 9.A Health statistics in Slovak regions



Source: Own calculation on the basis of data from Eurostat

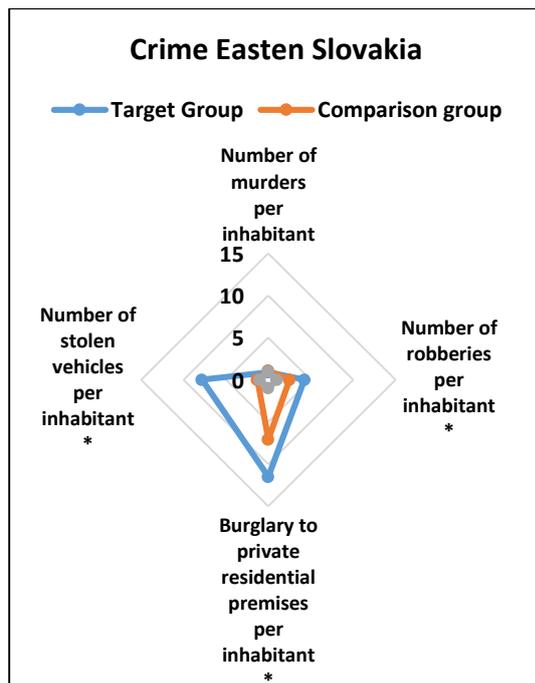
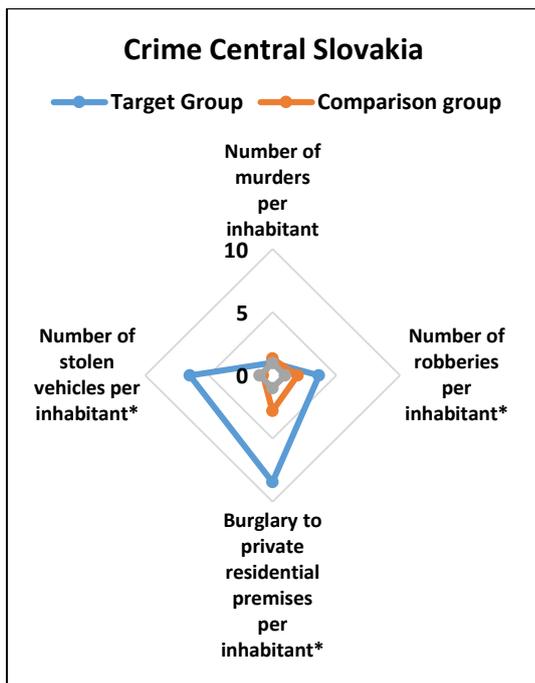
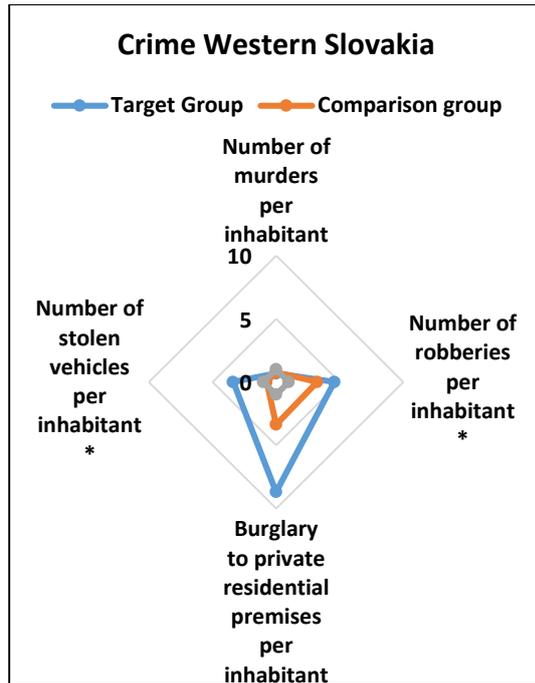
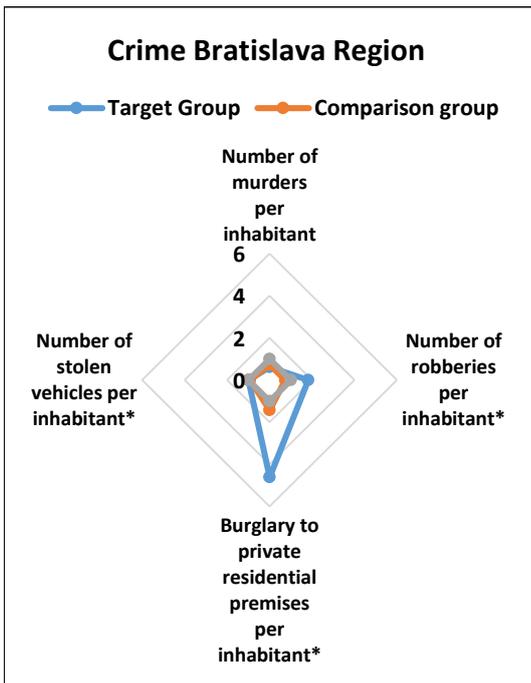
\*inverted values

## 10.A R&D in Slovak regions



Source: Own calculation on the basis of data from Eurostat

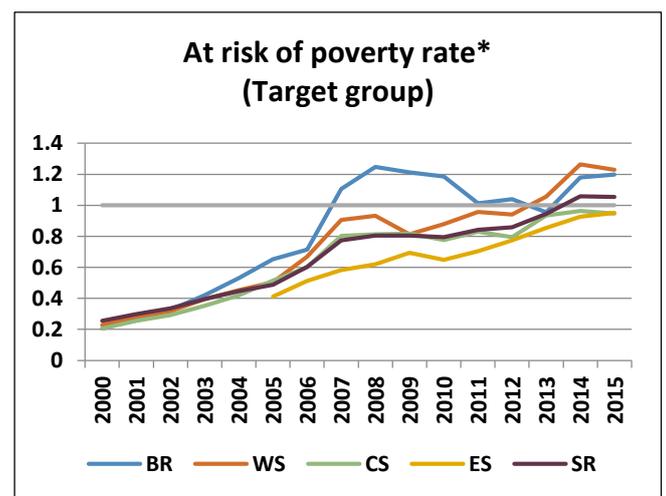
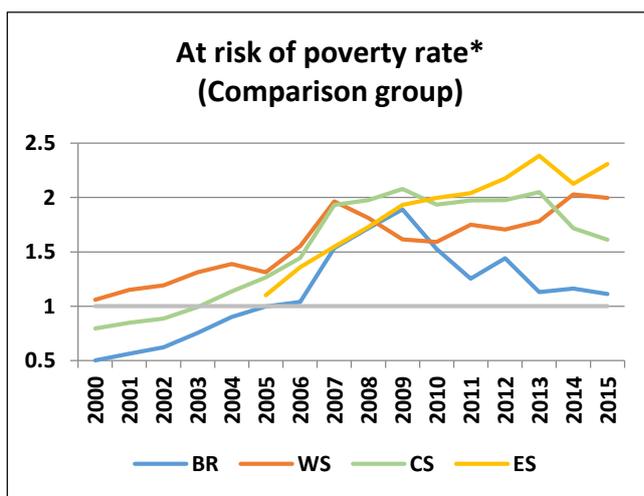
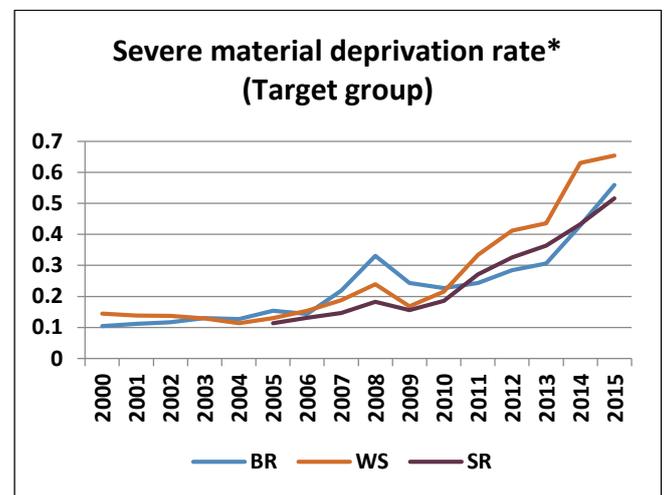
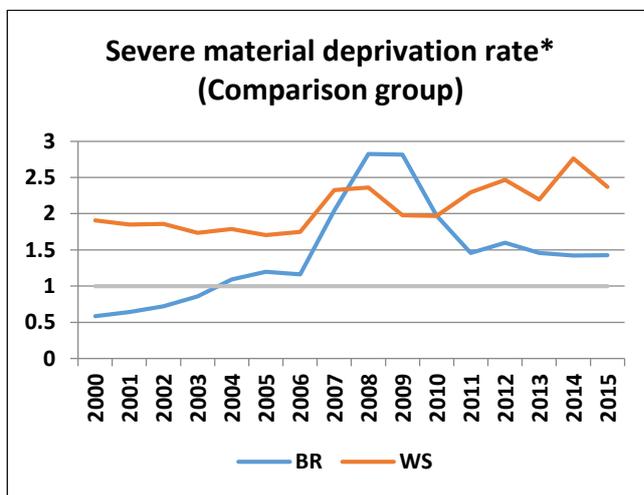
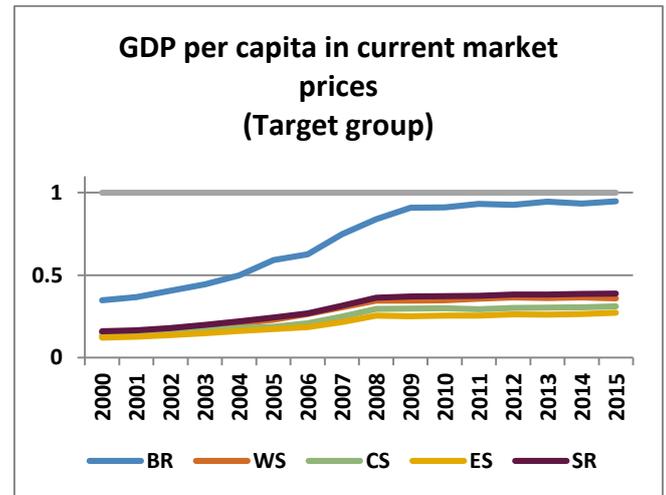
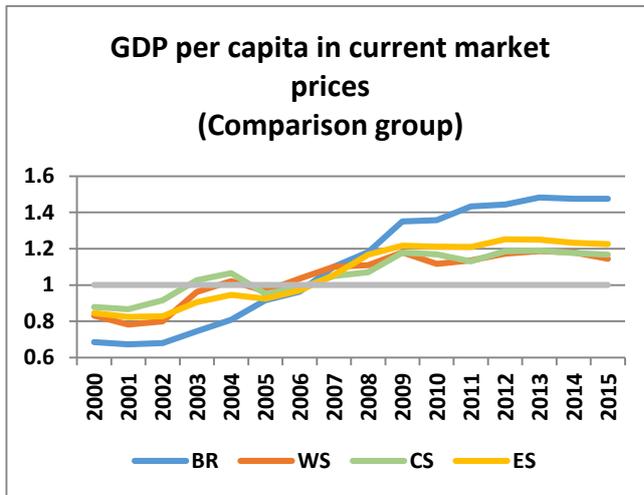
## 11. A Crime and safety in Slovak regions



Source: Own calculation on the basis of data from Eurostat  
 \*inverted values

## Appendix B: Analysis of selected indicators

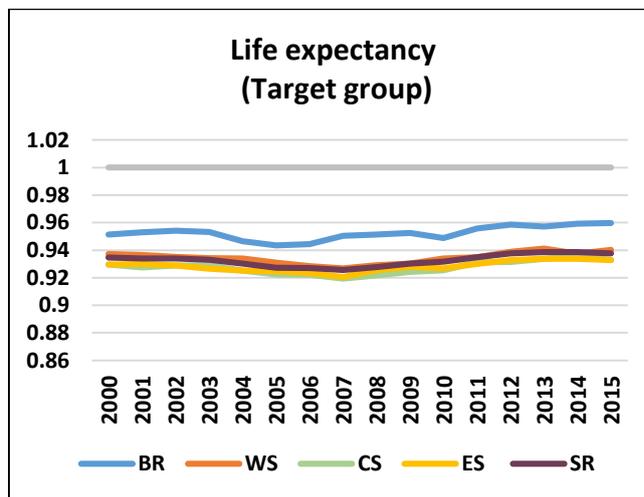
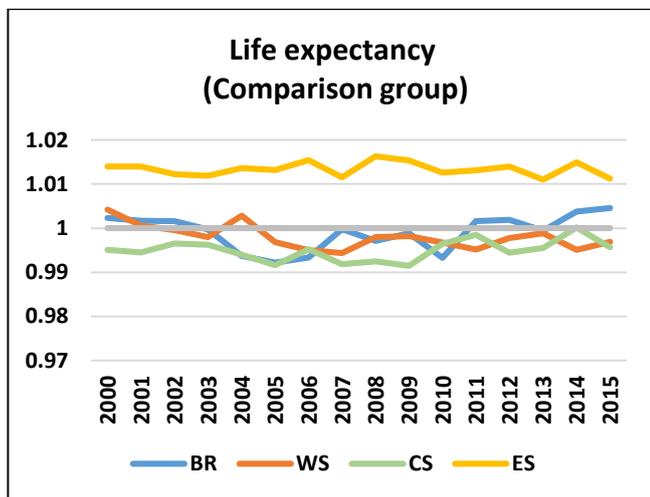
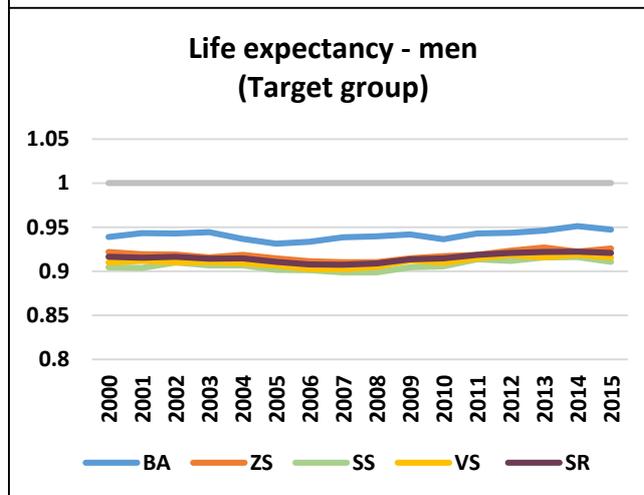
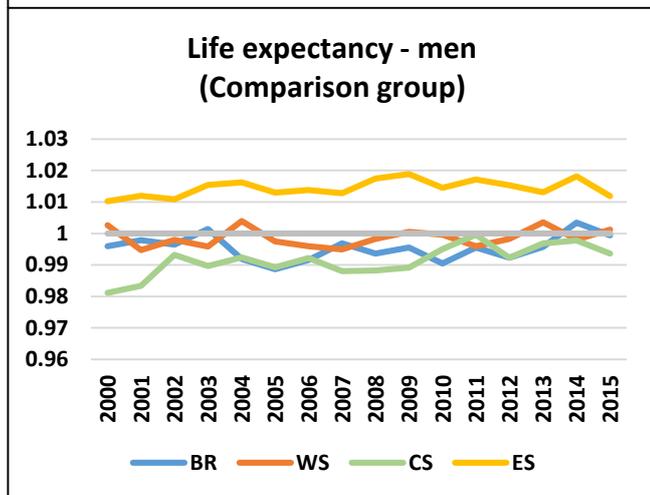
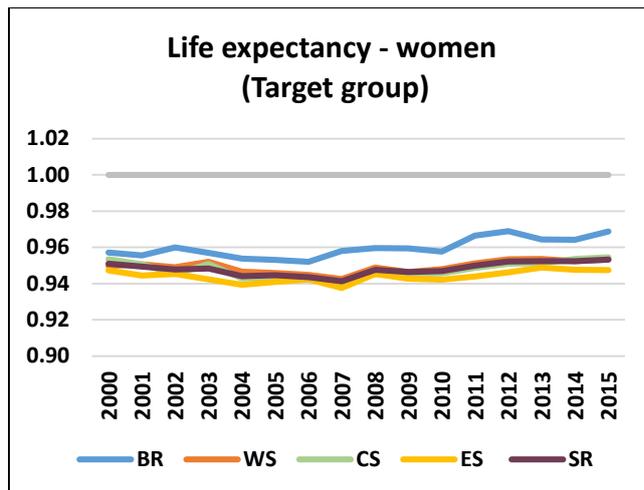
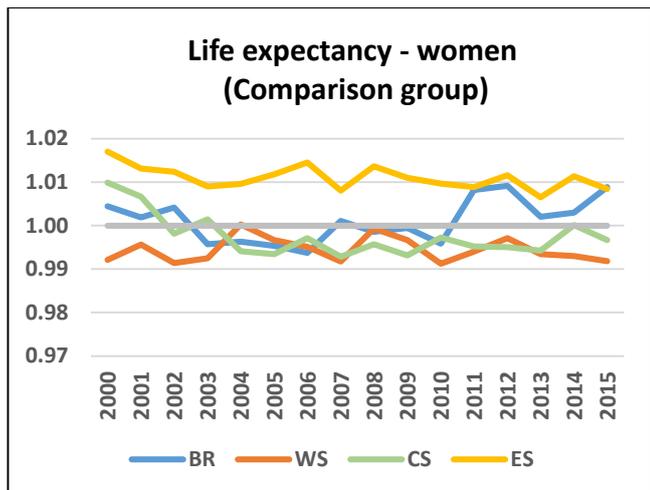
### 1.B Development of socio-economic indicators in Slovak regions

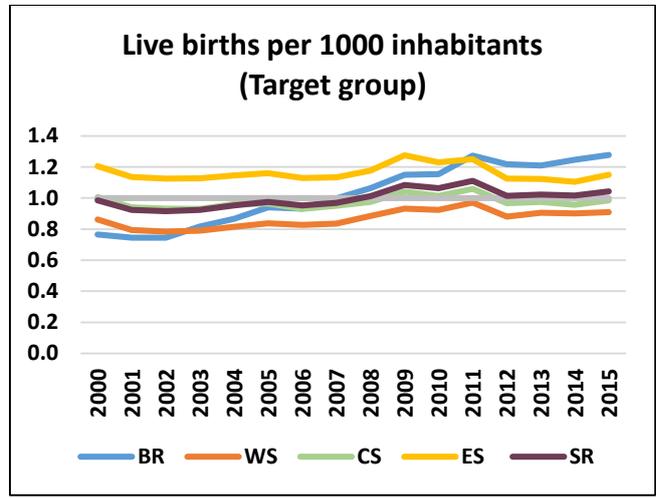
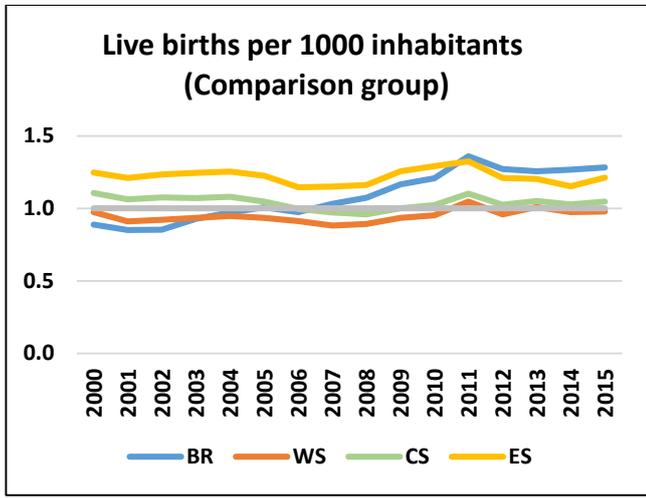


Source: Own calculation on the basis of data from Eurostat

\*inverted values

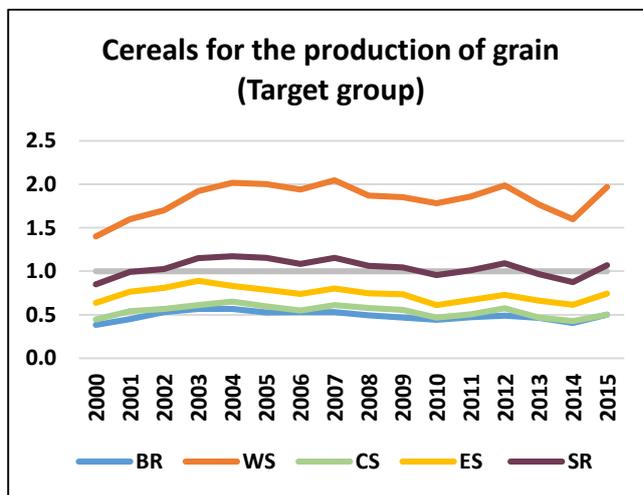
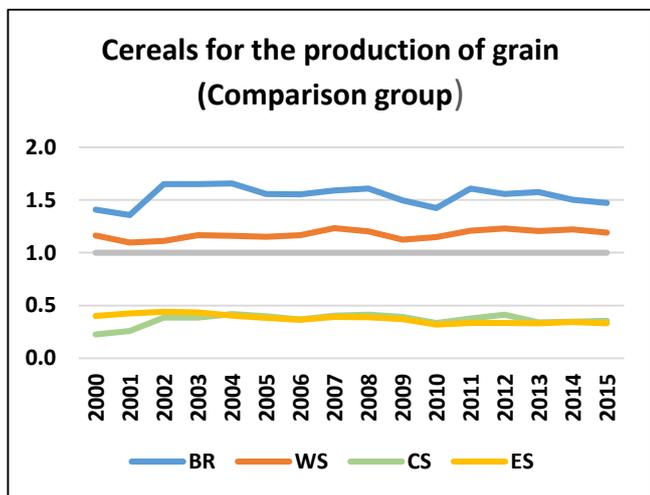
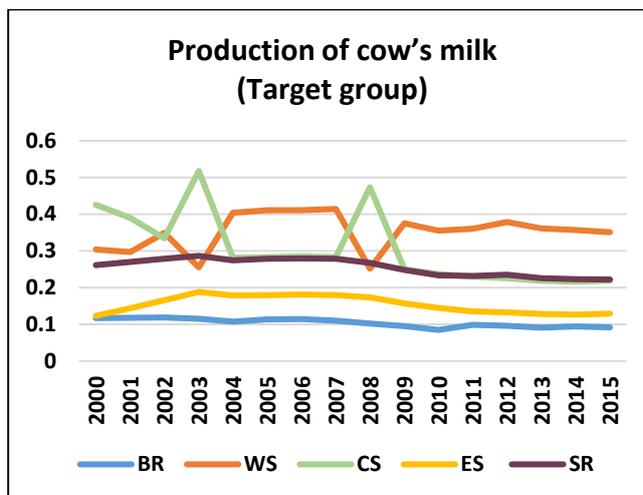
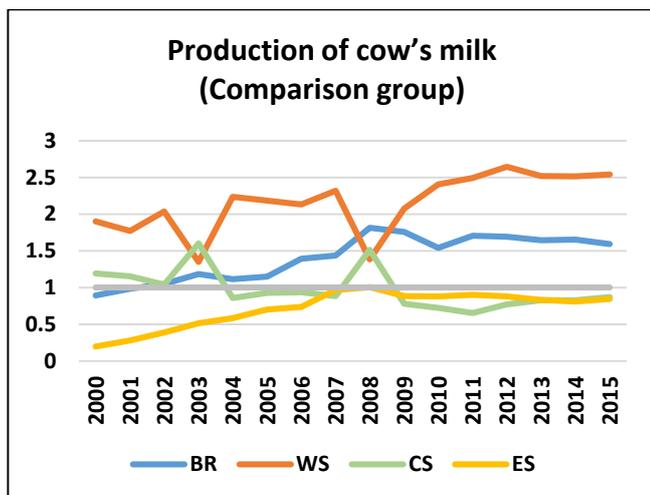
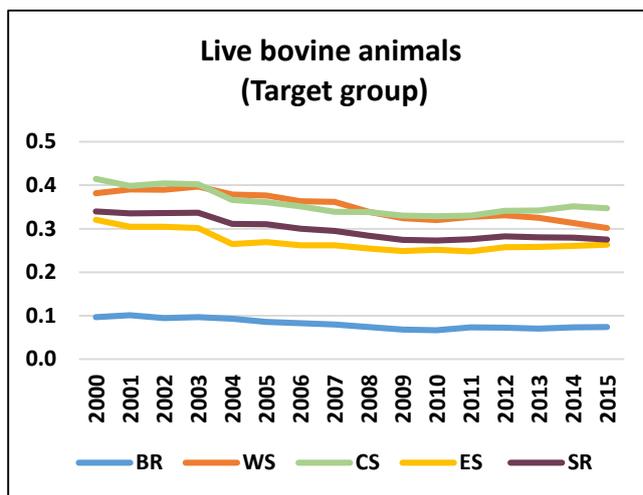
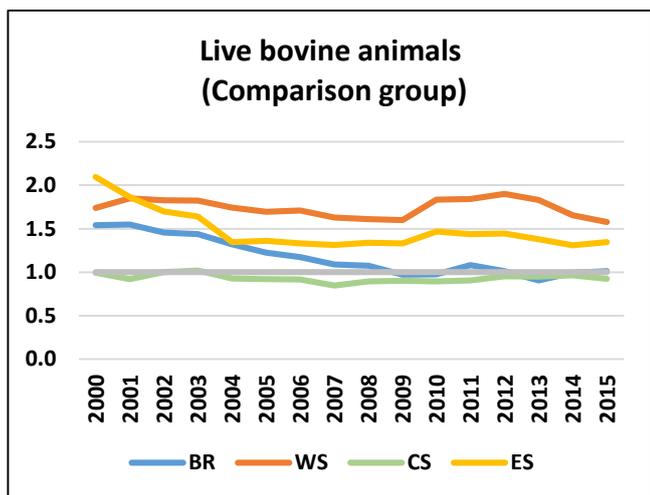
## 2.B Development of demographic indicators in Slovak regions

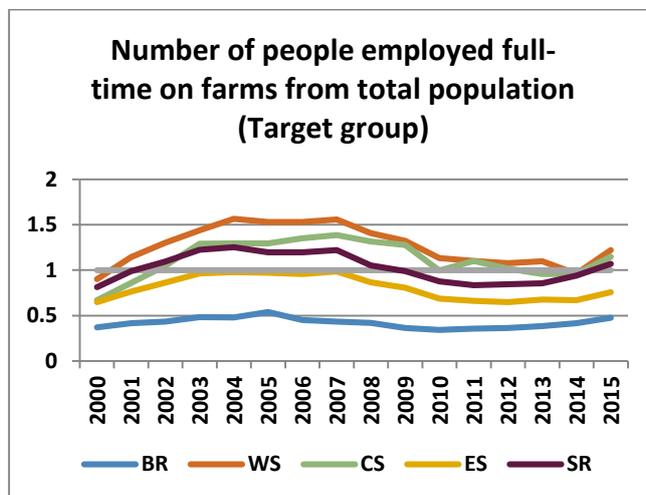
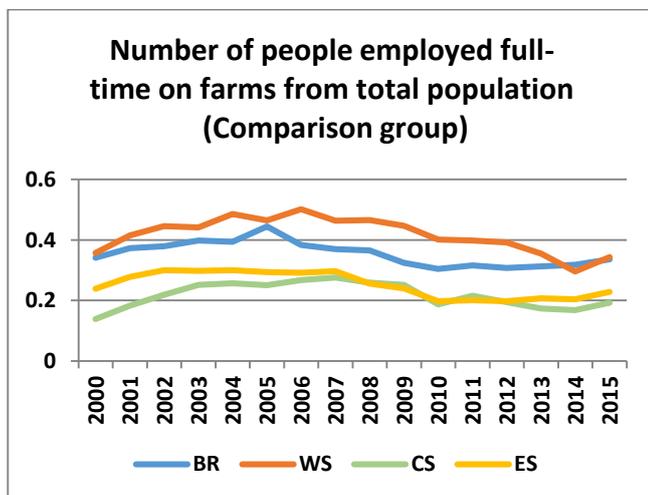
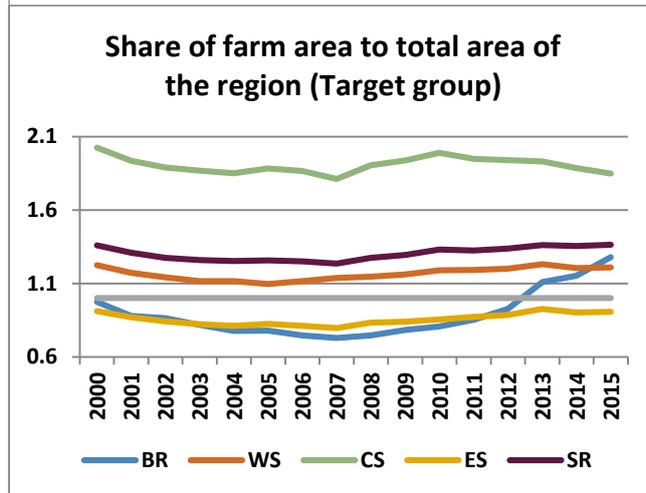
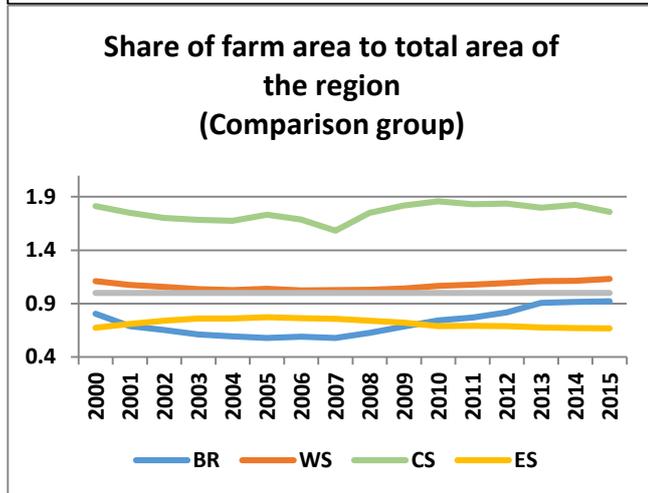
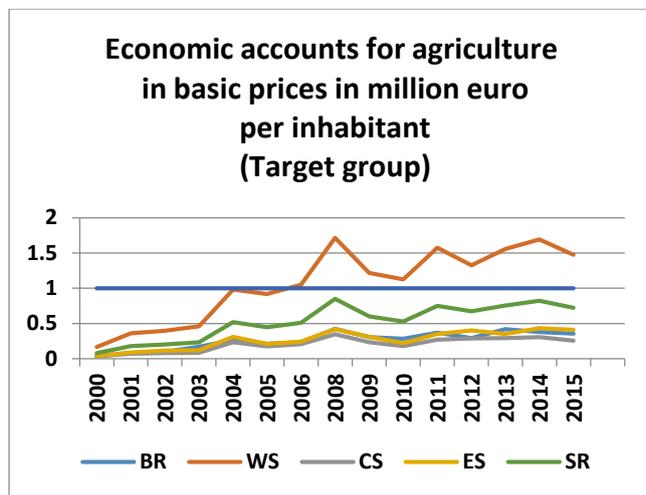
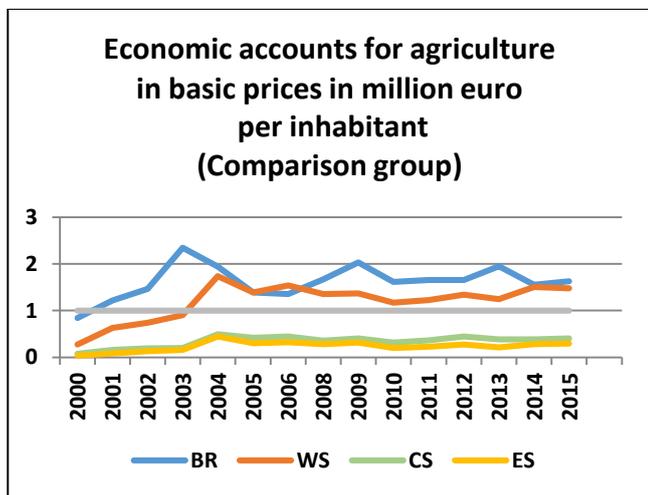




Source: Own calculation on the basis of data from Eurostat

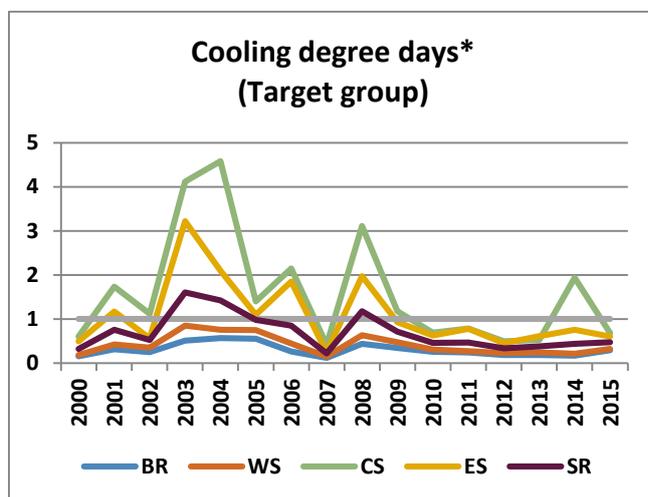
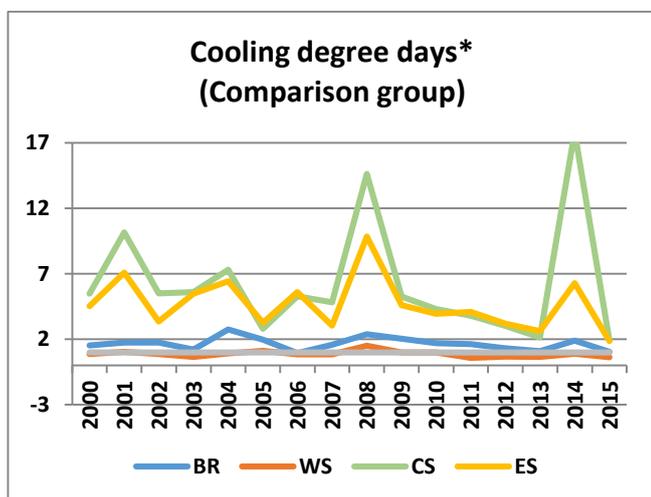
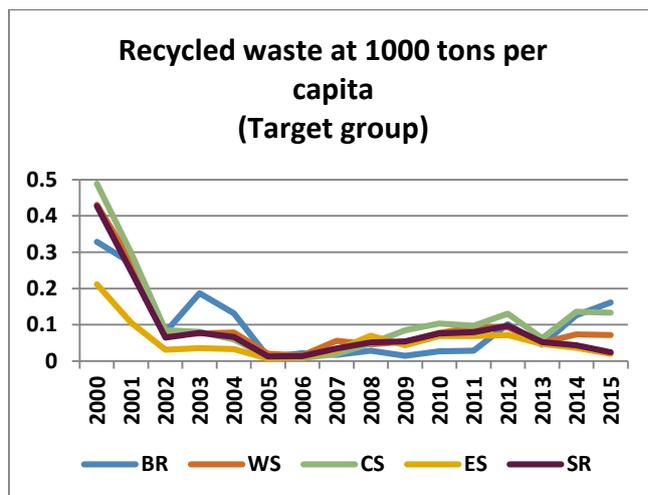
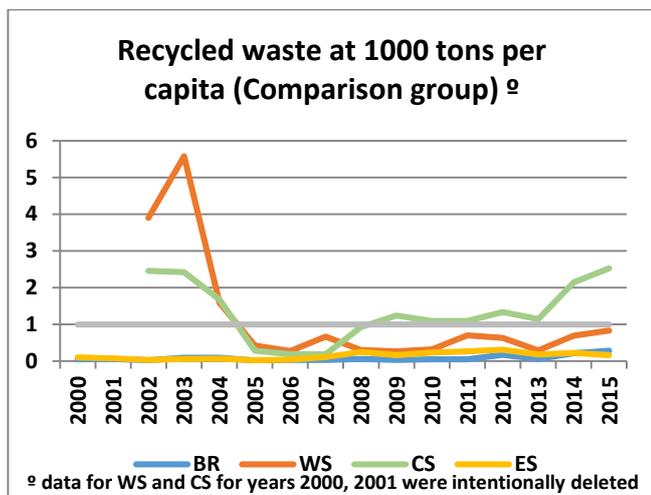
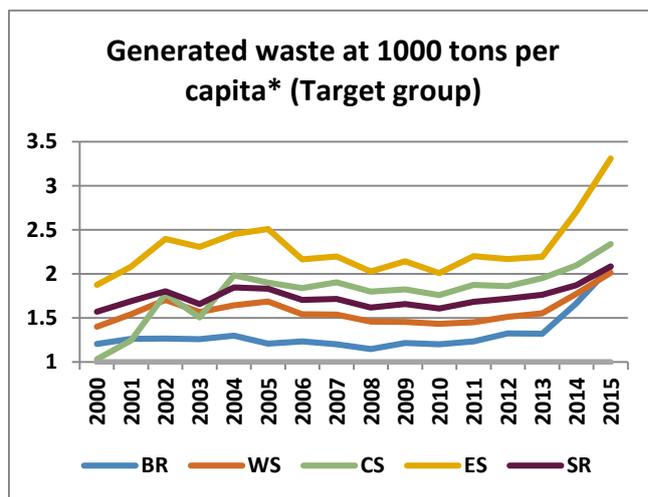
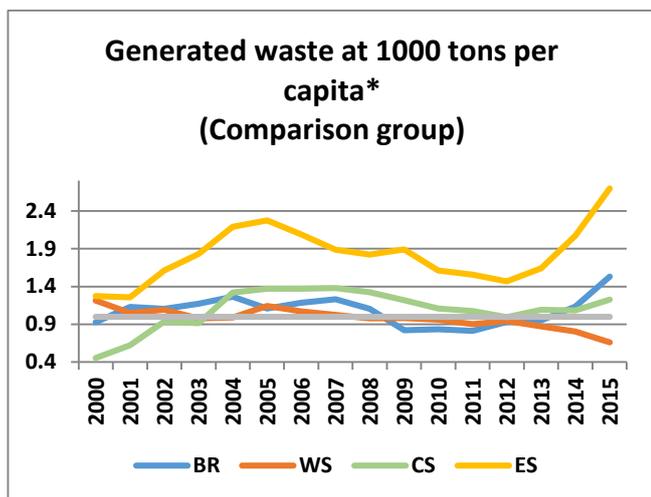
### 3.B Development of indicators of agriculture in Slovak regions





Source: Own calculation on the basis of data from Eurostat

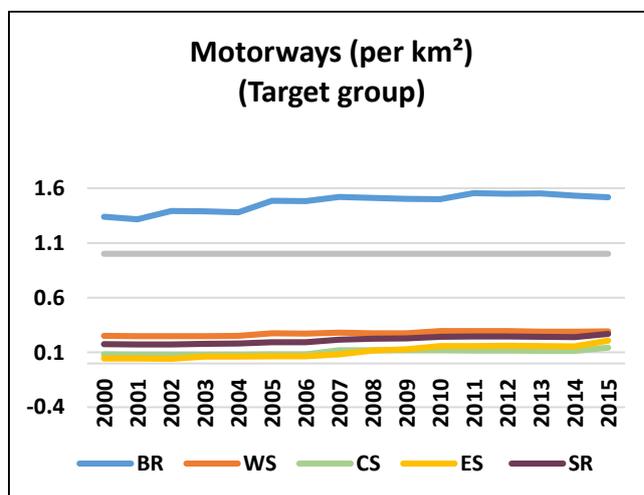
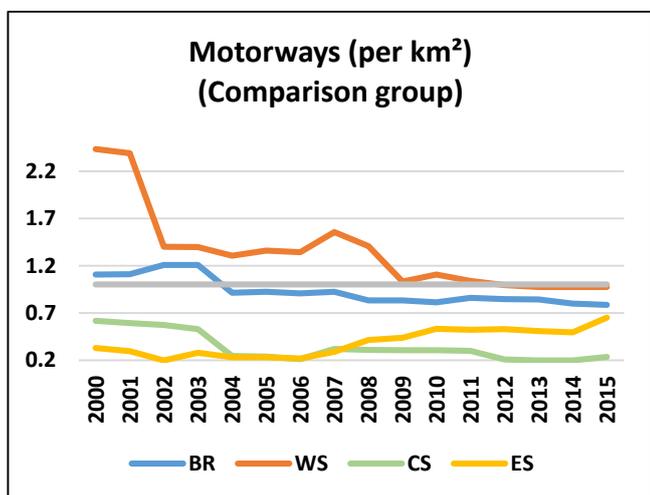
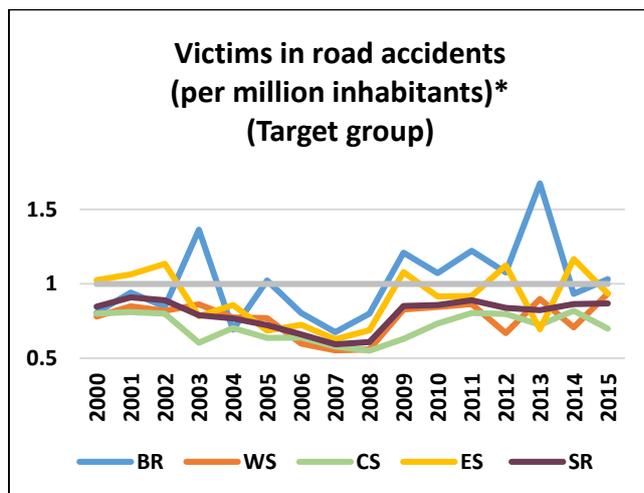
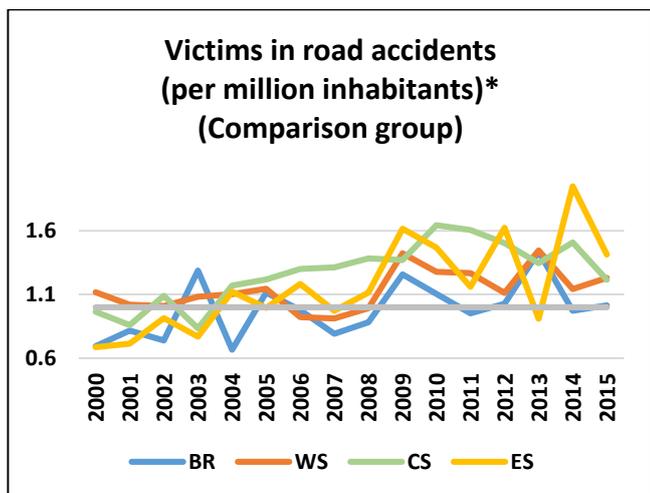
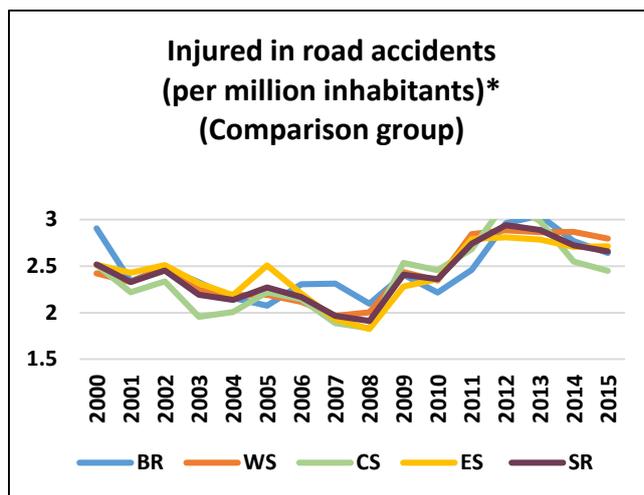
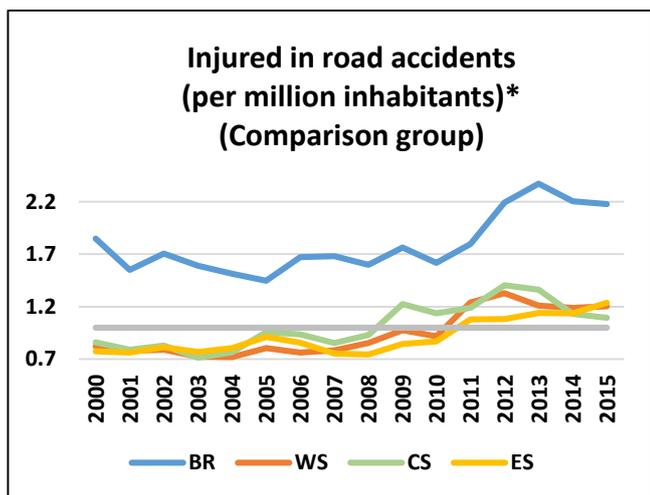
#### 4.B Development of environment indicators in Slovak regions

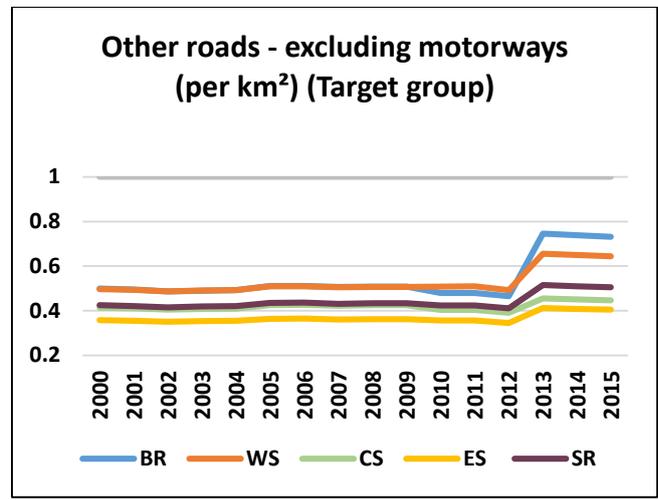
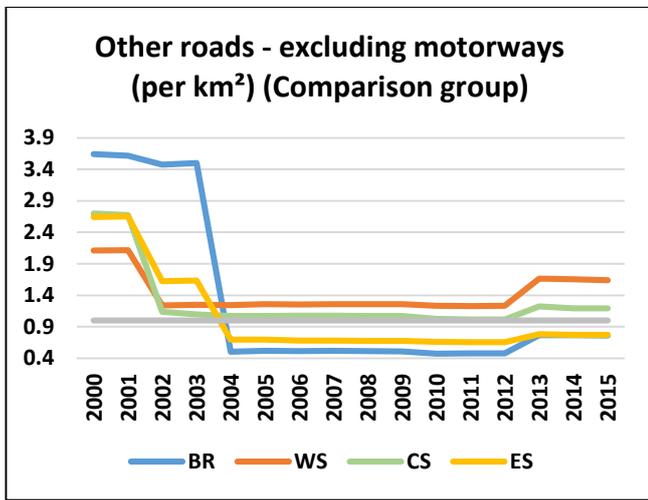


Source: Own calculation on the basis of data from Eurostat

\*inverted values

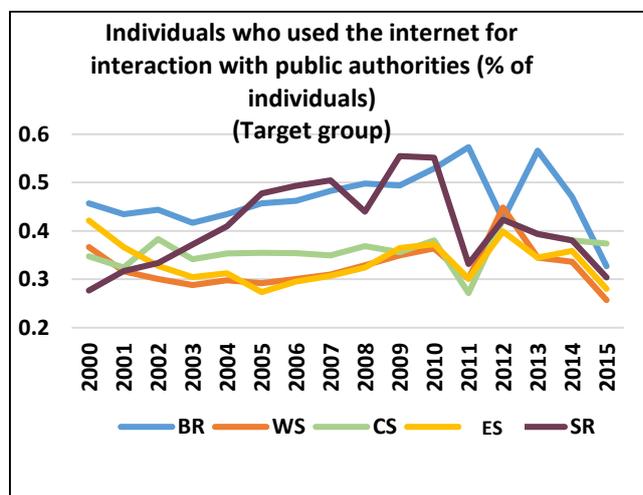
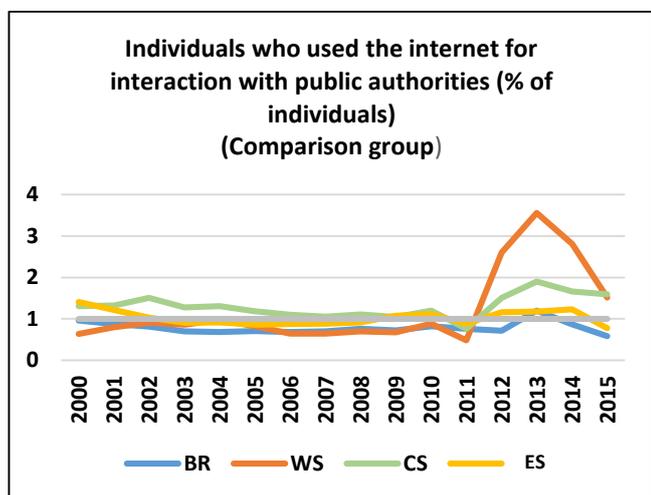
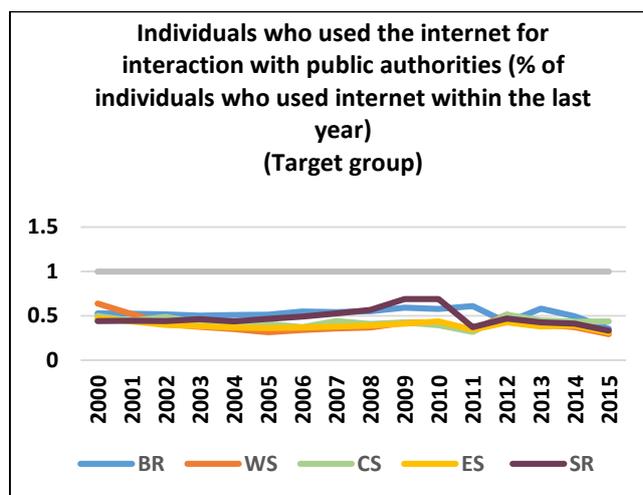
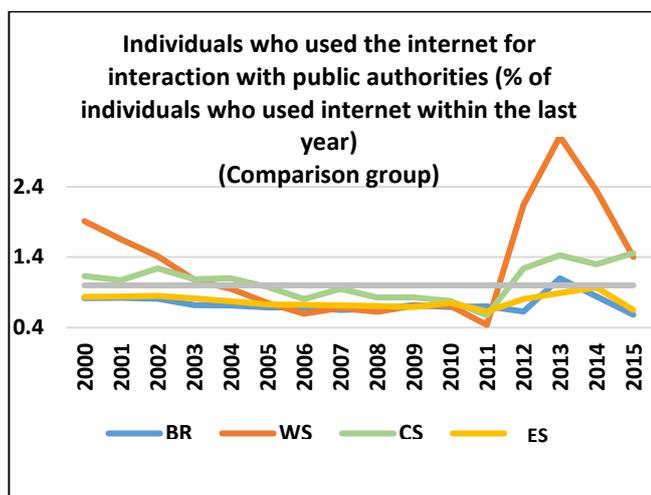
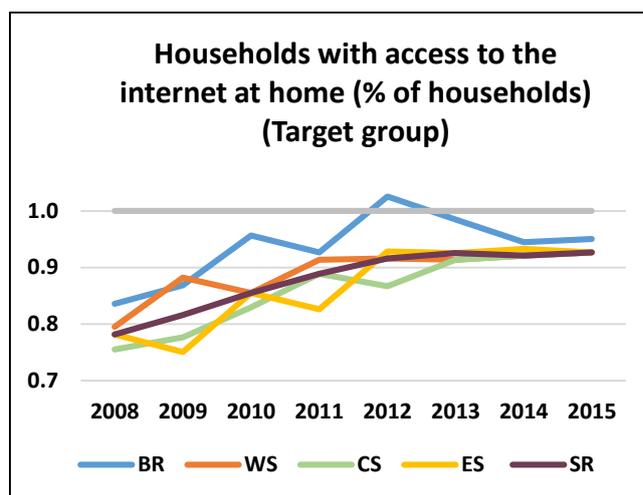
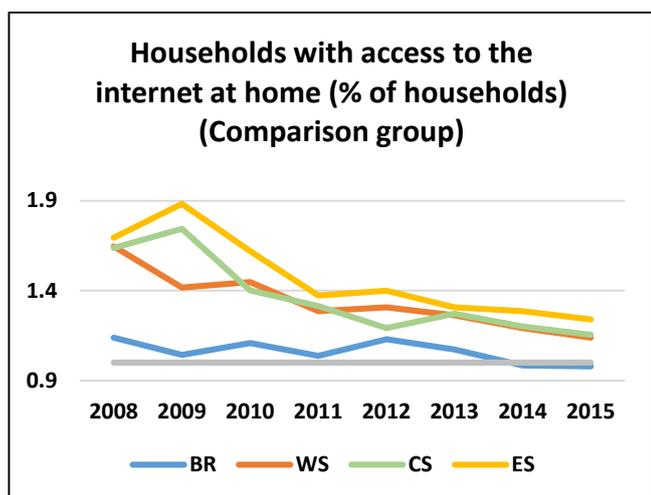
5.B Development of indicators of transport in Slovak regions





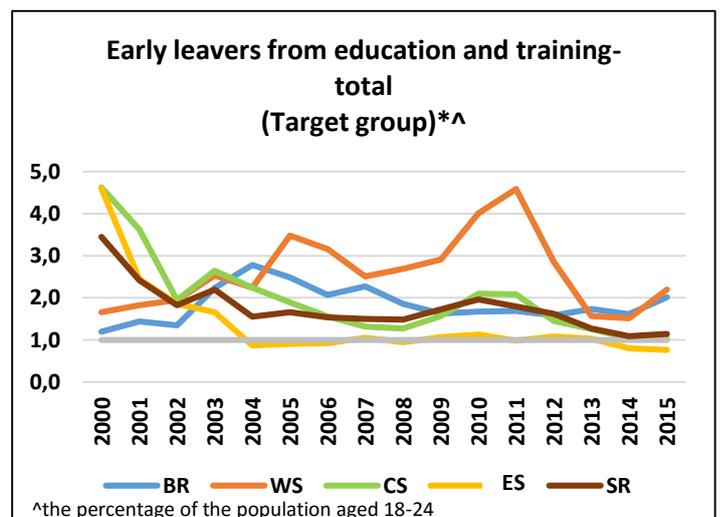
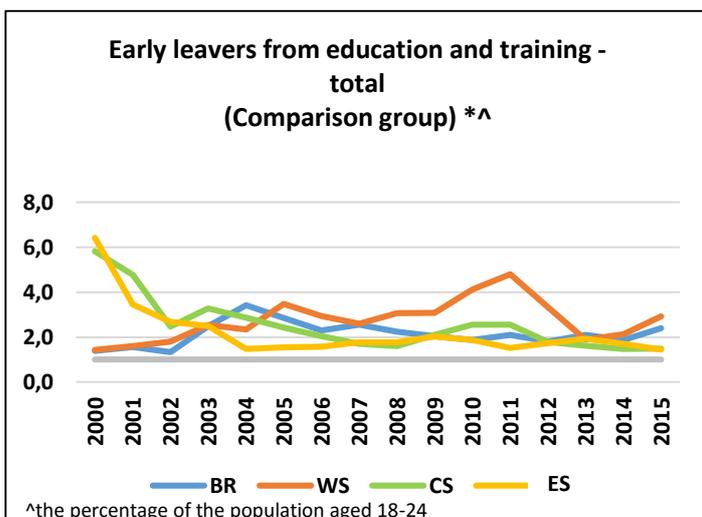
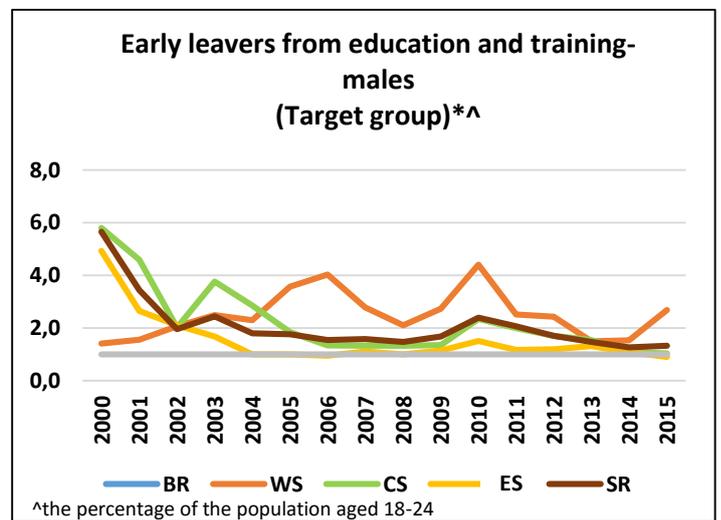
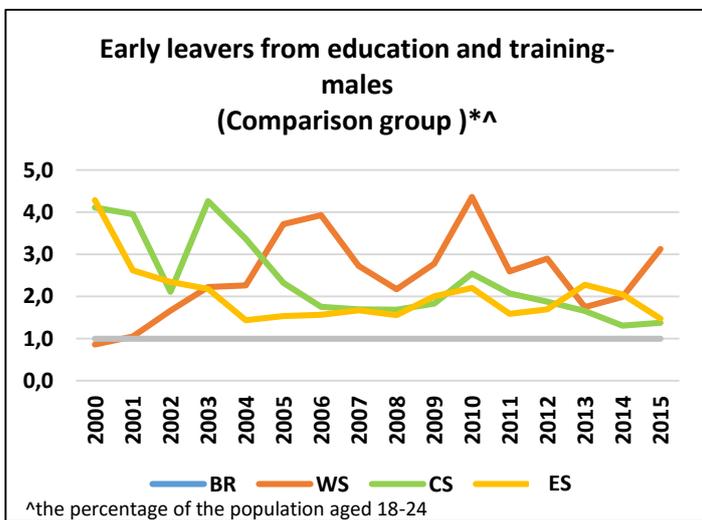
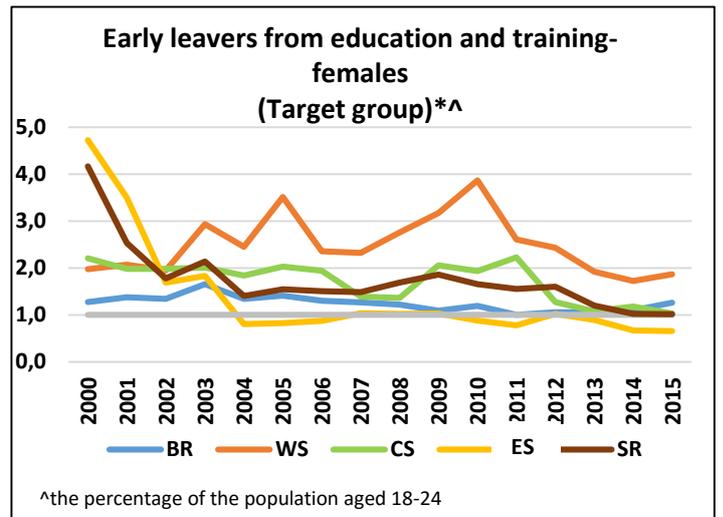
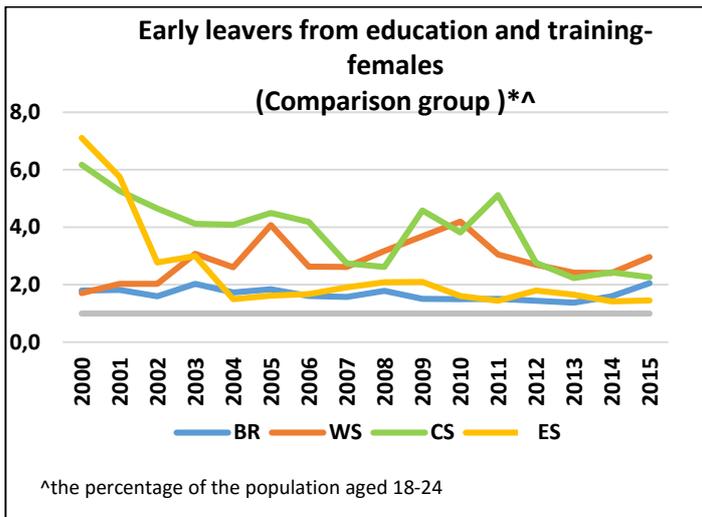
Source: Own calculation on the basis of data from Eurostat  
 \*inverted values

## 6.B Development of digital economy in Slovak regions



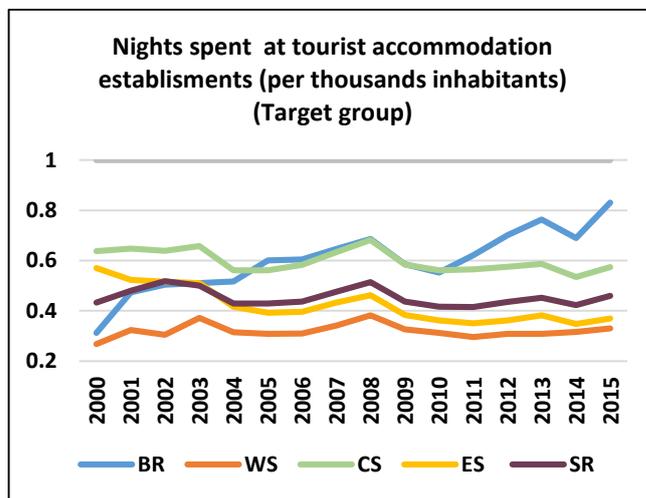
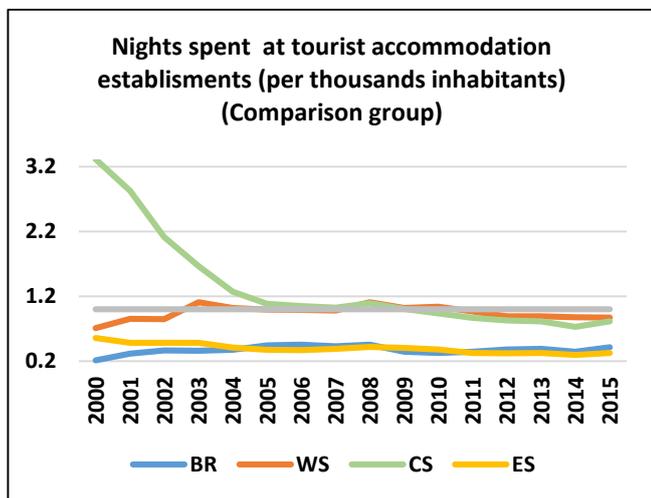
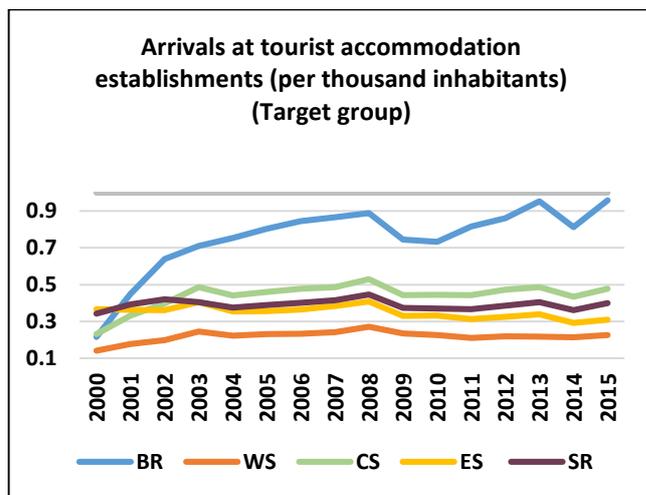
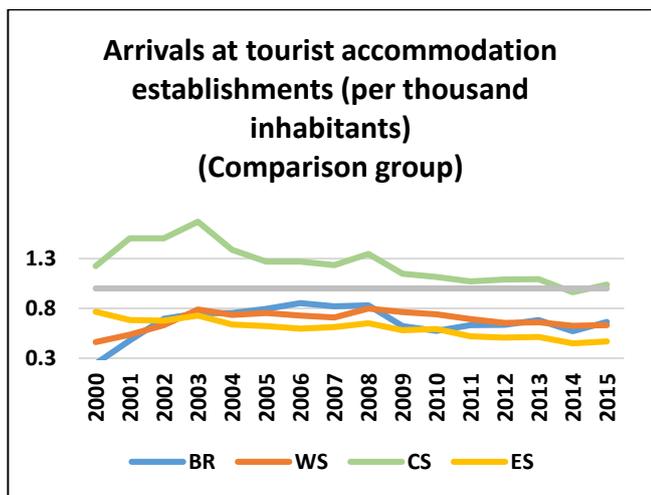
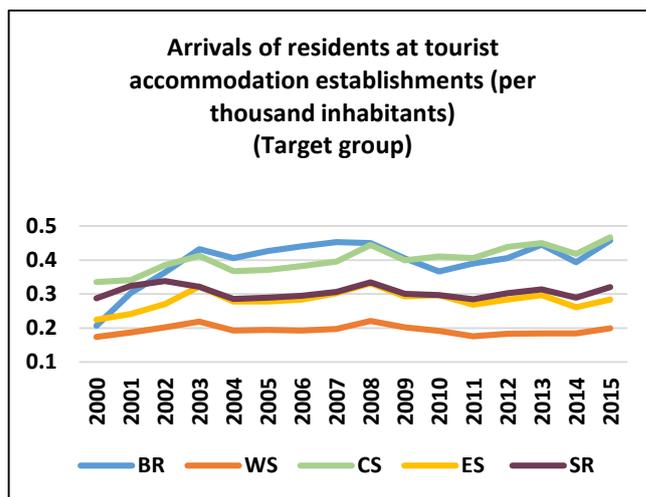
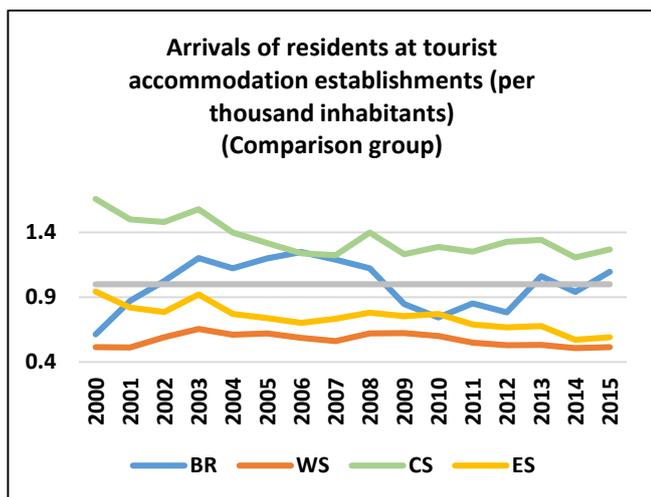
Source: Own calculation on the basis of data from Eurostat

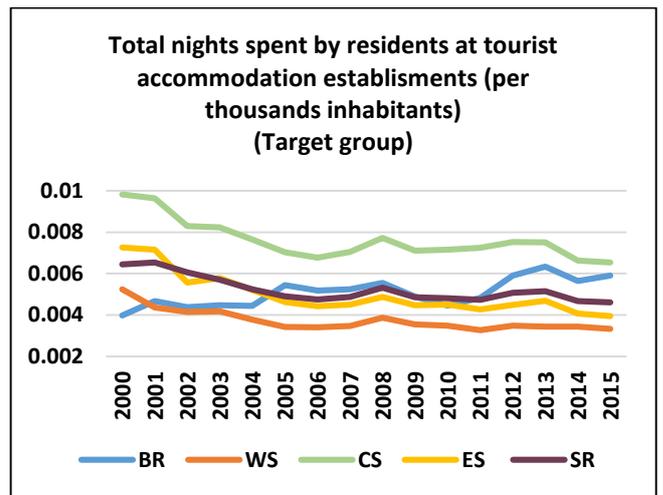
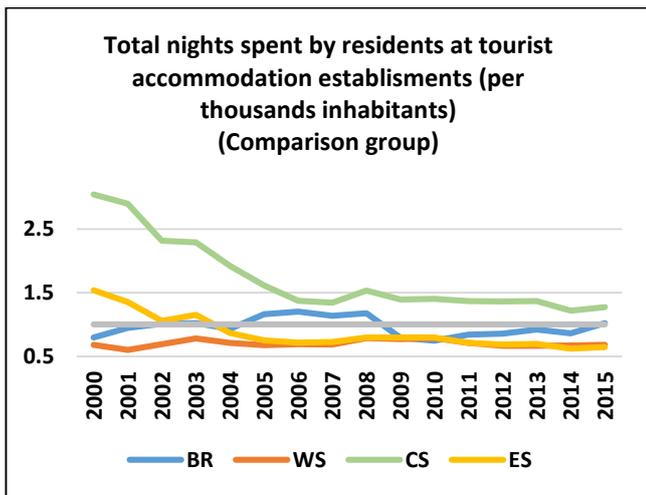
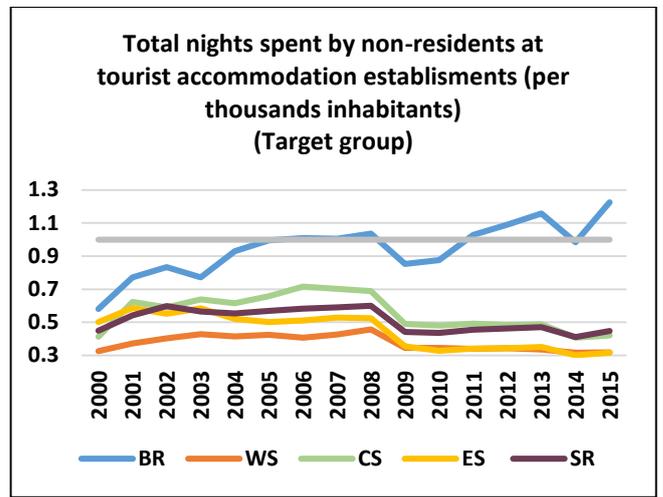
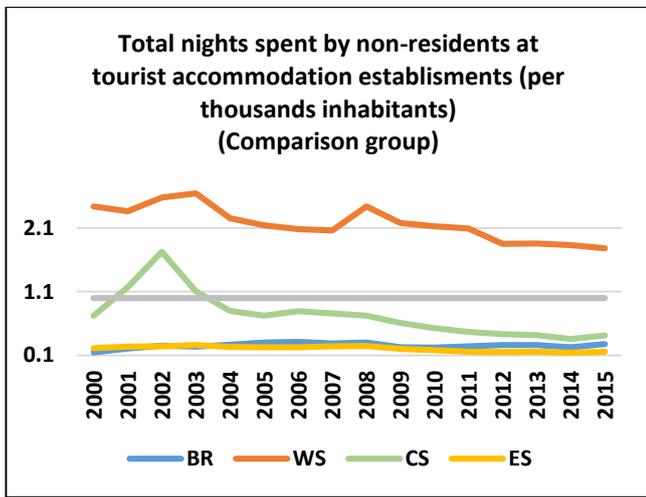
## 7. B Development of education indicators in Slovak regions



Source: Own calculation on the basis of data from Eurostat

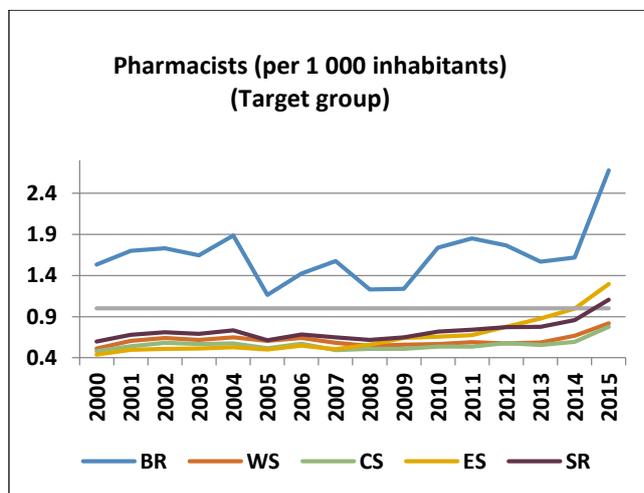
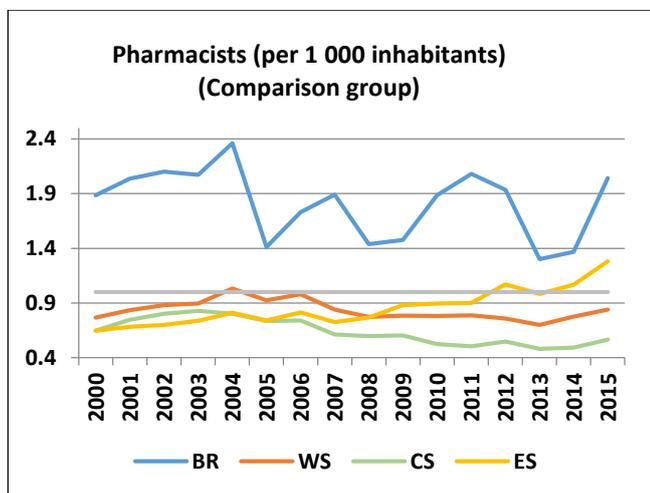
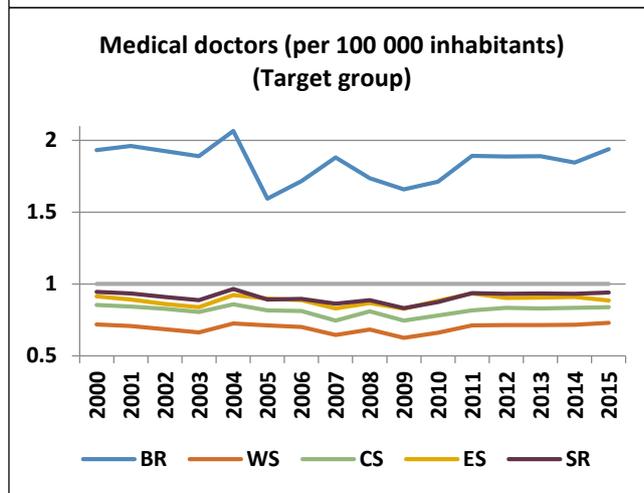
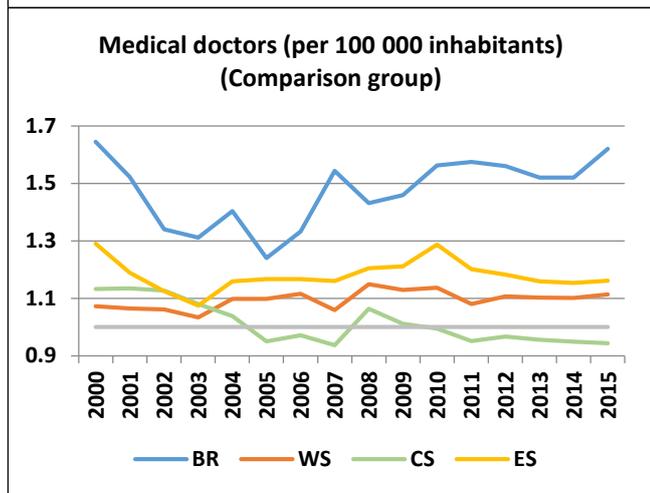
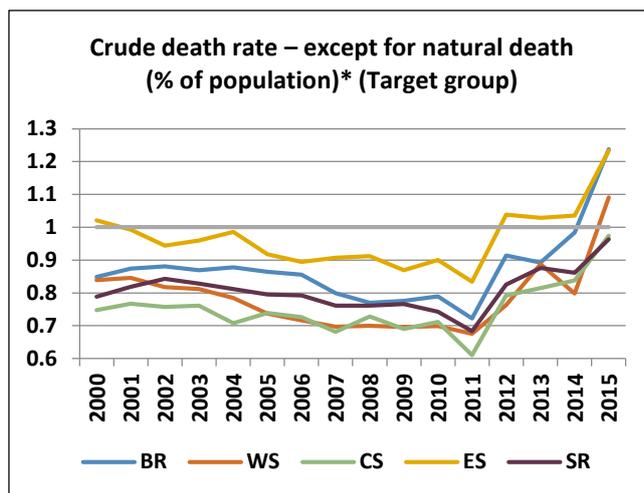
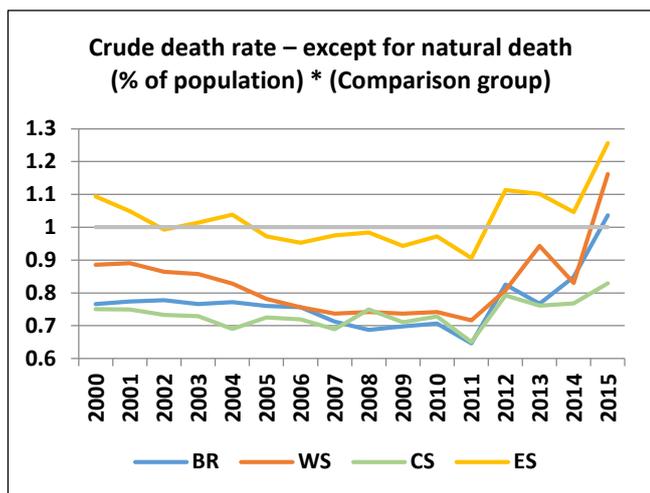
## 8.B Development of tourism indicators in Slovak regions





Source: Own calculation on the basis of data from Eurostat

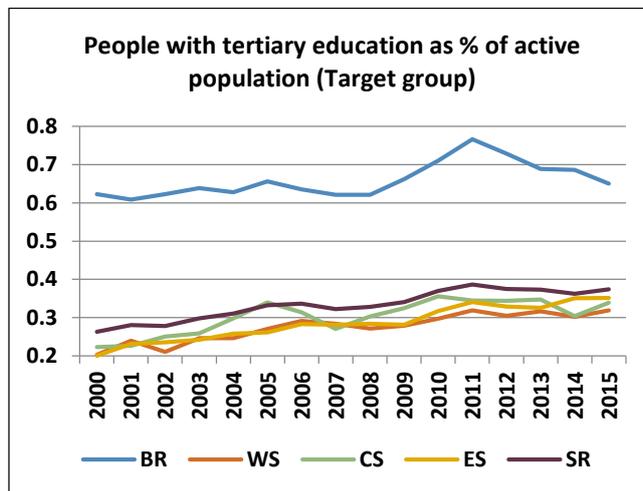
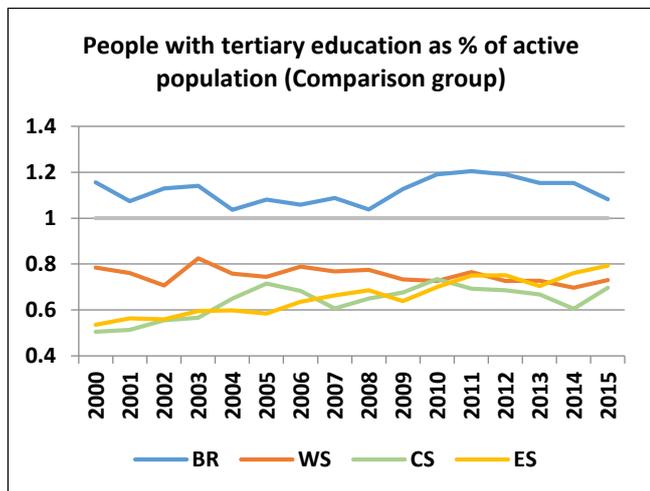
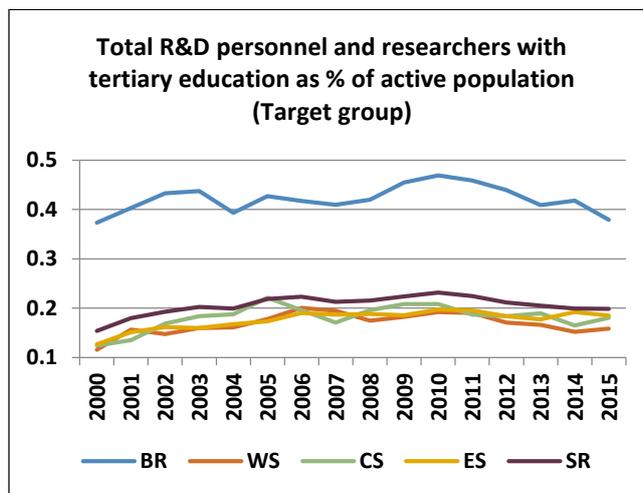
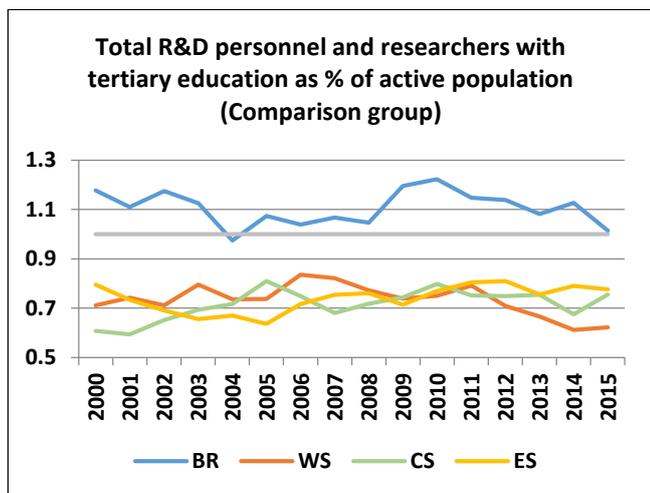
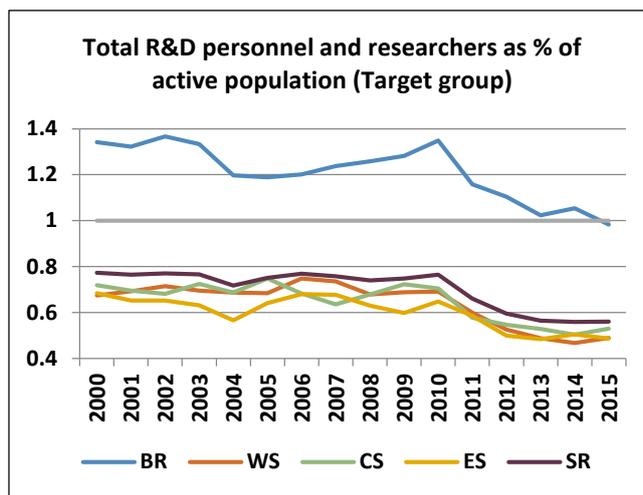
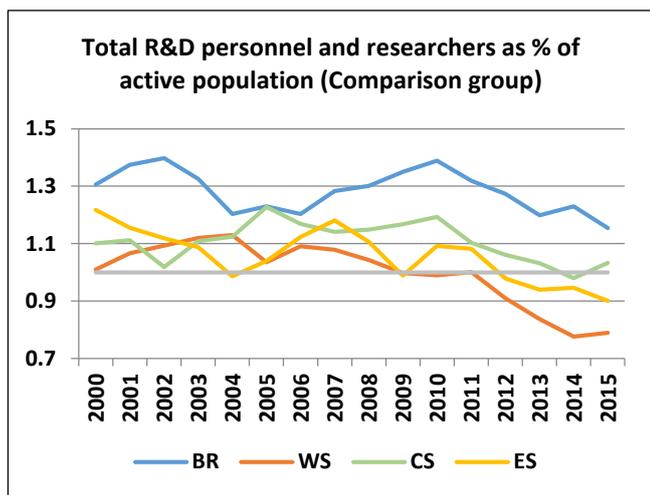
## 9. B Development of health situation indicators in Slovak regions



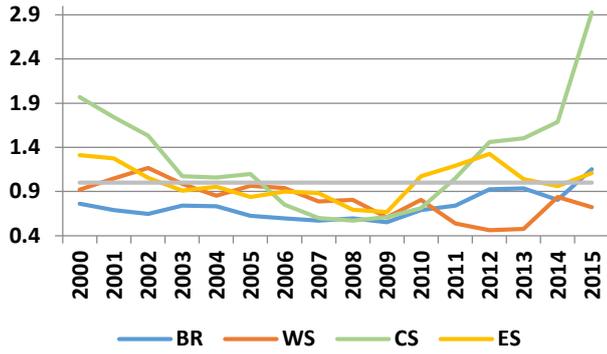
Source: Own calculation on the basis of data from Eurostat

\*inverted values

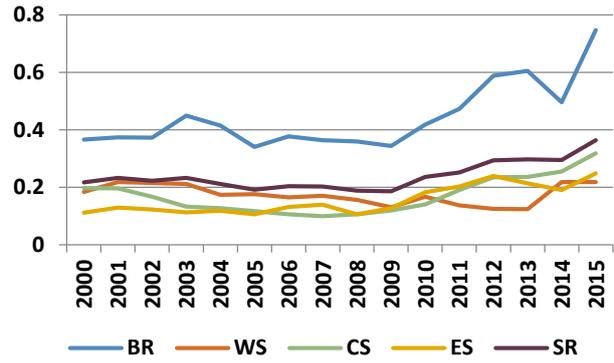
## 10.B Development of R&D indicators in Slovak regions



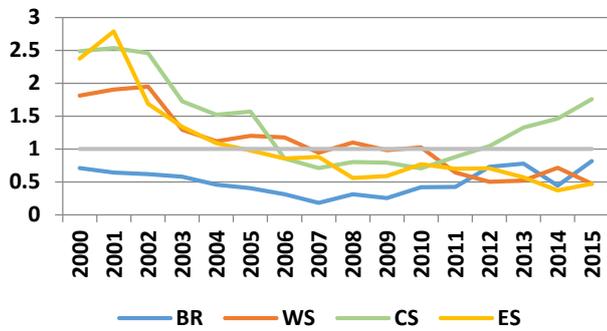
**Total intramural RandD expenditure in all sectors as % of GDP (Comparison group)**



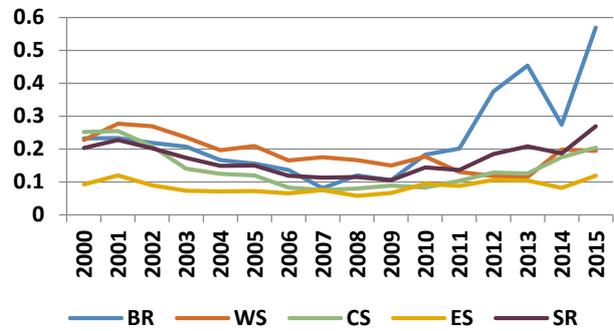
**Total intramural RandD expenditure in all sectors as % of GDP (Target group)**



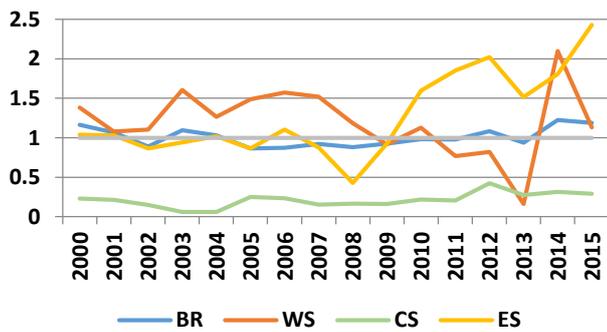
**Total intramural RandD expenditure in private business sector as % of GDP (Comparison group)**



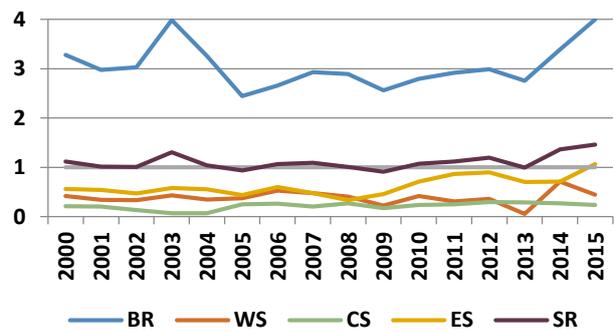
**Total intramural RandD expenditure in private business sector as % of GDP (Target group)**

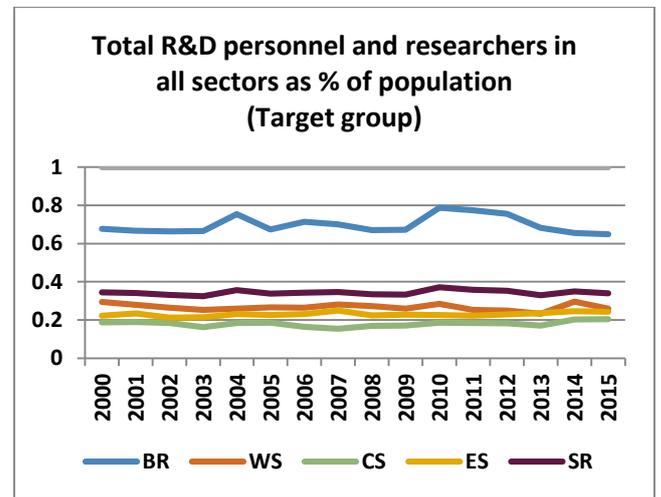
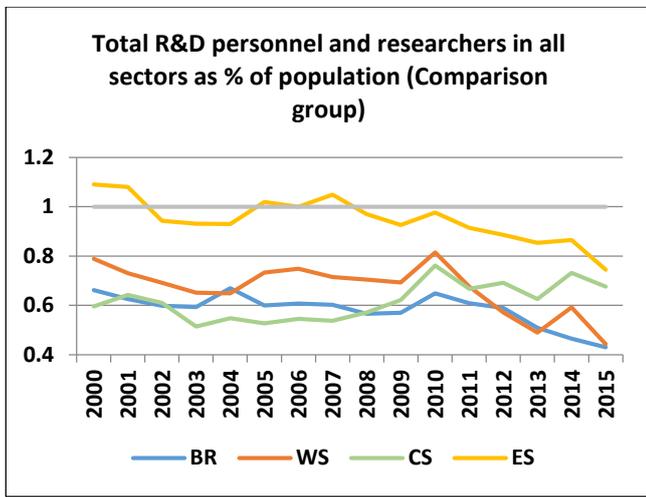


**Total intramural RandD expenditure in government sector as % of GDP (Comparison group)**



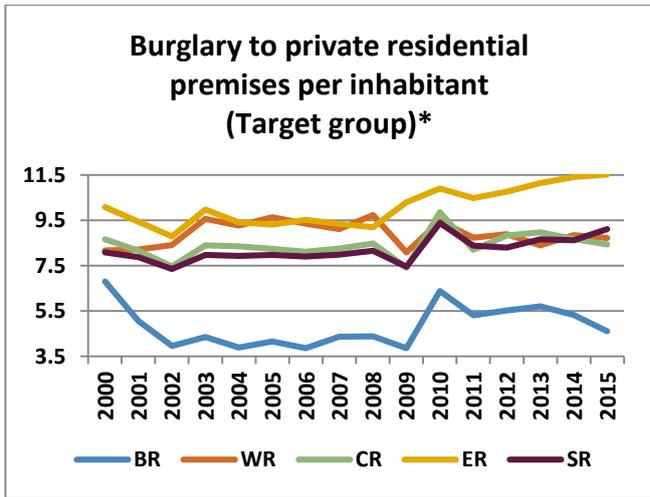
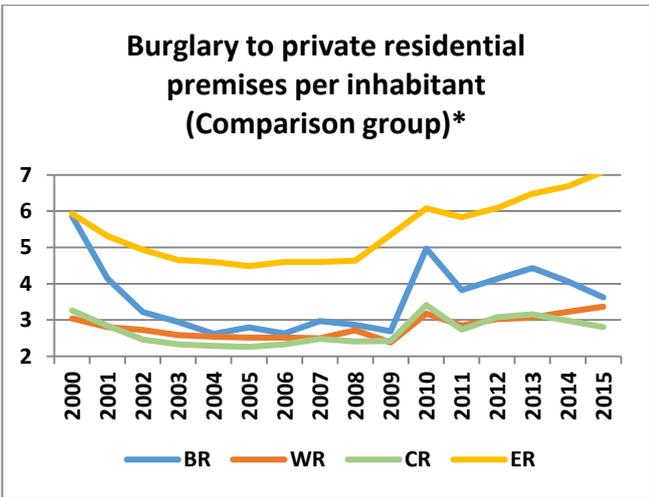
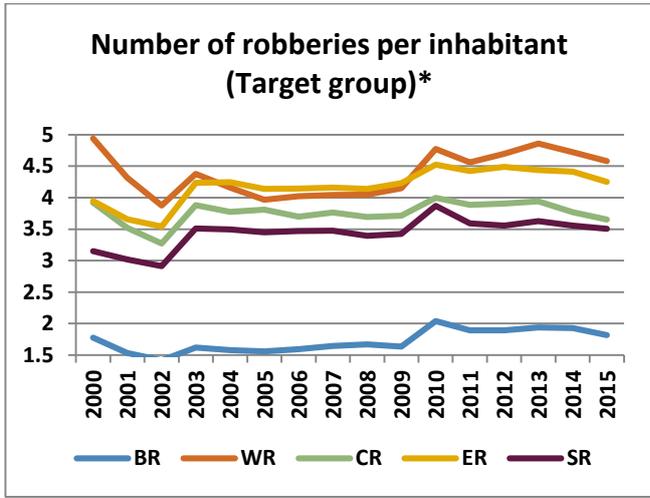
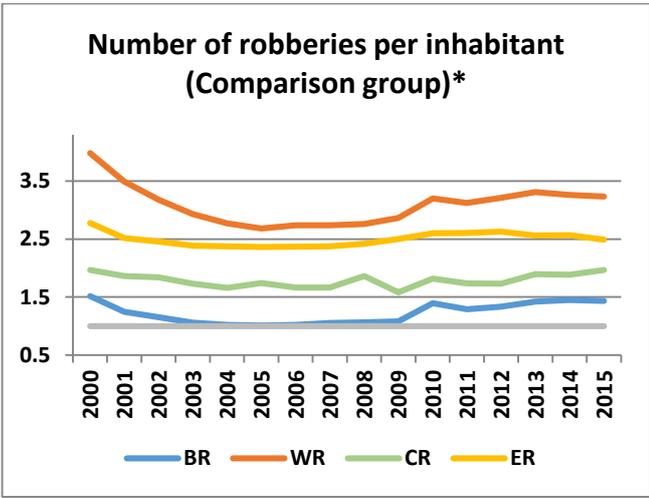
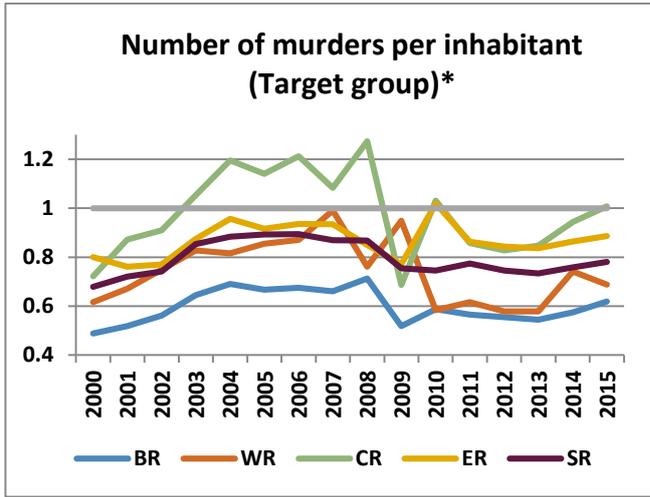
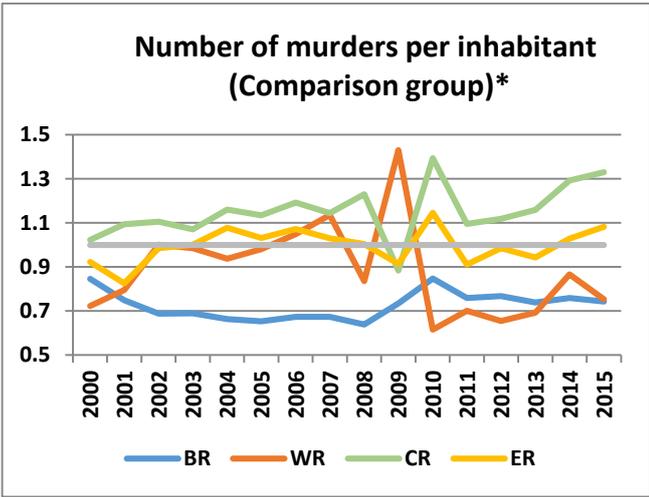
**Total intramural RandD expenditure in government sector as % of GDP (Target group)**

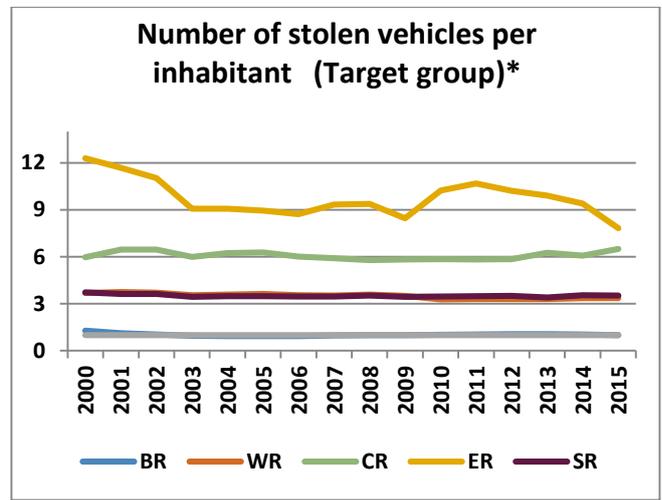
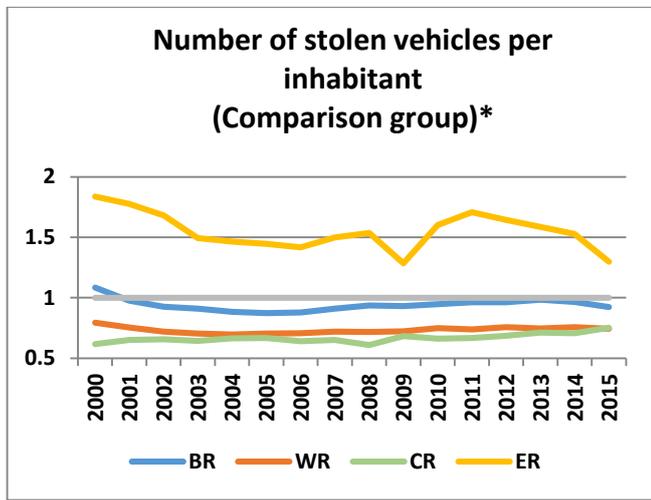




Source: Own calculation on the basis of data from Eurostat

11.B Development of indicators of crime and safety





Source: Own calculation on the basis of data from Eurostat  
\*inverted values