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## Resilience capacity and vulnerability: The case of Slovakia

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# Resilience Capacity and Vulnerability: The Case of Slovakia

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**Abstract:** The concept of resilience has been recently investigated from the perspective of several disciplines. This extensive research has brought many approaches anchoring the key definitions, linked to both the notion of stability in dynamics (return to the previous equilibrium after a shock) and to the idea of adaptivity (absorption of the shock leading to new equilibria). Among the various definitions and measurements which can be found in the literature, the Resilience Capacity Index (RCI) classifies the most resilient regions and municipalities, in the case of external shocks, according to three different dimensions: a) economic; b) socio-demographic; and c) community-connectivity. However, the RCI should also be tested empirically versus other resilience/vulnerability indicators. This is the approach which will be used in the present paper.

Vulnerability refers to the degree to which a system is susceptible to harm. In general, the concept of vulnerability has had limited attention in spatial economics. In the present paper, this concept will be adopted by analysing the dynamics of the unemployment growth rate, and comparing it to the RCI. In this context, the role of economic space is relevant, since the spatial units can provide good insights into resilience and vulnerability measures.

The country of interest in this paper is Slovakia. Slovakia is a country in central eastern Europe which is bordered by the Czech Republic, Austria, Poland, Ukraine, and Hungary and presents interesting socio-economic-policy characteristics. The chosen spatial unit is at the district level.

In the context of the 2007-2008 economic crisis, the RCI in the 79 Slovak districts is examined vs. vulnerability (based on the unemployment rate) in the first period of rising unemployment (2007-2011), as well as in the second period of following vulnerability/absorption to the economic shock (2011-2014). Similarly to previous research, the result show higher RCI in the major economic centres of Slovakia. In addition, a form of the west-east divide in RCI can also be seen. However, the reaction of the districts is ambiguous in terms of their vulnerability to the economic crisis. The more urban, export-

oriented districts seem to be exposed to higher vulnerability and to a rapid increase in unemployment in comparison to the rural districts. On the contrary, smaller, peripheral districts respond to a lesser extent or with a delay to the shock.

The approach of combining RCI with vulnerability indices provides a new understanding of the resilience-vulnerability relationship. Moreover, a deeper analysis of the Bratislava metropolitan region explains the connection between resilience capacity, economic resilience and vulnerability, as well as between employment and unemployment measures, justifying the need for an integrated approach considering all these concepts together.

## **1. Introduction**

Extreme events such as financial crises, terrorist attacks and natural disasters have given rise to plenty of studies exploring the response capacity of a system to external shocks (see, for example, Gunderson and Holling, 2002; Hutter et al., 2011; Pelling, 2011). Resilience studies have mainly focused on the length of the period needed – for a regional system – to return to its equilibrium after the impact of a shock, and on the ability and time required to absorb the disruptions. The concept of adaptive resilience (Martin, 2012) which is based on the theory of complex adaptive systems, refers to a system's ability to reorganize its structure, to generate new ways of operating, and to minimise the extent of the shock. No regional system (economy, households, communities, ecosystems) is immune to the impact of shocks, and the underlying factors of vulnerability and resilience change over time. In addition, the region may be relatively more resistant only in some respects. Thus, resilience should be understood as a multifaceted concept, and its investigation can reveal the potential risks of regional development, including ecologic and economic disruptions such as slow acting and long-lasting processes of recovery (Pendall et al., 2010).

Most of the new definitions of regional resilience refer to the idea of the ability of a local socio-economic system to recover from an external disruption or shock. Foster (2007, p.14) defines regional resilience as *'the ability of a region to anticipate, prepare for, respond to, and recover from a disturbance'*. Hill et al (2008, p.4) define resilience as *'the ability of a region ... to recover successfully from shocks to its economy that either throw it off its growth path or have the potential to throw it off its growth path'*.

Alternative approaches reflect the latent ability of the region to respond to future shocks, i.e. the expected resilience (Foster, 2007). This is the idea by Foster (2007) who developed the Resilience Capacity Index (RCI). The RCI, in its original version by Foster, has been adopted to classify the regional status on the basis of twelve resilience factors, and has been applied to

the U.S. metropolitan regions. This RCI index has also been used in combination with accessibility (Östh et al., 2015) as a way of a more complete investigation and measurement of economic resilience.

Vulnerability research has been shaped by human ecology, political economy, geophysical sciences and political ecology (Eakin and Luers 2006, McLaughlin and Dietz 2007). Several significant vulnerability studies have been written in psychology examining cognitive vulnerability (Riskind et. al., 2005), in a military context as survivability (Ball, 2003) as well as in transportation research (O’Keefe et al., 1976; Berdica, 2002; Reggiani et al., 2015). Vulnerability has also been examined regarding environmental hazards and risks (Blaikie et al., 1994; Kaspersen et al., 2005). According to these studies, politically disempowered and economically marginal groups are considered as the most vulnerable due to their lower coping capacities. They tend to be the most exposed and sensitive to the hazard. Further attention has been paid to the related outcomes of poverty, housing or hunger (Turner, 2010).

Vulnerability in regional science is related to resilience, and usually means the exposure to shocks. It represents the structural characteristic of the region generated by multiple factors and processes. If risk is used to designate the potential of shocks to affect the state of systems (or communities, households or individuals), vulnerability is “*the propensity or predisposition to be adversely affected*” (IPCC, 2012, p.5) In studies which have examined the impacts of global environmental change, vulnerability is included in the notion of resilience (Gallopin 2006). However, in research on hazards, the concepts of vulnerability and resilience are treated as separate with a certain degree of integration (Cutter et al., 2008).

Therefore, the aim of the present paper is to investigate the potential of these two approaches, RCI and vulnerability, in the context of Slovakia after the economic crisis of 2007-2008. Section 2 will describe the main definitions of economic resilience and vulnerability which have emerged from the scientific literature, while Section 3 will present the data and methodology used in the empirical analysis. Section 4 will outline the results concerning RCI, as well as the dynamics of vulnerability indicators in Slovakia. Finally, Section 5 will provide some retrospective and prospective remarks.

## **2. Economic resilience and vulnerability**

In the context of the economic crisis, the concepts of economic resilience and vulnerability have gained increasing attention (Christopherson et al., 2010). The linking of economies and interdependence of regions, in addition to the positive effects, has also highlighted the increased sensitivity to regional economic fluctuations (Kraft et al., 2011).

Economic resilience can be measured as the degree of impact of the recessionary shock on the regional economy, by considering the rise/decline of employment growth rates (Lagravinese, 2015; Martin, 2012). Adaptability is linked to system properties such as how rapidly companies are able to switch to other activities or how easily the employees can adjust to change. Economic vulnerability which can be regarded as the susceptibility of a system to external shock (Seeliger and Turök, 2013) can be measured as unemployment increases (Champion and Townsend, 2012; Lee, 2013). The unemployment change deals with the economic vulnerability of a region assessed by a higher number of workless local inhabitants.

Many regional scientists (e.g. Christopherson et al., 2010; Foster, 2007; Hassink, 2010; Hill et al., 2008; Newman et al., 2009; Vogel, 2007) believe that economic resilience can help to explain the essential question of why some regions can recover from external shocks in a relatively short time and why others remain in economic decline. The best way to quantify the economic resilience of regions is either regional productivity or regional employment (Martin, 2012). The common disadvantage of both indicators is their inability to prevent the influence of the job mobility factor. Martin (2012) has analysed economic resilience through four dimensions: resistance, recovery, re-orientation and renewal, in the context of British regions.

The economic view of vulnerability is rather different. The smaller economies, such as islands, tend to have a high degree of economic openness and export concentration. This is one of the factors which subsequently leads to their economic vulnerability given the higher exposure to external shocks (Briguglio et al., 2009). Economic vulnerability has been ascribed to the '*inherent conditions affecting a country's exposure to exogenous shocks*', whilst economic resilience is linked to public authorities, policy makers, businesses and the undertaken actions '*to enable a country to withstand or recover from the negative effects of shocks*' (Briguglio, 2004, p. 2).

Resilience and vulnerability have been studied in a way of framing the responses to social-economic-ecological changes (Seeliger and Turok, 2013). Resilience is explained as the capacity of a system to rebound after a shock, while vulnerability is about the susceptibility of the system to external shocks. Vulnerability has rarely been applied in spatial economics and has rather been adopted in transport science. Resilience and vulnerability are shown to be related to connectivity (between the cities or regions within the country or outside) and play a fundamental role in the configuration of spatial economic networks and associated network accessibility (Osth et al., 2015; Modica and Reggiani, 2015).

The paper focuses on the economic vulnerability of Slovak districts to the economic crisis of 2007-2008, in addition to their resilience capacity measured by the Resilience Capacity Index (RCI). RCI consists of three dimensions; a) Regional Economics; b) Socio-Demography; and c) Community Connectivity. The percentage change of unemployment is used to assess the economic vulnerability on the basis of the approaches by Lagravinese (2015) and Martin (2012) measuring economic resilience (or resistance) by the changes in employment.

A further aim of the paper is to analyse the economic vulnerability in spatial units (districts) smaller than regions, in order to understand the role of the spatial effects in the dynamics and variability of the shock propagation. In particular, 79 districts (LAU 1 level) in Slovakia, with an average population of 68,000 inhabitants, have been examined in this context. The introduction of RCI (Foster, 2007) in conjunction with economic vulnerability (Lagravinese, 2015) allows the study of several research questions:

Do urban districts have high resilience capacity? How important is proximity to the economic core?

Does high RCI also mean low economic vulnerability?

How intertwined is economic resilience (employment change) with economic vulnerability (unemployment change)?

### **3. Data and methodology**

#### **3.1. Economic resilience data**

The Resilience Capacity Index (RCI) developed by Foster (2007) is used to examine the resilience capacity of the Slovak districts. The RCI is a compound of 12 variables aggregated into three categories: A: Regional Economic attributes; B: Socio-Demographic attributes; and C: Community Connectivity attributes (see Appendix A).

**Regional Economic Indicators** reflect regional income equality, regional affordability measured by housing costs and income levels, diversification of the economy and business environment.

**Socio-Demographic Indicators** reflect the capacity of the region on the basis of educational attainment, disability, the share of the population with incomes no higher than the poverty line, and the percentage of incapacity for work.

**Community Connectivity Indicators** reflect the number of civic organizations, home ownership, voter participation rates and metropolitan stability measured by the percentage of long-duration dwellers in the district.

Data are collected from the years 2011-2014, as some of the indicators are only available from the census which is every 10 years. The emerging RCI values appear to be rather stable. However, due to the different measurement units of the indicators, z-score transformation was used to convert all the indicators to a common scale with a mean of zero and standard deviation of one.

### 3.2. Economic vulnerability data

The measurement of vulnerability is derived from an approach by Martin used to evaluate two phases of "resistance" and "recovery" of regions during the economic recessions in the UK (Martin, 2012). The calculation of economic vulnerability is based on the unemployment data at the district level (LAU1). The data are taken from the Statistical Office of the Slovak Republic database over the years 2007–2014.

Two subsequent indices represent the dynamics of vulnerability:

- a) *Vulnerability Index* of period 1 (2007–2011), which reflects the behaviour of the districts to the economic shock during the economic crisis;
- b) *Vulnerability Index* of period 2 (2011–2014), which displays the longer-term reactions of the districts after their exposure to the 2007/2008 crisis.

Figure 1 shows the dynamics of vulnerability which might have been expected.

The vulnerability index (VI) is measured by the relative change in unemployment, by taking into account the Lagravinese Index of Resistance (Lagravinese, 2015) based on Martin (2012). The vulnerability values have been calculated as follows:

$$\lambda = \left[ \left( \frac{\Delta X_d}{X_d} \right) - \left( \frac{\Delta X_N}{X_N} \right) / \left| \frac{\Delta X_N}{X_N} \right| \right], \quad (1)$$

where  $\left( \frac{\Delta X_d}{X_d} \right)$  and  $\left( \frac{\Delta X_N}{X_N} \right)$  are the percentage changes in unemployment at the district and national levels. A positive value of  $\lambda$  indicates that the district exhibits greater vulnerability (Vulnerability Index during period 1) or lower absorption of the shock (Vulnerability Index in period 2) compared to the rest of the country. A negative value of  $\lambda$  represents districts with a lower vulnerability or higher absorption of the shock than the national average.

FIG. 1 ABOUT HERE

The results emerging from the application of Eq. (1) on the 79 Slovak districts are analysed in the next section.

## **4. Results**

### **4.1. Resilience capacity of the Slovak districts**

The cumulative score of the three components of the RCI (Appendix A) shows the expected results. The highest values are found in the five districts of the capital city Bratislava (left lower corner, Figure 2). A comparatively good situation is also seen in the northwest parts of Slovakia, while the worst situation is in the east and south Slovak districts.

FIG. 2 ABOUT HERE

Figure 3 contains three maps representing the three dimensions of the RCI. The darker colours denote districts with a stronger capacity according to the three dimensions of RCI.

The first map (Figure 3a) displays the Economic dimension of the RCI. The best economic situation can be identified in the urban districts such as Bratislava and another central areas. This is due to the higher quality business environment and working opportunities followed by a higher nominal monthly wage. The areas of lower economic capacity are mostly located in the south-west and north-east parts of Slovakia.

The second map (Figure 3b) highlights the Socio-Demographic dimension of the RCI. The most developed capacity continues to be in all five Bratislava districts which lead in educational and health indicators.

The last map (Figure 3b) reflects the Community Connectivity dimension of the RCI and brings different results. The country is split into two main parts although the western part shows higher community connectivity capacity than the eastern part. Moreover, the dominance of Bratislava and other urban centres is lower.

Similarly to previous studies (Östh et al., 2015), the major urban centres lead in the first two dimensions. In this case, the capital city of Bratislava, confirms the highest RCI value. In fact, RCI reflects, to a large extent, the existing socio-economic disparities of Slovakia (Bartošová and Želinský, 2013; Halás, 2008). However, the reaction to the economic crisis (which is illustrated subsequently) will show how vulnerability can also be high in this Bratislava area.



FIG 3A. ABOUT HERE

FIG 3B. ABOUT HERE

FIG 3C. ABOUT HERE

#### **4.2. Economic vulnerability of the Slovak districts**

Most studies looking at vulnerability deal with either the (lack of) adaptive capacity of regions/countries to recover from the external shock or the sensitivity of regions/countries to external shock, measured by time series analysis. An integrated view of economic vulnerability combines two consecutive phases of vulnerability, as described in Section 3.2: a) the analysis of the Vulnerability Index (VI) reflecting the impact of the economic crisis of 2007 during the years 2007–2011 (VI of phase 1); b) the analysis of the Vulnerability Index dealing with the reaction after the crisis, during the years 2011–2014 (VI of phase 2). Both indices are measured – as indicated in Eq. (1) – by the percentage change of unemployment in the districts, while the percentage change of unemployment in Slovakia represents the benchmark. The darker colours demonstrate the higher vulnerability of districts to the impacts of the crisis, while lighter colours denote a lower vulnerability.

Interestingly, Figure 4 shows that the VI in both periods displays a much higher relative change in the unemployment rate in the western districts in Slovakia. This is probably due to the fact that these districts are closer to the European economic core and are export oriented. Their unemployment rate is affected more greatly, and their substantial resistance to the shock requires a longer period.

FIG. 4A ABOUT HERE

FIG. 4B ABOUT HERE

The maps in Figure 4 reveal the division of Slovakia into two halves. The first half contains the districts located in the western and north-western part of Slovakia, while the second half contains the districts in the eastern and south-eastern part.

In the western districts, there are a lot of large companies which are mainly aimed at export (e.g. car production for export such as Volkswagen, KIA and Peugeot). These companies employ inhabitants of the respective and neighbouring districts as well as from the whole country. Thus, the western districts are more vulnerable to external economic shocks than others because they have open economies, which are linked to the European economic core. This is the main reason for the higher percentage change in unemployment in the western districts in comparison to the eastern districts which are less dependent on global changes.

These two periods (Vulnerability period 2007-2011 and Vulnerability period 2011-2014), as well as the two basic reactions (unemployment rate higher or lower than the national average) can define four categories of districts:

- a. *Globally dependent* (vulnerable with low absorption capacity), lighter colour in both Fig. 4a and Fig 4b,
- b. *Coping with depression* (vulnerable but higher absorption capacity), darker colour in Fig. 4a and lighter in Fig 4b,
- c. *Resilient* (less vulnerable and good absorption capacity), lighter colour in both Fig. 4a and Fig 4b,
- d. *Second wave vulnerability* (less vulnerable but low absorption capacity), lighter colour in Fig 4a and darker in Fig 4b.

Globalization and export-orientation can explain the higher vulnerability and slower resilience of globally dependent districts. The districts further from Bratislava, often more rural, are less affected by the crisis. Their resistance is explained by their lower global dependence and lower accessibility. The general disadvantages of low accessibility and peripherality have hereby a positive side of lower accessibility to global shocks and protection of residents from global movements. This allows the creation of a taxonomy of districts into the four mentioned groups, as also illustrated in Figure 5.

FIG. 5. ABOUT HERE

### **4.3. Correlation analysis**

The combination of vulnerability with RCI, conceived as the expected capacity to react to future shocks, can bring apparently heterogeneous results. The correlation analysis shows that there is a significant positive correlation between the RCI and both indices of Vulnerability (VI – Vulnerability Index). This positive correlation means that high economic vulnerability accompanies a high RCI in these districts, as also highlighted in Figure 5. The construction of the RCI, particularly with regards to the first pillar of Economic Capacity and the second pillar of Socio-Demographic Capacity, would favour urban districts. Rurality is defined here as the percentage of the district population living in a rural area (Statistical office of the Slovak Republic, 2011). Indeed, the analysis also shows a significant negative correlation between the RCI and rurality of districts. As such, the more rural districts have a lower RCI than urban districts, such as the Bratislava districts and their neighbours.

FIG. 6. ABOUT HERE

The districts distant from Bratislava and the rural eastern districts are affected later, and to a smaller extent, from the 2007 shock.

By considering, as complement to the district analysis, the economic dynamics of the Bratislava region, it can be seen that the Bratislava region shows an increase in unemployment up until 2014, while the rest of Slovakia was able to decrease unemployment after 2012 (Figure 6). This begs the question of why the most relevant urban districts in the Bratislava region, which display the highest RCI, appear to be the most vulnerable over time.

FIG. 7: ABOUT HERE

This ‘apparent’ paradox is dealt with in the subsequent section which considers in more detail the Bratislava districts and their employment dynamics.

### **4.4. Resilience versus vulnerability**

As anticipated, the results of the empirical analysis illustrated in the previous sections show an apparent paradox, since the Bratislava districts display the highest RCI, as well as the

highest vulnerability indices. The explanation might be the following: export-oriented, urban regions with foreign-owned companies (located in the Bratislava region) are more vulnerable given that they are more influenced by global effects. The unemployment is spread over the years to the more distant districts with a delay and/or modestly. However, even though the Bratislava districts result to be more vulnerable (i.e. the relative growth rate of unemployment is higher than the growth rate of the nation), the RCI suggests they should have a real potential to overcome this vulnerability.

In addition, it should be emphasized that the vulnerability of the Bratislava districts only affects its residents, since the unemployment statistics are resident-based. In other words, as a result of the crisis, the residents of the capital are in competition with workers who have lost their job in other regions and with those looking for a better job (intensified centripetal forces of the core of Bratislava during the crisis).

Consequently, while the RCI of Bratislava districts is undoubtedly high, showing the potential and ability of the districts to produce jobs during the crisis also for the entire national labour market, competition in the national labour market is causing vulnerability for Bratislava residents. Thus, the employment and unemployment rates say something rather different, since the latter variable is based only on residents, while the former on the total workplaces (residents and commuters).

#### FIG. 8. ABOUT HERE

By considering in more detail the spatial economic scale, it is worth noting that the Bratislava region consists of the 5 districts of the Bratislava City (Bratislava I – Bratislava V). The adjacent mixed urban/rural districts are Malacky, Pezinok and Senec (Fig. 8). The Bratislava region has a favourable location given its border with Austria, the Czech Republic and Hungary, making it open to the European economic core. The positive spread effects have brought a rapid growth in three of the neighbouring districts of Bratislava in the last 20 years, in terms of new economic activities as well as in terms of population, thanks to suburbanization. However, the position of the capital is also a source of strengthening regional disparities at the national scale.

At a regional level, aggregating the five districts, the economic vulnerability based on unemployment seems to increase over the year, and its effects are probably widespread covering the whole country (Figures 4, 7 and 8). However, if employment is considered, it shows rather a different dynamic picture (Figure 9). Despite the period of increasing

unemployment in all five districts, three districts (Bratislava V, Senec, Malacky) showed a significant increase in employment. The other districts experienced a smaller decrease or remained stable. The number of jobs in Bratislava V continued to grow thanks to previously prepared FDI projects such as Lenovo, OMV, UNIPETROL, SHELL, AT&T Global Network Services, ESET, Faurecia, O2, etc. The Senec district also acquired several investments in logistics and benefits from the suburbanisation effects. The population in the Senec district rose 30% between 2007 and 2014. Therefore, it can be concluded that the Bratislava districts were rather resilience to the crisis (RCI based on employment data), while it was not so for the Bratislava residents (vulnerability indices based on unemployment data).

In other words, while the number of jobs in some Bratislava districts increased, the competition in the labour market caused that many local residents of the Bratislava districts lost their jobs due to residents from other districts in Slovakia.

FIG. 9. ABOUT HERE

## **5. Conclusions**

The adoption of a joint approach ‘RCI-vulnerability’, and its application to the Slovak districts, has highlighted the dynamic features of the socio-economic Slovakia system, after the shock produced by the 2007 economic crisis.

The RCI, based on twelve socio-economic-demographic variables, has shown itself to be positively correlated with the most urbanised districts of the Bratislava region. At the same time, the vulnerability analysis, based on the unemployment growth rate, showed high values in the same districts. This apparent paradox could be explained as follows. The economic vulnerability of the Bratislava region is caused by the increase in the unemployment of its residents, who have lost out to workers from other districts, as a result of the crisis. In addition, newcomers to the labour market, such as women and students, might have generated an unemployment growth after the economic crisis. In this context, it would be interesting to examine in future, the dynamics of the various economic sectors, as well as of the various cohorts, in order to understand which sectors, gender differences and group ages of workers have driven this vulnerability of residents in the Bratislava area.

The paper has highlighted another important factor of the global dependence of the economic core in Slovakia, that was immediately affected just after the crisis occurred: the increase in the unemployment rate continued even when the national unemployment rate curve had already reversed the upward trend caused by the 2008 crisis. The economic vulnerability seems to depend on the exposition of the region. The more open the district is to global markets and is more pro-export oriented with foreign-owned companies, the quicker the unemployment increases in comparison to closed economies. The peripheral districts, located far from the economic core, have only been mildly affected by the external shock, or only during the second period, as their global dependence is much lower. In a similar way to previous studies, the strong negative relationship between rurality and resilience capacity of districts has been confirmed.

The model of the two periods of vulnerability in combination with RCI has led to a new multifaced classification of the districts/regions and enables the anticipation of future consequences of potential shocks. In particular, the paper has brought the issue of economic vulnerability into the discussion, by showing the potential of an integrated approach in regional policy which combines resilience capacity with both economic resilience and vulnerability, as their effects are intertwined.

Finally, the analysis at the district level allows to map out resilience capacity and vulnerability dynamics in more detail, and have the ability to uncover patterns not visible at a more aggregated level.

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## **Appendix A**

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### **A. ECONOMIC CAPACITY**

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#### **A.1. Income equality**

The income equality is calculated using the average nominal monthly wage at the district level in years 2010-2014.

*Source: Statistical office of the Slovak Republic*

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#### **A.2. Economic diversification**

In the index, resilience is expressed as the local deviation from the national industrial mix in terms of the

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number of employees in the manufacturing, service and public sectors in year 2014. The standardized inverse share of deviation is used to calculate the RCI-index.

*Source: Statistical office of the Slovak Republic*

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### **A.3. Affordability**

The Slovak specification uses the median nominal monthly wage at the district level and the average price for one-room, two-room and three-room flats also at the district level in year 2014. By dividing the median nominal monthly wage by the average housing price, the affordability can be assessed. The resulting values are higher in areas with greater affordability. The standardized quota is used to calculate this component of the RCI-index.

*Source: Statistical office of the Slovak Republic, Slovak real estate portal*

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#### **A.1.4. Business environment**

The Business Alliance of Slovakia annually ranks the business climate in Slovakia but only at the national level (Business environment index) with the exception of 2011 when the rank was made at the district level (Regional business environment index).

*Source: Business Alliance of Slovakia*

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## **B. SOCIO-DEMOGRAPHIC CAPACITY**

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### **B.1. Educational attainment**

The percentage of individuals aged 25+ with an education equal to or higher than a bachelor's degree divided by the percentage of individuals aged 25+ with no upper school education than a bachelor's degree in year 2011. The resulting values are high if the share of higher educated individuals is larger than the share of lower educated individuals, and vice versa. The standardized quota is used to calculate this component of the RCI index.

*Source: Population and housing census 2011*

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### **B.2. The without disability**

It is calculated as the percentage of a district area's population that receives contributions to compensate severe disability in year 2014. The inverse measure calculated from this percentage is used as an indicator.

*Source: Central Office of Labor, Social Affairs and Family*

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### **B.3. The out of poverty**

The out of poverty indicator measures the district share of the population having a greater annual income than what is defined as the poverty line in year 2013. Within the European Union, the poverty line is defined as having a disposable income of less than 60% of the median disposable income in the country.

*Source: Statistical office of the Slovak Republic*

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### **B.4. Health-insured**

Because the Slovak health care system is compulsory, the original Health-Insured indicator makes little sense in the Slovak context. Aggregated to the district level, the percentage of incapacity for work is used to calculate the RCI-index. This percentage is calculated as the proportion of the number of calendar days of incapacity for work due to disease or injury to the average number of health insurance, multiplied by the number of calendar days in the year 2014. The Slovak specification is not similar to the original specification.

*Source: Statistical office of the Slovak Republic*

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## **C. COMMUNITY CONNECTIVITY CAPACITY**

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### **C.1. Civic infrastructure**

Civic infrastructure is measured by the number of civic organizations in a district, classified according to NACE-2 as being either political, religious, sports-oriented or other (including but not limited to organizations focusing on folklore, literature, music and arts, societies, and horticulture) in year 2015.

*Source: Ministry of Interior of the Slovak Republic, Public Administration Section*

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### **C.2. Metropolitan stability**

The share of population that remains resident in the municipality over a five-year period (2010-2014). The greater the share of long-duration stayers, the greater the collective knowledge is on how to cope with shocks locally.

*Source: Statistical office of the Slovak Republic*

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### **C.3. Home ownership**

The share of the population residing in owner-occupied housing in each municipality in year 2011.

*Source: Population and housing census 2011*

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### **C.4. Voter participation**

The share of the voter-eligible population that voted in the last (national) election in year 2012.

*Source: Statistical office of the Slovak Republic*

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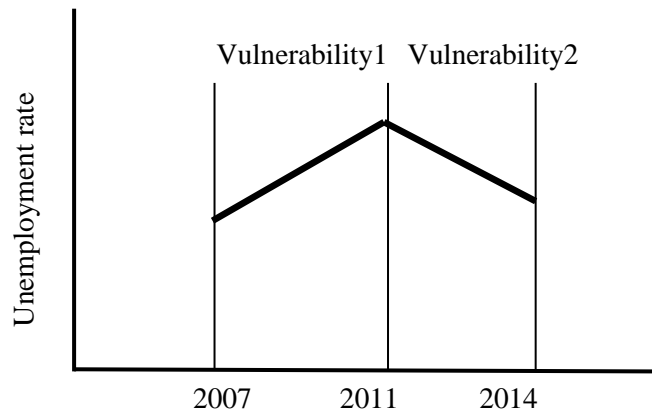


Fig. 1. Impact of the recessionary shock on the unemployment rate – two phases of the dynamics of vulnerability

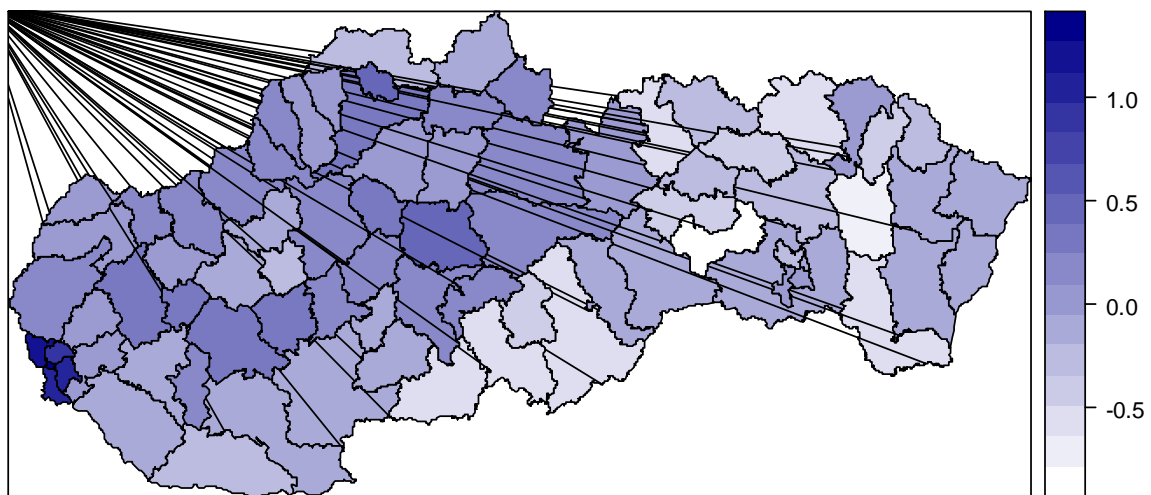


Fig. 2 Resilience capacity index in the 79 Slovak districts. Legend: darker colours indicate higher values of RCI and represent better resilience capacity. Source: author's own processing

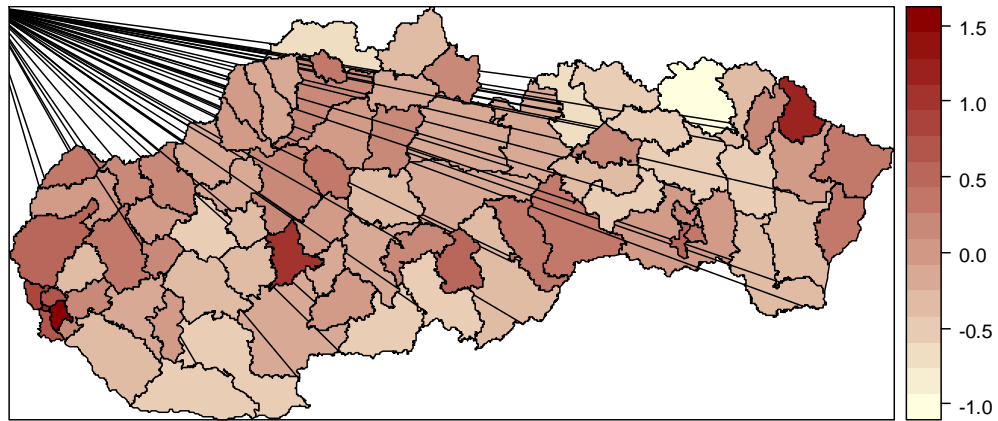


Fig 3a. Economic Capacity

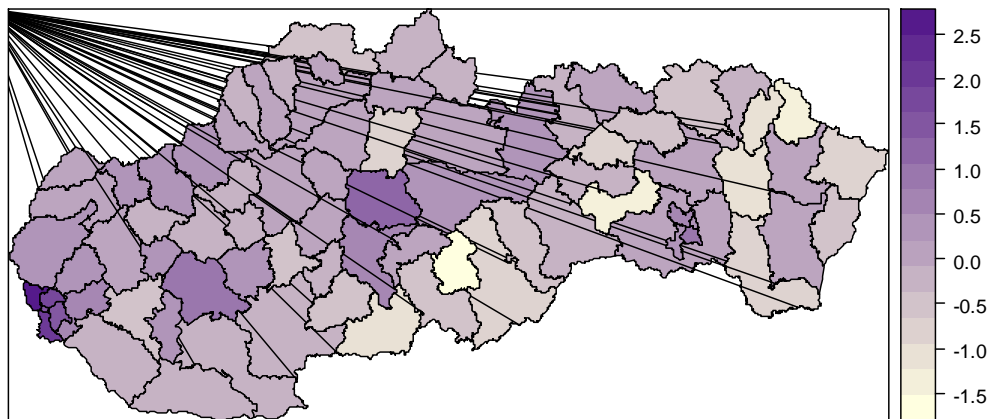


Fig 3b. Socio-Demographic Capacity

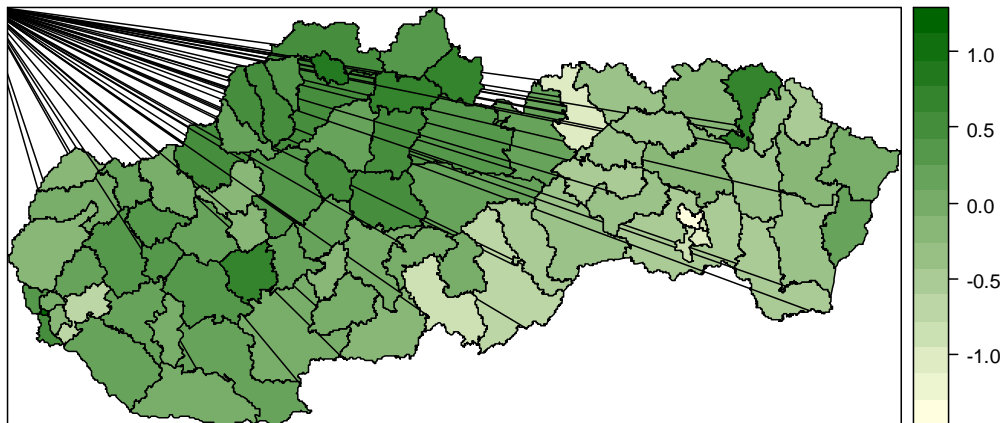


Fig 3c. Community Connectivity Capacity

Fig. 3a, 3b, 3c reflect the three dimensions of the Resilience Capacity Index in the 79 Slovak districts. Legend: The darker colours indicate higher values of the indices and represent better situation in the districts and vice versa

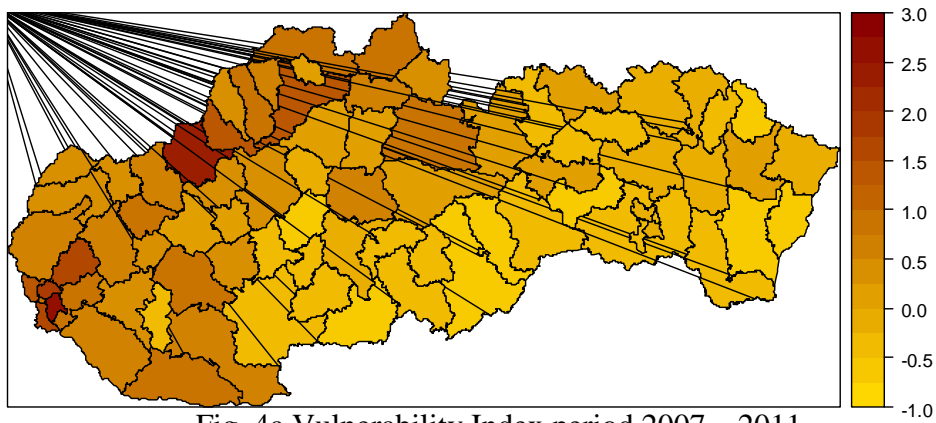


Fig. 4a Vulnerability Index period 2007 – 2011.

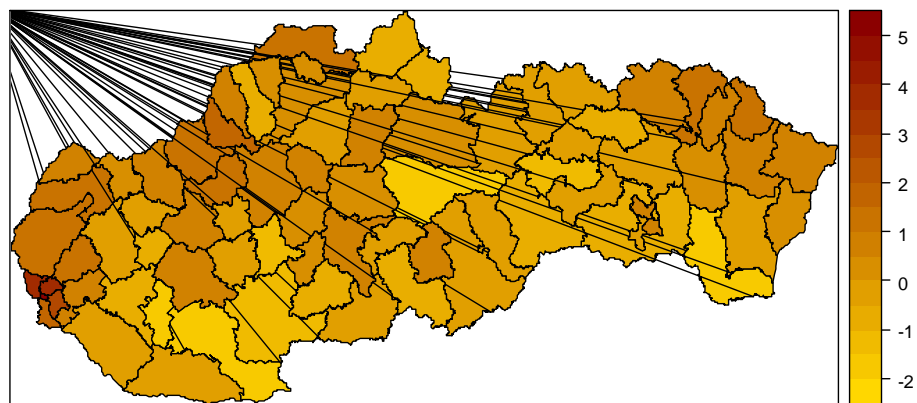


Fig. 4b Vulnerability Index 2011 – 2014.

Fig. 4a and 4b. Vulnerability Index for the two periods (2007–2011) and (2011– 2014) in the 79 Slovak districts. *Notes:* Darker colours indicate higher values of the index and represent districts with higher vulnerability during the greatest impact of the economic crisis 2008 (period 1) and after it (period 2) and vice versa

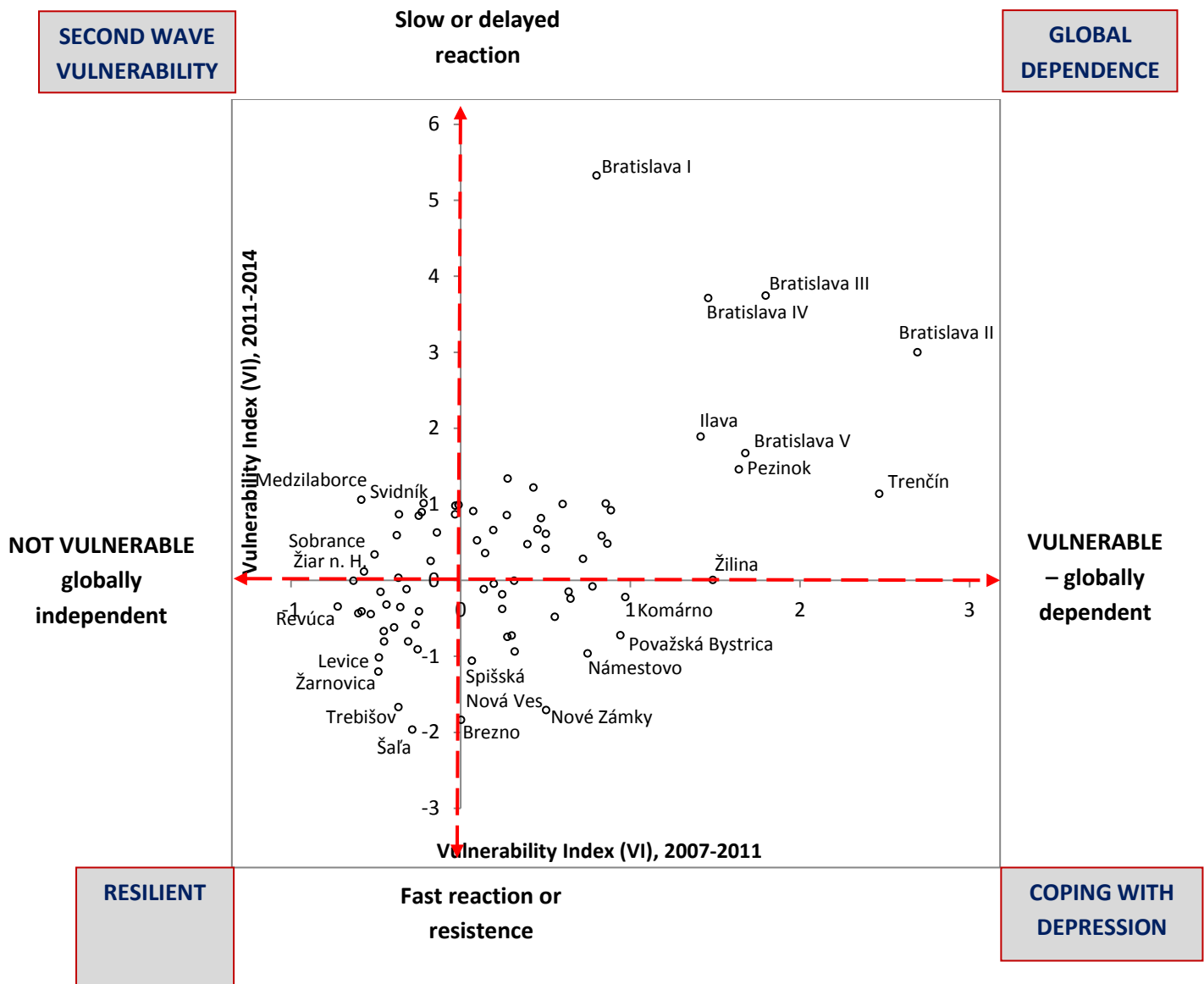


Fig. 5. Taxonomy of the Slovak districts according to the Vulnerability Index (VI) in the two periods (2007-2011) and (2011-2014)

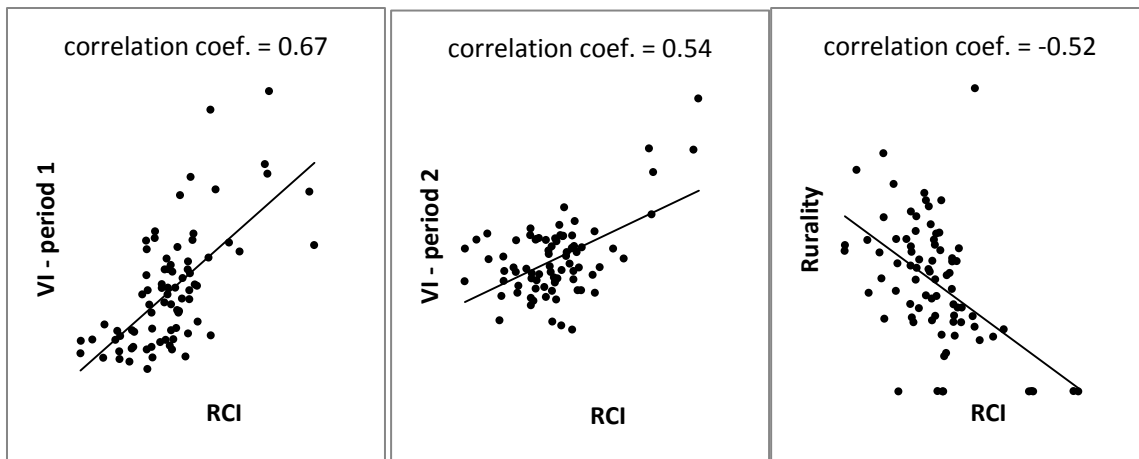


Fig. 6. Resilience capacity confronted with vulnerability and rurality

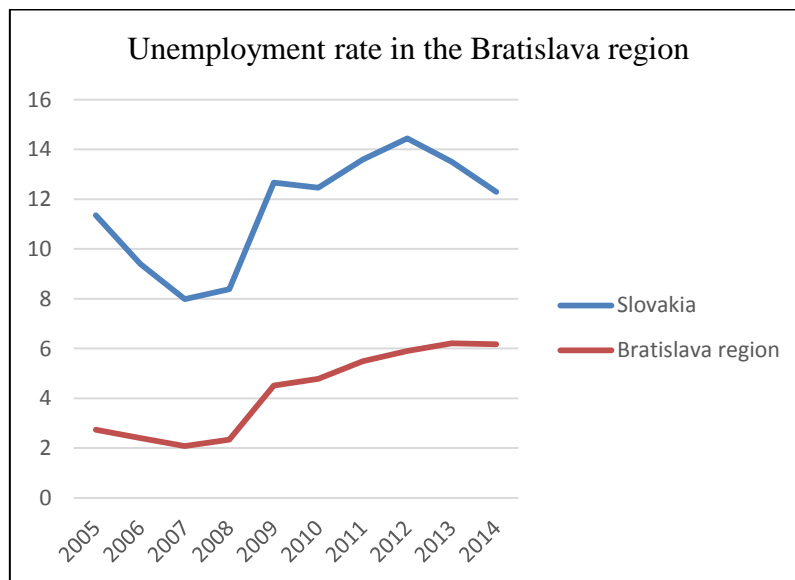


Fig. 7: Unemployment rate in the Bratislava region and Slovakia (%)

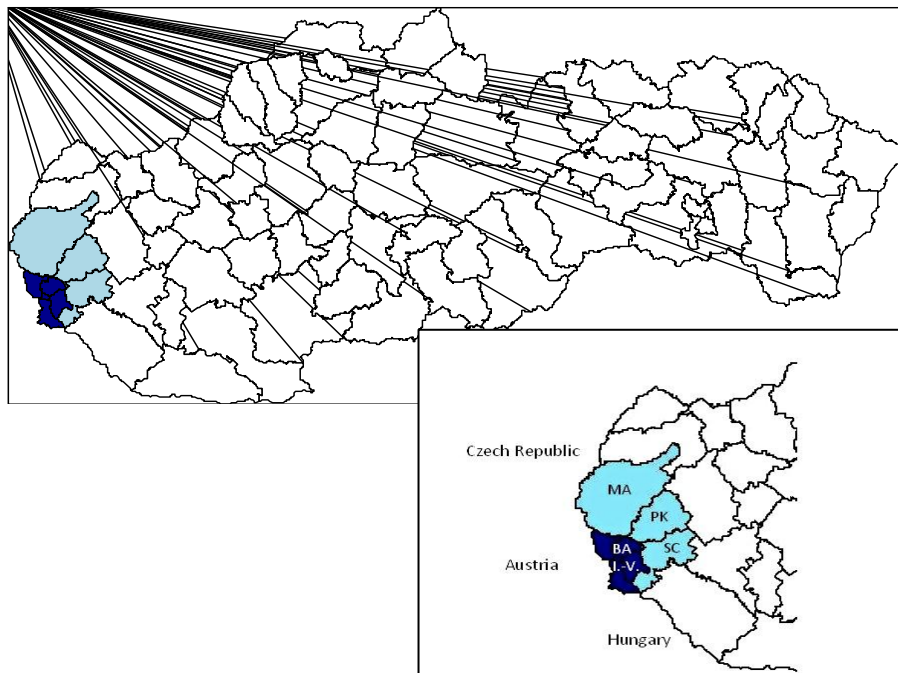


Fig. 8. The five districts of the Bratislava region

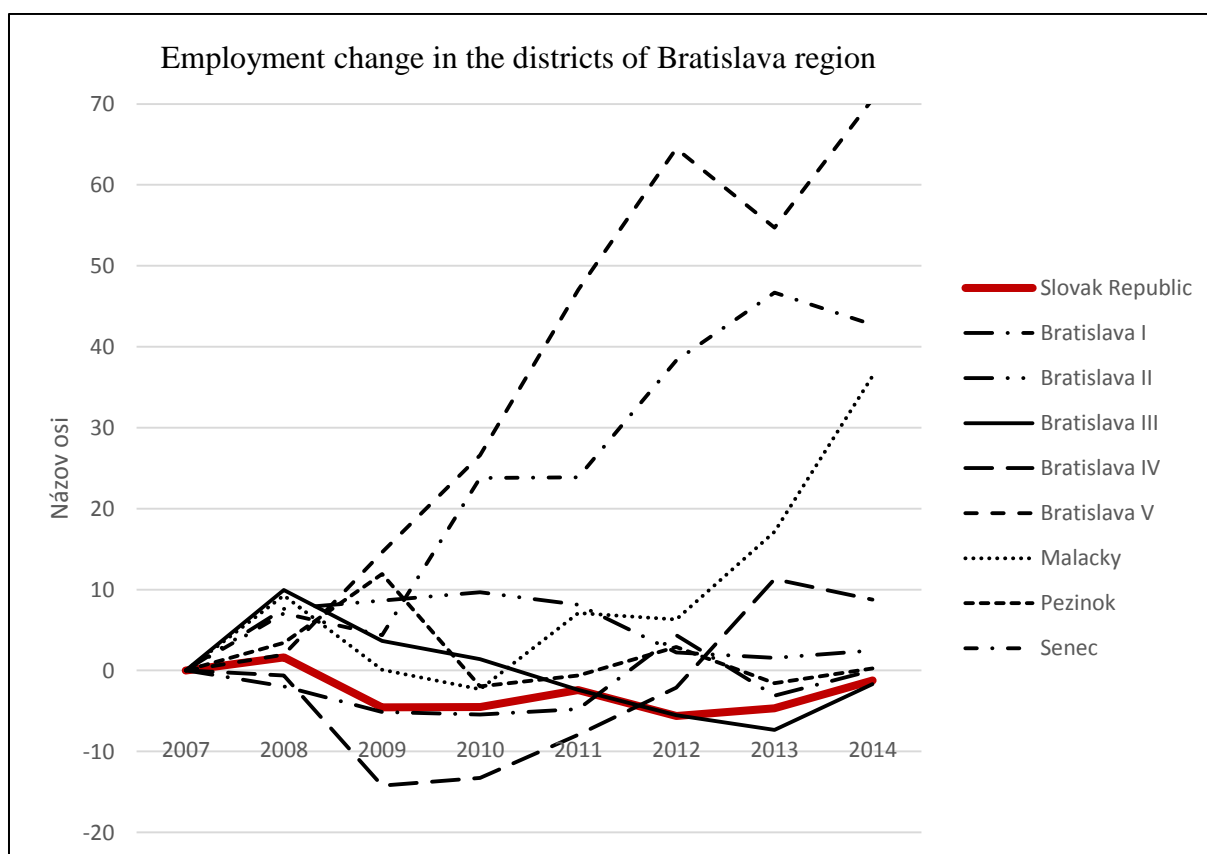


Fig. 9. The districts of the Bratislava region: employment and its minimum value (Statistical Office SR, 2015)