WHICH CITIES ARE VULNERABLE TO THE GLOBAL ECONOMIC CRISIS? EVIDENCE RELATED TO SLOVAK CITIES

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Abstract
The capacity of cities to respond to major recessionary shocks and hazards is an essential factor of long-run growth as it affects the existence, persistence and evolution of regional disparities in economic prosperity. Vulnerability to recession shocks in terms of rising unemployment varies from city to city and there are hidden factors behind the responses. The 2007 economic crisis provides an opportunity to study the vulnerability of cities to its effects. Three critical factors of vulnerability are investigated – prosperity, size of the city and regional affiliation. Prosperity is shown to be at the expense of the negative externality of greater vulnerability to external global shocks and disturbances. A lower ability to respond mainly relates to regional centres, larger cities as well as the smallest local units.
Keywords: urban prosperity, urban vulnerability, city-size, Slovak local units.

1. INTRODUCTION

Economic collapses affecting the economy and lives of people around the world are considered the hallmark of today's global economy. Cyclic alternating periods of economic growth and decline, recession, recovery and re-growth represent an intrinsic part of the market economy. Since 1970, there has been a worldwide series of economic declines which have had extensive and often serious consequences. Economic shocks that cause significant damage can be, in essence, integrated into a general group of natural hazards such as climate change effects, catastrophic events, earthquakes, fires or flooding. In practice, the effects of economic downturn rarely spread evenly among the different national or regional

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economies (Davies, 2011). The response of any socio-economic system to external shocks or disturbances depends on its current state, specific context and external links.

The 2007/2008 global economic crisis after the collapse of the US bank Lehman Brothers almost destroyed the world's financial architecture. The crisis erupted at a time when the Slovak economy was at the peak of its business cycle. Nevertheless, the external demand shock had an immediate impact on GDP growth, public finances, consumption and employment. When faced with natural disasters, dense, urban settings tend to be more resilient (Berke and Campanella, 2006). Therefore, the 2007 economic crisis provides an excellent opportunity to study the vulnerability of cities to its effects. Cities faced business bankruptcies and the loss of jobs. Yet, vulnerability to recession shocks in terms of rising unemployment varies from city to city and there are factors behind the responses to recessions which need to be identified. This article is aimed at investigating three critical factors of vulnerability – prosperity, size of the city and regional affiliation.

2. RESILIENCE EXPOSURE AND VULNERABILITY

Urban and regional experts have to propose solutions to solve serious problems caused by large-scale environmental and economic disasters, affecting local communities in different parts of the world. The development of new resilience models is related to the major threats of climate change or financial and economic crises and their devastating effects. The subsequent massive recessions can be viewed as 'system-wide' shocks that inevitably repeat, interrupt and disrupt the periods of economic growth and development (Martin, 2012).

City resilience is understood as the capacity of the urban economy, built system, institutions, citizens and community to prepare, respond, adapt or accommodate the negative effects of the external shocks and hazards they experience, whether chronic or acute, global or local (ARUP, 2014). A core interest of resilience studies is to understand the way in which local and regional economies respond to the disturbances and disruptions. Consequently, effective measures need to be proposed and tested regarding how to strengthen the capacity of an urban system to absorb disturbance and still retain its basic functions, identity, structure and feedbacks (Desouza and Flanery 2013, Lhomme et al., 2013, Lu and Stead, 2013). Resilience is explainable by the degree of flexibility, retention of key features and by the ability to transform the regional or urban system to another stage.

The conjoint concept of vulnerability is more concerned with the susceptibility and exposure to perturbations of the system or one of its parts to the harmful effects of external shocks (Seeliger and Turok, 2013). While exposure can be considered as a relational attribute, vulnerability is an attribute of the system itself, which is revealed when the system is exposed to an external shock (Gallopín, 2006). Vulnerability refers to the structural changes in the system caused from the outside and implies changes

in its stability settings. Although there is no consensus on the exact meaning of the related terms, the vulnerability of a system can be explained by three different elements – exposure, sensitivity and capacity to response. Resilience, in comparison to vulnerability, rather highlights the transformation of a system and its trajectory of change.

Economic vulnerability as a narrower notion refers to exogenous economic shocks; unforeseen events which expose the city or region (Briguglio et al., 2009). An external shock such as a global economic crisis has an asymmetrical territorial impact. This can be explained in terms of economic vulnerability, measured as the increase in the unemployment rate during the crisis. The interesting issue is how to interpret the response of local units to an unpredictable exogenous shock, and which factors are behind the higher or lower economic vulnerability.

European urban dynamics activated by the recent economic crisis of 2007/2008 have shown a substantial negative impact in urban regions and peripheral rural regions, undermining the performance of the capital metropolitan regions. Lower vulnerability has been identified in the middle-sized cities or rural regions close to regional centres (Dijkstra et al., 2013). Middle- and small-sized cities have displayed much less negative annual GDP growth rates in comparison with the capital cities. There are several examples of European countries (Austria and Germany) where the majority of cities have outperformed their capital cities (Parkinson et al., 2014). A static view of the first-rank metropolitan cities shows their powerful position in production performance in comparison with the medium and small cities (Camagni, Capello and Caragliu, 2016). However, the dynamic view does not confirm evidence of the superiority of large cities regarding productivity growth over the past few years.

3. PROSPERITY

The capacity of cities to respond to major recessionary shocks is an essential factor of long-run growth as it affects the existence, persistence and evolution of regional disparities in economic prosperity. Natural disasters, global movements, armed conflicts, climate change impacts and poor financial management all represent threats to the prosperity of cities and regions. However, a related research question may be raised. Can the long-term prosperity of a city or region guarantee lower vulnerability and a more readily response to external shocks, fewer damages and overall higher resilience?

There are several approaches to the measurement of living standards, economic growth, socio-economic development, quality of life or other signs of prosperity. Most studies treat prosperity as an economic imperative and use standard economic measures for its analysis such as income, productivity or GDP growth (see Blok, Hofheinz, Kerkhoven, 2015; Hacker, Loewentheil, 2012; Murphy, Clemens, Palacios, Veldhuis, 2014; NCSG, 2012). Economic performance and the wealth of cities/regions/countries are

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clearly the key structural attributes of prosperity, even though the picture of today's prosperity would not be complete without considering the aspects of infrastructure, sustainability, democracy and equity and quality of life. The notion of prosperity should take into account labour market characteristics, sufficiency and a variety of jobs, opportunities for career advancement, stimulating high-quality employment environments, creativity and invention supported by training and acquisition of formal and informal education (Murphy, Clemens, Palacios, Veldhuis, 2014).

Therefore, the prosperity of a city is comprised of more facets than just the economic one. Urban prosperity has also been defined as a multi-dimensional concept in the UN-Habitat flagship report (UN-Habitat, 2012). In a broader, organic sense the view of prosperity exceeds its previous narrow understanding as an economic success, and rather advocates a socially broad-based, stable and resilient type of development, combining both tangible and intangible aspects. This new approach to prosperity has been accompanied by an evaluation tool labelled as the City Prosperity Index (CPI). It has the form of a composite index consisting of the five dimensions corresponding to the individual dimensions of prosperity. Cities are considered facilitators of (1) productivity and (2) infrastructure development, including institutional arrangements that contribute to the enhancement of (3) equity and social inclusion, (4) quality of life and (5) environmental stability.

Most of the approaches related to prosperity evaluate countries or regions. Therefore, the evaluation or benchmarking of cities not only represents a shift to a lower unit level, but even more importantly, amplifies cities as real engines of prosperity. It appears that cities are the first who are impacted by a global crisis because of the enormous concentration of country productivity. A rapid strike in a place also means the possibility of there being a concentration of resources in co-operation with public authorities to launch a rapid recovery and absorption of the external shock.. Based on that argument, prosperous cities have accordingly superb conditions for an effective response to external shocks and a quick recovery, which is included under the concept of resilience. Nevertheless, the high concentration of production and direct dependence on global changes make them vulnerable at the same time.

4. RESEARCH QUESTIONS AND METHODOLOGY

Consequently, it makes sense to examine the relationship between prosperity and vulnerability. The main research question in the article is therefore to study the exposure of urban areas and their capacity to respond to a global crisis and to what extent cities are vulnerable according to their prosperity.

It appears that the best way to identify the factors of prosperity in relation to vulnerability is to assess the reaction of smaller local units, middle-sized towns and cities after the onset of the 2007 financial crisis and to measure how long the effects of the shock to the economic downturn lasted. The most appropriate

variable for the economic downturn is the unemployment rate, which was statistically recorded during the whole crisis period 2007-2011, from its beginning to offset.

Q1: What is the relation between prosperity and economic vulnerability of cities, middle-sized towns and smaller local units?

Q2: What is the role of spatial proximity of the local units? How is prosperity and vulnerability spread and how are the effects of a global external shock propagated?

Q3: The size of the local unit, as well as its location within a more urban or rural environment, are expected to influence vulnerability. What is the role of the size and geography in explaining economic vulnerability?

The empirical analysis is possible for all 2891 Slovak local units (territorial level LAU-2), by comparing their situation before (2007) and at the end of the crisis (2011). The variety of data were possible to obtain by combining different data sources - Central Office of Labour, Social Affairs and Family, Census of population and housing in 2011 and Statistical Office of the Slovak Republic.

5. PROSPERITY ACROSS THE SLOVAK LOCAL UNITS

The reason for the comparison is the regional geographical distribution of Slovakia into the more developed western part neighbouring Austria and the Czech Republic and the less developed eastern part (Halás, 2008; Žudelová and Urbančíková, 2015; Džupka et al, 2016). The regional territorial division is possible by categorising the units according to NUTS II (4 regions) or NUTS III (8 regions) level. Table 1 gives an overview of the territorial division of Slovakia, including the number of local units and the population. The numbering of the regions from SK1 to SK4 respects the movement from the west to the east of the country. This can be used to illustrate and investigate the effect of the West-East development axis on prosperity and vulnerability.

TABLE 1 - THE ADMINISTRATIVE TERRITORIAL DIVISION OF SLOVAKIA

Region NUTS2	SK1	SK2	SK2	SK2	SK3	SK3	SK4	SK4
Region NUTS3	1	2	3	4	5	6	7	8
Region name	Bratislava	Trnava	Trencin	Nitra	Zilina	Banská Bystrica	Prešov	Košice
Number of local units	89	251	276	354	315	516	664	461
Total population	610850	557151	599831	706758	695698	654668	801939	774103

The measurement of the prosperity of the local units follows the City Prosperity Index (CPI) developed by the UN-Habitat (2012/2013). It is adjusted to the conditions of all Slovak local units and takes into account their size to differentiate between the smaller local units, smaller municipalities, middle-sized towns and cities. Undoubtedly, considerably less data exist in the public sources on the smallest possible territorial units than at the aggregate level of a country or region. The only possibility was to combine the various

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possible sources of information to evaluate the prosperity of the local units. The prosperity is studied in a relation to to the economic vulnerability defined as the relative change in the unemployment rate. The environmental dimension is not reflected and the model includes four dimensions of the prosperity index related to economic vulnerability: (1) Economic performance, (2) Infrastructure development, (3) Equity and social inclusion and (4) Quality of life.

TABLE 2 - PROSPERITY INDICATORS

(1)	**Economic performance**
•	[output] ***Municipality output*** (value added of enterprises per capita)
•	[unempl_r] ***Unemployment rate***
(2)	**Infrastructure development**
•	[p_water] ***Piped water*** (percentage of households connected to the water supply in the apartment)
•	[sew] ***Sewerage*** (percentage of households connected to the sewage system)
•	[gas] ***Gas*** (percentage of households connected to the gas system)
•	[mob] ***Mobile*** (percentage of households owning a mobile phone)
•	[int] ***Internet*** (percentage of households connected to the internet)
•	[access_dc] ***Time accessibility*** to the district capital city
(3)	**Equity and social inclusion**
•	[hous_eq] ***Housing equity*** (the ratio of households with an apartment size more than 120 square meters and apartment size smaller than 40 square meters)
•	[o_unempl] ***Older unemployment*** (fraction of inhabitants over 50 out of work)
•	[w_unempl] ***Women unemployment*** (women out of work)
•	[vot_part] ***Voter participation*** (voter participation in the elections to the National Council)
(4)	**Quality of life**
•	[h_edu] ***Higher education*** (percentage of inhabitants with higher education)
•	[l_edu] ***Lower education*** (percentage of inhabitants with basic education or no education)
•	[avrg_age] ***Average age***
•	[bad_health] ***Health*** (deaths per capita)
•	[net_migr] ***Net migration*** (the local unit migration inflow minus outflow)

Due to the different measurement units of the indicators' standard scores (z-scores), the indicators were converted to a common scale. Z-scores may be positive (above the mean) or negative (below the average). The formula is $z = (X – \mu) / \sigma$, where z is the standard score, X is the raw value, μ is the mean and σ is the standard deviation. With z-scores, indicators measured on different scales can be combined into a single index such as the UN Habitat CPI. For a better comparison of the values, the normalisation of the z-scores to a standard range (0, 10) is done, meaning the average value is 5, minimum value 0 corresponds to 5-4σ and maximum value 10 to corresponds to 5+4σ.

The following figure (Figure 1) reflects the CPI values of the eight NUTS III regions. As expected, prosperity is similarly distributed as typical variables of production and the rate of unemployment. Indeed, higher prosperity values can be seen in the local units located in the west and north-west of Slovakia – Bratislava, Trnava, Žilina and Trenčín regions.

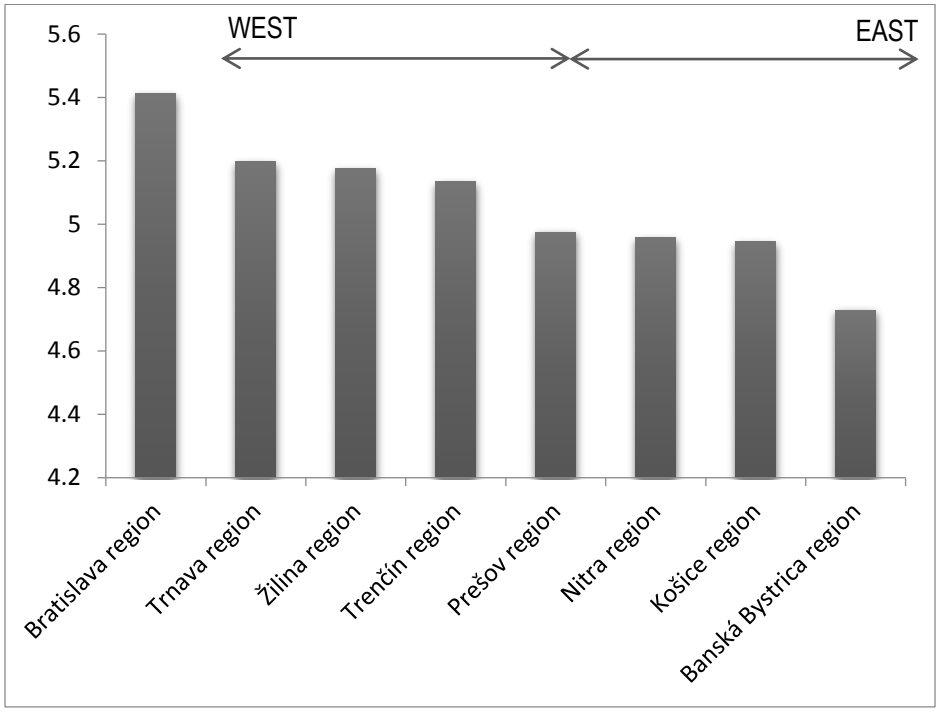

FIGURE 1 - MUNICIPAL PROSPERITY – THE REGIONAL AVERAGES

The size of the local units is denoted as R for regional centres, T for middle-sized towns and M for municipalities -smaller local units. The NUTS II comparison not only shows higher prosperity in the west of the country (Figure 2, left side), but also higher prosperity in the regional centres and middle-sized cities in comparison to the smaller local units.

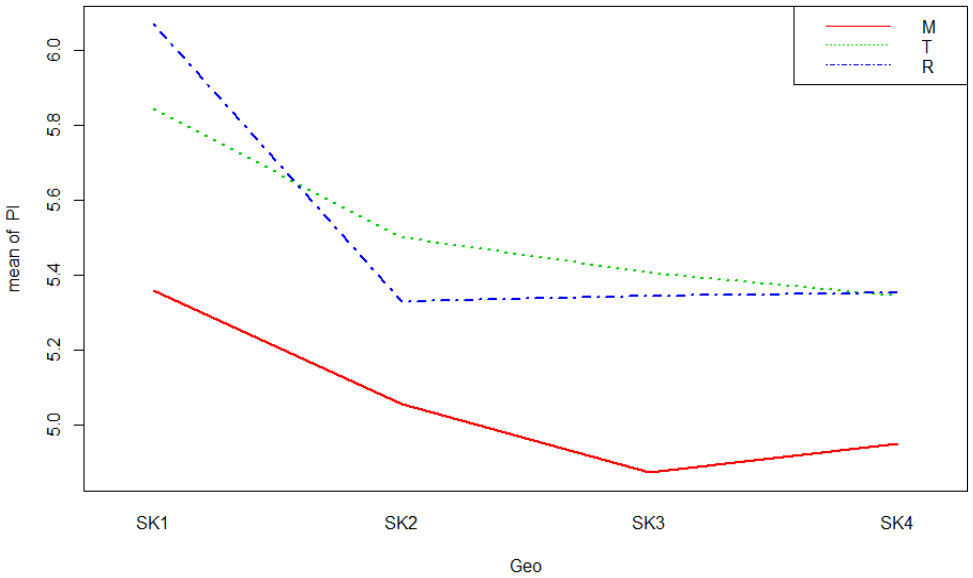

FIGURE 2 - PROSPERITY OF THE THREE CATEGORIES OF LOCAL UNITS ACCORDING TO REGIONS IN THE SLOVAK REPUBLIC

Figure 3 shows the exclusive prosperity of the capital region of Bratislava in comparison to all other NUTS III regions, especially in the case of regional centres.

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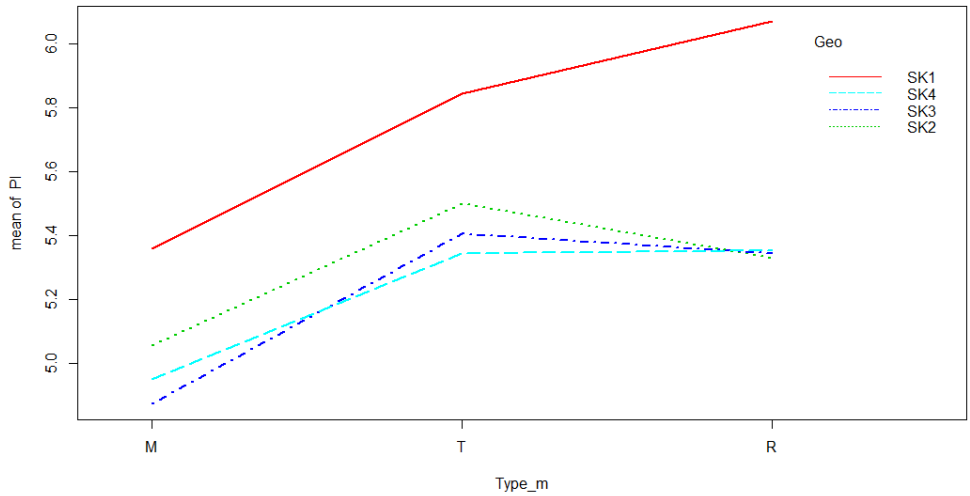

FIGURE 3 - PROSPERITY IN THE SLOVAK REGIONS ACCORDING TO THE THREE CATEGORIES OF LOCAL UNITS

There is a regional difference between the west and east of Slovakia in all dimensions of prosperity. The west and northwest part is more industrial, attracting foreign investments especially in the automotive industry (Kia Motors, PSA, Volkswagen, Land Rover). In addition, there is the average accessibility of the regional centre; 13.5 minutes in SK1 and 32.7 in the SK4 region. The quality of life is driven e.g. by the highest concentration of highly educated people (15.3%), while in the rest of the regions the average percentage is 7.3 - 9.7%. The net migration is negative in more rural and peripheral areas (-0.36 in Banská Bystrica and -1.73 in Prešov), while the western regions benefit from high positive net migration (41.0 in Bratislava or 11.2 in Trnava region).

6. VULNERABILITY: RESPONSE TO 2007 CRISIS

The prosperity index applied to the lowest territorial units confirms, to a large extent, prosperity split into the western and eastern parts of the country. The first Q1 research question aims to study if prosperity is interrelated with lower or higher economic vulnerability. Higher prosperity should help the city form a resilient economic and built system, effective in the case of global external shocks. Prosperous cities should also have mechanisms to empower rapid and effective actions against the destructive effects of external forces, especially if hazards have a local character. Yet, the vulnerability of prosperous cities may be high if the external shock is globally driven, such as an economic crisis. The large number of economic connections to the leading world financial and industrial centres is a key element of prosperity, but equally represents an immediate danger during the first wave of a global crisis.

The question of whether prosperity is a sufficient protective mechanism to cope with an external global shock, or other factors are more essential in explaining higher or lower resilience and adaptive capacity, can be tested on the example of the 2007 crisis. The ratio of relative growth in unemployment to the average growth in the country as a whole can be used to measure the response to the global recession.

Thus, the country response is used as a benchmark to measure the relative resistance of regions (Lagravinese, 2014; Martin, 2012):

$$\lambda = \left[\left(\Delta X_d / X_d \right) - \left(\Delta X_N / X_N \right) \; / \left| \Delta X_N / X_N \right| \right],$$

where $\left(\Delta X_d / X_d \right)$ and $\left(\Delta X_N / X_N \right)$ represent the percentage changes in unemployment at the local unit and the national level respectively. A positive value of λ indicates higher vulnerability (VI1 - Vulnerability Index during the time period 2007-2011 – during the strongest impact of the 2007 crisis). A negative value of λ is associated with lower vulnerability or higher absorption of the shock than the national average. The empirical results (Figure 4) exhibit higher vulnerability of the more prosperous western local units. This is confirmed regardless of the size of the local units. However, the middle-sized towns (T) show a lower exposure to the effects of the crisis.

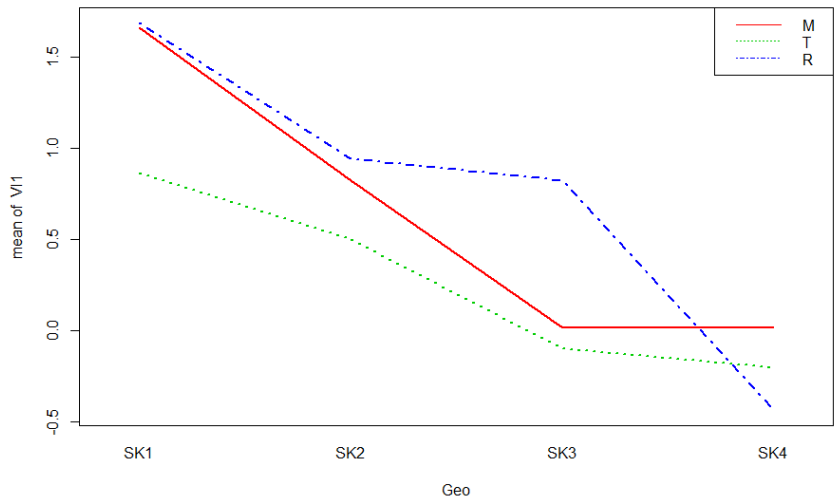

FIGURE 4 - THE VULNERABILITY PATTERN OF THE THREE CATEGORIES OF LOCAL UNITS ACCORDING TO THE REGIONS FROM WEST TO EAST (SK1 TO SK4)

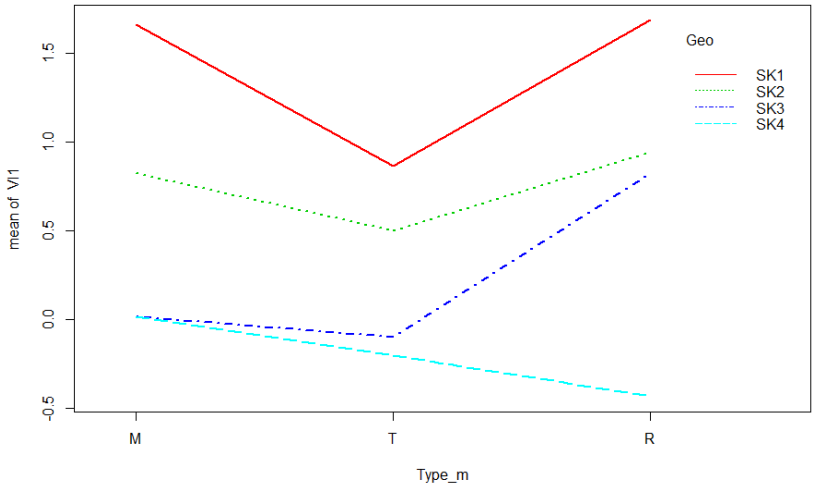

FIGURE 5 - THE VULNERABILITY PATTERN OF THE REGIONS ACCORDING TO THE THREE CATEGORIES OF LOCAL UNITS

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Figure 5 highlights the highest exposure of the crisis in the SK1 Bratislava region and explains that vulnerability varies according to the size, which is most seen in the SK1 and SK2 regions. The piecewise linear shape of the curve displays higher vulnerability of the smaller local units (M) and regional centres (R).

The boxplots evidently demonstrate a difference between the regions and confirm the decreasing vulnerability from the west to east of the country (Figure 6). The city-status factor identifies a different reaction to the crisis in the group of middle-sized towns. There is much higher variability in the group of smaller local units; several of them were critically affected by the crisis.

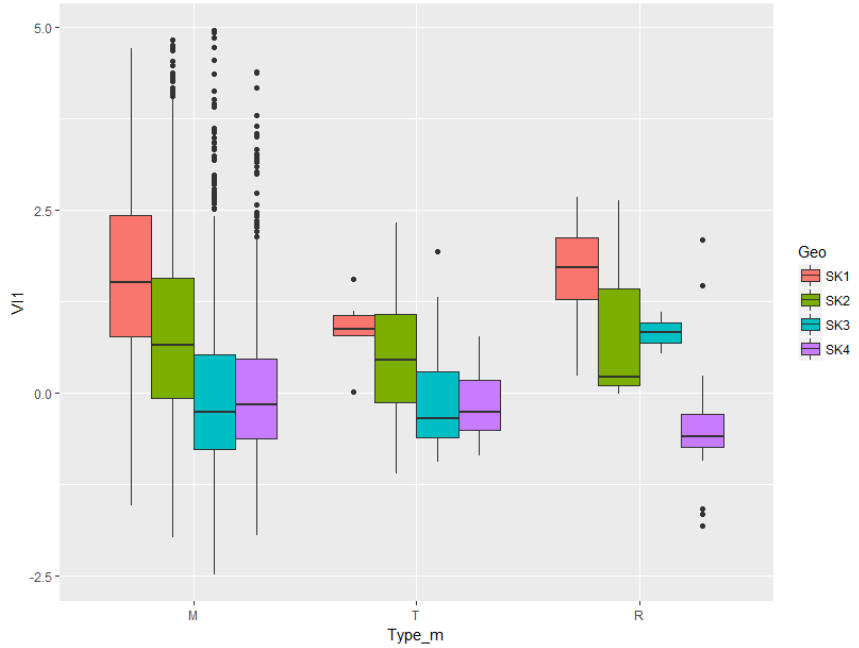

FIGURE 6 - VULNERABILITY OF NUTS II REGIONS IN THE THREE LOCAL UNIT CATEGORIES

The pre-visualization of the vulnerability suggests its dependence on the status of the city (municipality, smaller local unit (M), the middle-sized towns (T), the regional centre (R) as well as on the regional affiliation (NUTS2 level regions: SK1, SK2, SK3, SK4). The empirical investigation raises an opportunity to formulate three groups of hypotheses which are studied in the next two sections.

A. The prosperity and economic vulnerability are in the reverse direction. In addition, more prosperous local units are also more vulnerable if the external shock is global.

B. The size of the city does have a significant effect on vulnerability. Middle-sized towns are the least vulnerable local units.

C. Region affiliation does have a significant effect on vulnerability considering the west-east axis. More prosperous local units are in the west while the less vulnerable are in the east of the country.

7. SPATIAL SPREAD OF PROSPERITY AND VULNERABILITY

The previous section has shown the relationship of the prosperity and vulnerability factors as formulated in the Q1 research question. Both factors can be studied more in their spatial context, as both prosperity and vulnerability can be expected to have a character of spreading into the environment. The spatial autocorrelation approach based on simultaneous features of locations and variables can evaluate whether the existing spatial patterns are either clustered or random and to identify localised areas with strongly positive or negative associations of the data values. Local spatial patterns are studied using the method of Local Indicators of Spatial Association – LISA (Anselin, 1995) via the nearest neighbour matrices.

Let the centroid (centres of gravity) distances for each spatial unit i to all units $j \neq i$ be ranked as $d_{ij(1)} \leq d_{ij(2)} \leq ... \leq d_{ij(n-1)}$. For each $k = 1,...,n-1$, the set $N_k(i) = \{j(1), j(2),..., j(k)\}$ contains k closest units to i. For any given k, the k-nearest neighbour weight matrix, W has spatial weights defined as:

$$w_{ji} = \begin{cases} 1 & j \in N_k(i) \\ 0 & \end{cases} \qquad (1)$$

where wij = 1, if centroid of j is one of the k nearest centroids, wij = 0, otherwise.

The most commonly used is k=6, (according to simulations made by LeSage and Fischer 2008). A LISA-statistic is defined as any statistic that fulfils two criteria (Anselin, 1995): the LISA for each observation gives an indication of significant spatial clustering of similar values around that observation, and the sum of the LISA for all observations is proportional to a global indicator of spatial association. The local version of global Moran's I-statistic for each region i and year t is written as:

$$I_{i,t} = \frac{(x_{i,t} - m_t)}{\overline{m}} \sum_j w_{ij}(x_{j,t} - m_t) \quad , \text{with} \quad \overline{m} = \sum_i (x_{i,t} - m_t)^2 / n \qquad (2)$$

where $x_{j,t}$ is the observation in region i and year t; m_t is the mean of the observations across regions in year t; and the summation over j is such that only neighbouring values of j are included. A positive value for $I_{j,t}$ indicates spatial clustering of similar values (high or low), whereas a negative value indicates spatial clustering of dissimilar values between a region and its neighbours. The present results were based on 99999 permutations, and p-values obtained for local Moran's I-statistics are actually at pseudo-significance levels.

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Moran scatterplots reflect the spatial lag $W_{z,t}$ against the original values z_t. The four different quadrants of the scatter plot correspond to the four types of local spatial association between a region and its neighbours. HH (high-high) denotes a region with a high value surrounded by areas of high values; LH (low-high) is a region with a low value surrounded by areas with high values, and so on. The quadrants HH and LL (respectively LH and HL) refer to positive (respectively negative) spatial autocorrelation, indicating spatial clustering of similar (respectively dissimilar) values. The map (Figure 7) displays the values of the Prosperity Index in all Slovak local units, including towns and cities before the start of the financial crisis of 2007/2008. The areas with clustered high prosperity values (HH) are found around the capital Bratislava, along with the western border with the Czech Republic as well as a smaller red area assigned to the second largest city of Košice in the East. The phenomenon of regional disparities between the East and West can be explained by the theory of cumulative causation (Myrdal, 1957, Hirschman, 1958). The growth pole of the capital Bratislava influences its neighbouring areas positively which confirms the positive externalities - spread effects. On the other hand, the city of Košice, the East-Slovak metropolis, is an island of prosperity which has a strong economic basis that only creates benefits for its citizens or newcomers. In fact, there is rather a negative backwash effect of Košice which can be identified in the neighbouring areas characterised by persisting stagnation. The low prosperity (low-low) areas in dark blue embody the second category of larger homogenous areas. These wider connected areas are of a lower quality of life and have either a agricultural, mining or mountain character. The smaller tessellated areas in the north-east or south-east are significantly marked by their low accessibility and peripherality (Halás, 2008; Spišáková, 2010).

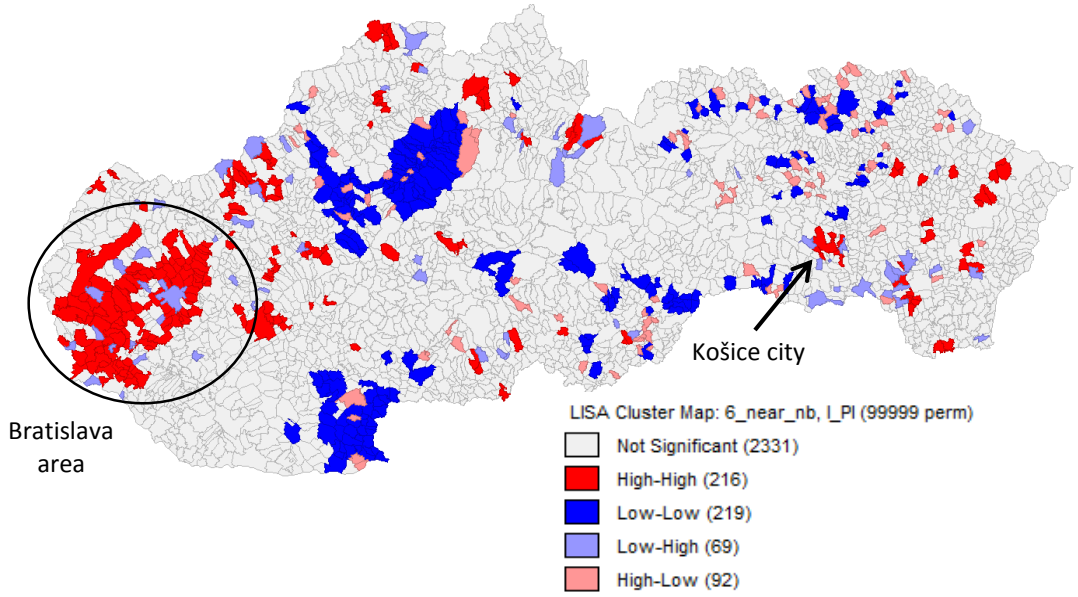

FIGURE 7 - SPATIAL DISTRIBUTION OF THE PROSPERITY INDEX: 2891 SLOVAK LOCAL UNITS
Note: Moran's index of spatial autocorrelation = 0,149

The same LISA method applied to the Slovak local units shows their vulnerability to the global 2007 financial crisis (Figure 8). The spatial spread of the vulnerability to the effects of the crisis (Q2 research question) is confirmed by the several areas of high-high vulnerability (shown in red) as well as the areas of low-low vulnerability (shown in blue).

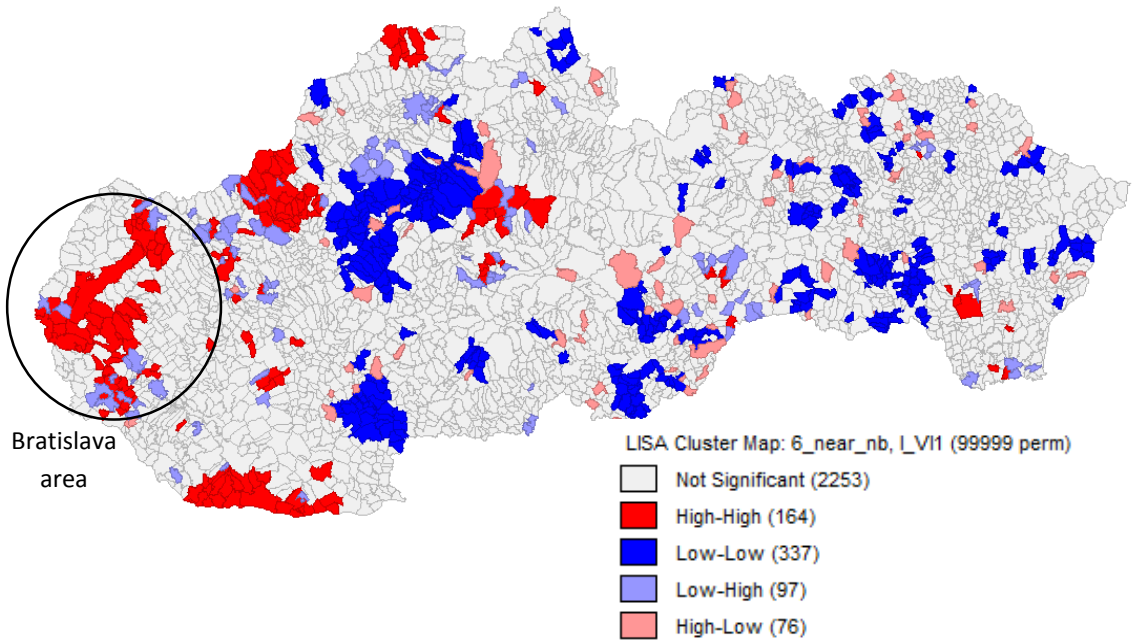

FIGURE 8 - SPATIAL DISTRIBUTION OF THE VULNERABILITY TO THE 2007 CRISIS: 2891 SLOVAK LOCAL UNITS
Note: Moran's index of spatial autocorrelation = -0,001

The assessment of the two maps (Figures 7 and 8) points to several territories of simultaneous greater prosperity and vulnerability. The multinational companies are mostly located in the red shaded areas in the west of Slovakia. This higher prosperity is also shown to have the other side of vulnerability risk if a global shock happens. Similarly, other areas can be identified as not prosperous, but as less open to external global influences are therefore less vulnerable to global shocks.

8. SLOVAK CITIES: SIZE AND GEOGRAPHY AS THE CRITICAL FACTORS OF VULNERABILITY

The third research question integrates the previous models of prosperity versus vulnerability. This considers the geography factor of location within a more urban or rural environment together with the size of the local units as the critical factors influencing vulnerability (Q3 research question). The size of the city matters in relation to prosperity but also to the vulnerability to global external shock. The grouping of data by a factor of the size of the local units is carried out in two stages following a hierarchical principle.

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Level 1: Status of the local unit is again defined as Municipality – smaller local unit (M), the middle-sized town (T), the regional centre municipality (R).

Level 2: Each group of M, T, R is divided into cluster intervals based on the the quantiles method.

The idea was to identify a natural number and size intervals of the local units and to respect the status of the three categories M, T and R. A further condition was to keep the total population in each group approximately the same and in that way to cluster local units into comparable categories (Table 3). By law, Bratislava and Kosice consist of several municipalities (city wards) which are considered as single units in the analysis, and all of them are part of the same regional labour market (the explained variable is the unemployment rate), and this group is accordingly named as regional centre municipalities.

TABLE 3 - ASSIGNMENT OF THE LOCAL UNITS TO CATEGORIES

	Municipalities: smaller local units					**Middle-sized towns**			**Regional centre municipalities**
Levels	M1	M2	M3	M4	M5	T1	T2	T3	R
Borders	Lowest	<250	<470	<750	<1338	Lowest	<7500	<15750	All
Number of cities	531	543	547	572	557	40	39	51	46
Total population	410766	472970	478790	505978	550172	635535	502372	716328	1128087

The statistical analysis is divided into the testing of two hypotheses:

I. Impact of the city size.

H0: Size of the city has no significant effect on vulnerability.

II. Impact of the region affiliation.

H0: Region affiliation has no significant effect on vulnerability.

I. One-way (univariate) analysis of the effect size of the city

As the normality of the distribution is not met, the Kruskal-Wallis one-way analysis of variance by ranks is used. The Kruskal-Wallis Test is shown to be highly significant X^2(8) = 34,674 (37,738) > 15,5 (nominal X^2 for 8 freedom degree) and p < 0,05, so the null hypothesis is rejected and the assumption about the impact of the size of the city on its vulnerability is confirmed. Thus, it is meaningful to apply post-hoc tests for providing pairwise comparisons. The Kruskal-Dunn test (Table 4) returns the lower triangle of the matrix that contains the p-values of the pairwise comparisons. Therefore, the size factor is significant in relation to vulnerability and other categories especially in the case of M1, M5, R categories (p<0.05). In particular, the smallest units M1 have a much higher variability of responses to the crisis. The strategic

situation is evidently a barrier for better resilence to economic shocks in the M5 group. These consist of the larger local units without the city status, having fewer measures and possibilities for urban development. The most stable, coherent and comparable are the middle-sized towns in the T1-T3 categories.

TABLE 4 - THE PAIRWISE COMPARISON OF THE CITY SIZE EFFECTS ON VULNERABILITY BETWEEN 9 TYPES

```
posthoc.kruskal.dunn.test(x=VI1, g=Size, p.adjust.method="none")

##  Pairwise comparisons using Dunn's-test for multiple
##                           comparisons of independent samples
## data:  VI1 and Size
##    M1      M2     M3     M4     M5     T1     T2     T3
## M2 0.0017  -      -      -      -      -      -      -
## M3 0.0027  0.8820 -      -      -      -      -      -
## M4 4.9e-06 0.1627 0.1219 -      -      -      -      -
## M5 8.3e-08 0.0267 0.0180 0.4006 -      -      -      -
## T1 0.2913  0.9030 0.9470 0.5239 0.3445 -      -      -
## T2 0.4738  0.6546 0.6946 0.3384 0.2072 0.8096 -      -
## T3 0.2111  0.9475 0.9968 0.5204 0.3237 0.9610 0.7616 -
## W  0.0265  0.3290 0.3009 0.6646 0.9147 0.4301 0.3022 0.4307
```

II. One-way (univariate) analysis of the region affiliation

Again, the Kruskal-Wallis Test is highly significant X^2(7) = 687,5 (125,85) > 14,1 (nominal X^2 for 7 freedom degree) and $p < 0.05$, so the null hypothesis is rejected. So, the assumption of the significant impact of regional affiliation on vulnerability is confirmed. A post-hoc test (Table 5) for pairwise comparison returns p-values in the lower triangle of the matrix. Significant differences ($p<0.05$) exist between many pairs of NUTS III regions. There is a key difference if a city is part of the Bratislava region (SK1) region, but regional affiliation has an even stronger explanatory power than the city size.

TABLE 5 - THE PAIRWISE COMPARISON OF THE REGIONAL AFFILIATION EFFECT ON VULNERABILITY BETWEEN 8 REGIONS

```
posthoc.kruskal.dunn.test(x=VI2, g=Region, p.adjust.method="none")

##  Pairwise comparisons using Dunn's-test for multiple
##                           comparisons of independent samples
## data:  VI2 and Region
##
##   1       2       3       4       5       6       7
## 2 1.1e-07 -       -       -       -       -       -
## 3 0.00030 0.01440 -       -       -       -       -
## 4 1.5e-09 0.44239 0.00058 -       -       -       -
## 5 0.00325 0.00032 0.27941 2.0e-06 -       -       -
## 6 2.0e-06 0.15587 0.15990 0.01226 0.00625 -       -
## 7 0.01193 4.4e-07 0.02727 2.8e-11 0.30793 6.2e-06 -
## 8 8.7e-12 0.07813 4.1e-06 0.28927 1.3e-09 0.00011 < 2e-16
```


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9. CONCLUSIONS AND RECCOMENDATIONS

The concepts of local and regional resilience and vulnerability have the ability to improve the understanding of external shocks and their consequences and should be considered in the strategic management of cities and regions. An active approach of the local government in promoting economic resilience largely determines the start and process of adaptation of the local system to the impacts of external shocks (Dawley et al., 2010; Lang, 2010; Zgodavová et al, 2016). Cities are becoming an effective platform for strategies reinforcing local responses to global crises. The quality of urban planning and management are vital to achieving prosperity, sustainable development and resilience to the increasing pressures of global challenges. Thus, integrative urban planning would have the power to overcome existing sectoral policy silos, and an inclusive development programme can provide a balance between various spatial and functional dimensions (Wong, 2014). The economic resilience of the city or region is often derived from its unique conditions and each local system requires unique measures and interventions. Another problem of effective actions by local governments is the constant dynamics of the local system. Effective intervention by the local government requires a response with minimum delay in obtaining information about the local system and the subsequent implementation of actions (Boschma and Frenken, 2007).

The results of the analysis have shown that prosperity is at the expense of the negative externality of greater vulnerability to external global shocks and disturbances. A lower ability to respond mainly relates to regional centres, larger cities as well as the smallest local units. Therefore, the political decision-makers and experts should explore mechanisms that work differently depending on the size of cities and the region of their location.

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