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Resilience of the Czech Regions to an external economic shock

Abstract: The article explores resilience of the Czech NUTS3-level regions to an external economic shock in the form of the latest global economic crisis of 2008-2009. It begins with a brief introduction of the concept of resilience and of terminological and methodological issues associated with operationalizing it. Next, regional resistance to the external economic shock is assessed using sensitivity indices of relative output and employment contractions. Finally, the nature and severity of the shock as well as regional disparities in recoverability are investigated using employment data.

Keywords: resilience, region, economic shock, downturn, sensitivity, recession, Czech regions.

As the latest global financial and economic crisis of 2008 slowly subsided, a question has arisen of resistance and the capacity of regions to face the crisis without losing their stability and functions. These two qualities can be subsumed under the notion known as 'resilience'. Resilience as a new buzzword has entered both the world of academic discussion and of practical policy. However, this progressive move within both spheres seems to be somewhat ahead of full understanding of the concept. Moreover, its anchoring among other concepts relating to economic growth and development remains rather vague and not fully explained. Undoubtedly, there is still much to be done in terms of conceptualizing and assessing resilience as well as its links to patterns of economic growth. Since the notion of resilience originally came to economics and regional studies from ecological studies, its fundamentals are naturally wider than those of competitiveness. It is of special importance at the regional and local level, where strategies and activities supporting long-term sustainable development are sorely needed in the face of rising volatility of the globalized world economy.

1. Literature review

The notion of resilience originated in ecological studies. Subsequently, experts in regional analysis, spatial development, and economic geography picked up the concept and used it in their disciplines. In recent years, there has been an increasing amount of literature on regional resilience in association with the global financial and economic crisis of 2008. The most significant contributions to this research area are presented by Martin et al. (2012, 2015, 2016), Foster (2007),

Hill et al. (2012), Bruneau et al. (2003), Briguglio et al. (2008), and Boschma (2015). In Czech academic literature, the concept of regional economic resilience has been expounded for instance by Lungová (2011b, 2013), Koutský et al. (2012), Sucháček (2012), and Svoboda (2013). Several recent studies investigating the impact of the crisis on local and regional economies have been carried out, such as Clark (2009), Perlo, Paredes and Gonzales (2009), Lee (2009), and in Central and Eastern Europe, Blažek and Netrdová (2012), Sagan and Masik (2014), and Mrinska (2015). Besides, territorial impact of the latest crisis and estimating resilience of regions was the subject of applied research known as ECR2 (Economic Crisis: Regional Resilience) that was carried out across the European Spatial Planning Observation Network territory (Bristow et al., 2014).

Resilience can be loosely described as a multidimensional quality of a system (territory). There is a degree of uncertainty around both the terminology regarding resilience and the way of operationalizing it. A generally accepted definition of resilience is still lacking. Yet, it provides valuable insight into regional and/or local economic development. Martin et al. (2015) use the term 'resilience' to refer to a complex process rather than a feature or outcome. Foster (2007) defines regional economic resilience as a region's ability to estimate, prepare, respond to and recover from an economic shock. What is more, Martin et al. (2016) identify four sequential steps that might be subsumed under the term resilience:

- risk of (vulnerability or sensitivity to) disturbances,
- resistance to the impact of a shock (scale, nature and duration of a shock),
- re-orientation (the extent of structural adjustment of a region's firms, industries and workers after a shock),
- recoverability (restoring the growth path prior to a shock).

Bruneau et al. (2003) also identify four properties of resilience. Two of them account for end-state resilience in terms of actual performance of regions in response to a shock. These are robustness (the strength of a region to withstand a shock without losing its function) and rapidity (the capacity to achieve goals in order to prevent future disturbances). The remaining two properties show the capacity and potential of regions to build and achieve resilience. These include redundancy in terms of the capacity of regions to ensure functioning in times of disturbances, and resourcefulness in terms of the capacity to identify problems and mobilize resources in the face of a shock.

Some experts point to a difference between economic resilience as policy-induced changes and vulnerability as inherent features affecting a country's exposure to exogenous shocks. Adopting this view may make it easier to measure resilience. In this vein, only what a country and/or a region can do to reduce its vulnerability would be a subject of assessment (Briguglio et al., 2008). With respect to the above, the risk of being affected by external shocks seems to consist in two things: the first is linked to the inherent conditions of regions, and the second to the ability to cope with adverse shocks (see Figure 1).

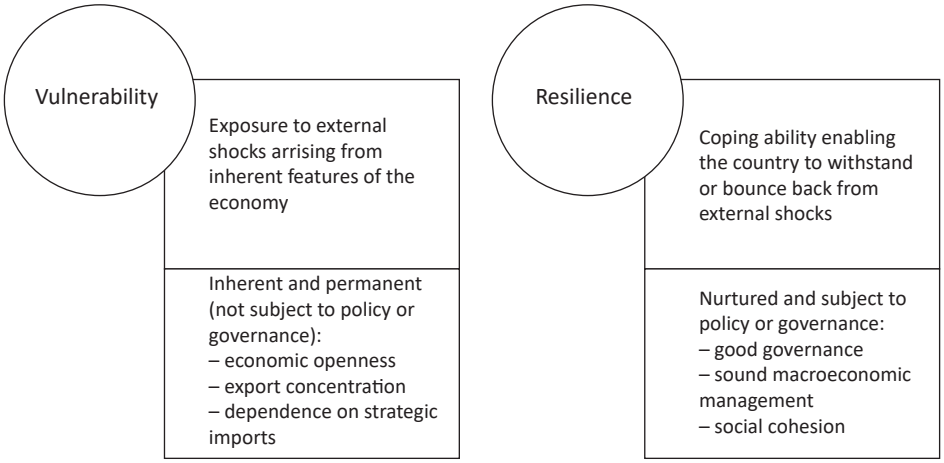

Figure 1. Risks associated with being adversely affected by external shocks

Source: Briguglio et al., 2008, p. 3, own elaboration.

This view is supported by Foster (2007) who recognizes two types of resilience: performance and preparation one. Preparation resilience assumes the ability of a region to anticipate and prepare for disturbances, which is clearly linked to the capacity of local/regional actors to formulate policy measures. Preparation resilience is divided into two stages: assessment and readiness. Performance resilience assumes the ability of regions to respond and recover from disturbances, hence may be in a way associated with inherent features of regional economies.

2. Objective and Methodology

As the concept of resilience is rather wide, it is worth narrowing this research to particular attributes of resilience. In the article, the components that might resemble robustness by Bruneau (2003), vulnerability by Briguglio (2008), resistance and recoverability by Martin et al. (2016), and performance resilience according to Foster (2007) are explored. Induced structural changes and applied policy measures are not a subject of investigation. The article aims to answer the following research questions:

1. Are there any regional disparities in both the onset of the downturn and the recovery?
2. Are there any regional differences in sensitivity of regions to the analyzed external demand shock?
3. Can the latest global financial and economic crisis of 2008 be regarded as a national economic downturn shock with negative impacts on all regions?
4. Are there any regional disparities in recoverability of the regions from the shock?

To begin with, *the source of the shock* must be identified. In the article, it is the global financial and economic crisis of 2008-2009. Then, *representative variables* need to be selected which would reflect the severity of the shock. Usually, the data on real gross domestic product (GDP), gross value added (GVA), employment and/or unemployment are used with different explanatory power. Shocks in the form of successive hits over a relatively short period of time pose a great challenge, especially when operationalizing recovery. In theory as well as in practice, there are no generally agreed upon standards of the *scale and the nature of a shock as well as recovery*, which creates space for testing various methods of measuring it.

After selecting suitable indicators, the way to process them needs to be decided. Should the impact of the shock be measured as an absolute change in given indicators, as a *slowdown* in their growth rate, as the *duration* of a contraction, or rather by *comparing* their value *at the bottom* of the trough *with some counterfactual level* that would have been reached had the shock not occurred? Apparently, estimating such counterfactuals is a problem *per se*, for using different models leads to diverse results. Similarly, when assessing capacity of regions to bounce back from a shock (recoverability), researchers may focus on the time needed for a region to get back to its pre-shock state (the level of employment and/or GDP), and/or on its long-run growth path. Besides, the notion of so-called 'perverse' resilience cannot be omitted. This means the threat that resilience may lock a system into a dysfunctional and/or inefficient state (see arguments in 2.1 in the context of figure 5).

Finally, in order to assess resilience to a shock, a disturbance needs to have happened sufficiently long ago to allow for measuring recovery; data must be available in all regions in the years representing the onset and the end of the crisis and recovery periods. By all means, precise time frame of both the downturn and the recovery is rather difficult to determine.

2.1. Methodological framework

The paper draws on two methods that differ in the 'reference standard' while exploring resilience to shocks. The first refers to changes in absolute values of chosen indicators, whereas the second to a region's long-term growth path. This approach was adopted to see if the two methods gave the same results.

To begin this process, resistance to a shock is gauged using two basic macroeconomic indicators (real GDP expressed in volume indices and total employment in total number of employed people). To do so, the procedure used by Martin (2012) is applied in which the percentage decline in regional employment and/or output between peak and trough is compared to the reference value equal to the respective decline at the national level. If the ratio known as 'sensitivity index' is greater than one, it means higher sensitivity to a recessionary shock (thus lower resilience). In comparison, the index lower than one implies relatively higher resilience of the region (thus lower sensitivity) to an economic downturn. The term

'resilient' is used here even though only one dimension of resilience is focused on, known as 'resistance'.

Secondly, the method developed by Hill et al. (2012) is adopted, though with some adjustments. This procedure is wider and covers three dimensions of resilience according to Martin et al. (2016): risk, resistance, and recoverability. Hill et al. (2012) begin with identifying the nature of the shock. The differentiation between three types of regions – shock-resistant, resilient, or non-resilient – is based on their ability to respond to a shock. This procedure is particularly useful in suggesting a precise operationalization as follows (Hill et al., 2012, p. 9):

- A national economic downturn shock is such that leads to more than 2 p. p. decline in the national growth rate from its annual growth rate over the previous eight year.[1]
- A region is assumed to be negatively affected if, in the year of a shock or the year thereafter, its economy experiences a substantial downturn, defined as a decline of more than 2 p. p. from the previous eight-year average growth rate. If a region does not experience economic downturn, it can be called '*shock-resistant'*.
- Once a region is negatively affected, it can be classified as '*resilient*' if its annual growth rate returns to its growth rate from the eight year pre-crisis period within a relatively short period of time. Otherwise, the region is *'non-resilient'*.

However, the suggested method needs to be treated with caution. Especially the length of time needed for returning to the pre-crisis growth rate requires careful consideration. A large volume of empirical evidence exists concerning the average length of expansions and contractions during the business cycle. Hill et al. (2012) refer to Hausmann, Prichett, and Rodrik (2005) who analyzed a sample of 110 countries and identified more than 80 episodes of growth acceleration since the 1950s that lasted at least eight years. Furthermore, historical data on the US business cycle confirms that the average length of expansion measured in GDP terms has extended to almost eight years since the 1990s. In contrast, the average duration of contraction measured in GDP terms has not changed significantly and it is usually estimated to last around eleven months. Nevertheless, to show the impact of economic downturns while assessing resilience, researchers usually analyze employment.

Whereas output development typically rebounds soon, it is the workforce that bears the main stress. Employment reflects whether the workforce laid off during contractions is rehired as the demand for the region's products and services picks up. It is worth noting that labour markets have faced many challenges in recent years, which may have affected employment patterns. A phenomenon known as 'hysteresis' may have come into play which describes a situation in which a single disturbance leads to permanently lower employment. Moreover, impacts of gradual structural and institutional changes, policy implications as well as regional disparities in the pre-crisis growth rates cannot be extracted from the analysis.

[1] This value of a decline in growth rate draws on Haussmann, Pritchett, and Rodrik's (2005) use of an increase in growth rate to measure growth accelerations.

Hill et al. (2012) suggest that a resilient region should resume its eight-year pre-crisis employment growth rate within four years from the onset of the downturn. This period is based on an analysis of 1,476 employment shocks between 1978 and 2007, where an average length of time from the onset of the downturn to recovery was 2.9 years. A major problem with this method is that even regions with very low pre-crisis employment growth rate or even with a negative growth rate were considered resilient if they bounced back fast enough to their growth path. For these reasons, the procedure is slightly adjusted. A region is assumed to be *resilient* if it *exceeds the national eight-year average pre-crisis growth rate* within a relatively short period. Taking into account the slowdown in 2012-2013 in the Czech Republic, a four-year period seems to be reasonable.

The average annual growth rate of employment is calculated using the geometric mean as follows:

$$\bar{k} = \prod_{i=1}^{n} (k_i)^{\frac{1}{n}} \tag{1}$$

Where = $\bar{k}$ geometric mean of individual annual growth rates in subsequent years, n = number of years, k = annual growth rates.

To summarize, resistance to a shock is assessed by comparing overall relative contractions in both GDP and employment between peaks and troughs. Consequently, the annual growth rates of employment are investigated to identify whether regions can be classified as shock-resistant, resilient, or non-resilient.

3. Application to the Czech Regions

The entire analysis is carried out for fourteen higher territorial self-governing Czech units (NUT3 level in terms of NUTS classification). A major source of data is the Czech statistical office, particularly its database of regional accounts and the public database.[2]

To begin the analysis, let us specify the source of the economic downturn. The global economic crisis of 2008-2009 undoubtedly had multiple causes (Lungová, 2011a). The sub-prime mortgage crisis, which broke out in July 2007, is usually argued to be its immediate trigger. The financial crisis peaked in autumn 2008 when the whole financial system faced a high risk of break-down. Gradually, the financial crisis transformed in 2009 into one of real economy. In response, various economic policy measures were implemented to mitigate its impacts. The financial collapse was averted; however, public finances of many national economies deteriorated considerably. Therefore, some governments (including the Czech government) resorted to implementing austerity policy measures in order to slow down rising national debts. This in turn decelerated economic recovery.

While the financial crisis raged on a global scale in 2008, the Czech economy only reached its peak (in absolute figures). Subsequently, in 2009, a considerable drop in real GDP was recorded as a result of the external demand shock. Despite

[2] It is to be noted that data of the same sort obtained from various statistical databases may differ.

the annual increase in real GDP by 2.6%, in relative terms, already in 2008 the GDP growth rate decelerated by 2.9 p. p. The world economy began to pull out of recession relatively soon in response to various fiscal and monetary impulses. However, the Czech economy did not appear to be recovering fast. Whereas the onset of this economic recession was rather fast and caused mainly by external factors, it soon became evident that the 'double-dip recession' hypothesis was true. The second slowdown in 2012-2013 can be mostly attributed to weak domestic demand, due to consumers' and investors' general pessimism, which seemed to be compounded by austerity policy measures and only mitigated by exports.[3] The recovery that began in the second half of 2013 was very weak. At last, the Czech economy appeared to come out of recession in 2014, when real GDP increased annually by 2%.

3.1. Structural features of regional economies

To understand the outcomes of the analysis, let us study the key structural characteristics of regional economies, using 2007 as the base year before a full blow of the crisis. Much of the current literature on economic resilience conventionally agrees on the crucial significance of industrial structure to the vulnerability of regional economies. However, a rising number of empirical studies point out that industry diversification no longer fully accounts for regionally differentiated responses to cyclical developments (such as Martin et al., 2016).

Traditionally, industrial specialization is believed to accelerate economic growth if the main industry thrives. However, it makes the region more susceptible to shocks when the dominant industry is hit by a downturn. By contrast, a highly diversified economy may not achieve such fast economic growth, but it may ensure greater stability and thus resistance to economic shocks. Not every instance of diversification guarantees better resistance, though. The degree of sectoral inter-relatedness that may exist even in a diverse economic structure is of key importance as well. All the same, a highly specialized region may prove to be resistant to an economic shock.

Specialization of the Czech regions can be demonstrated using specialization indices (SI). Regional specialization is reflected in the distribution of a certain sector/industry in the total economic activity of a region. The index value varies from 0 to 1. The closer to 1, the more specialized the region is (see *table 1*).

Relatively low values of the indices, ranging from 0.103 in Prague to 0.209 in the Liberec region, do not show substantial specialization at NUTS3 level. The Liberec, Zlin, Vysocina, Pardubice and Plzen regions, with SI > 1.6, have rather high proportion of employment in manufacturing industry (the Liberec region over 42%, followed by the Vysocina, Zlin, Pardubice and Plzen regions, ranging between 38 and 35%). In comparison, Prague, the South Moravian, Karlovy Vary,

[3] Since the article is focused on an external economic shock, there is not enough space to analyze the second downturn, as its cause was different from the first one. Therefore, only first peaks and troughs are included in the analysis.

Moravian-Silesian and Usti regions have the highest proportion of employment in the tertiary sector (81.5, 58.5, 57.8, 57 and 56.4%, respectively).

Table 1. Specialization Indices in the Czech Regions (2007)

NUTS3*	PHA	STC	JHC	PLK	KVK	ULK	LBK	HKK	PAK	VYS	JHM	OLK	ZLK	MSK
SI	0.103	0.133	0.137	0.16	0.138	0.13	0.209	0.167	0.168	0.179	0.134	0.152	0.18	0.133

* Note: PHA – Prague, STC – Central Bohemia region, JHC – South Bohemia region, PLK – the Plzen region, KVK – the Karlovy Vary region, ULK – the Usti nad Labem region, LBK – the Liberec region, HKK – the Hradec Kralove region, PAK – the Pardubice region, VYS – the Vysocina region, JHM – the South Moravian region, OLK – the Olomouc region, ZLK – the Zlin region, MSK – the Moravian-Silesian region.

Source: Czech Statistical Office, database of regional accounts, own elaboration.

Manufacturing and construction industries have usually been regarded as more cyclically sensitive than private service industries, and the latter more sensitive than public sector services. Thus, the spatial distribution of the above-mentioned industries may explain most of the geographical differences in resistance to economic shocks. However, this may no longer be true once the fiscal austerity measures are introduced (as was the case of the Czech Republic). To illustrate the spatial distribution of industries, the location quotient (LQ) is provided (see *table 2*).

A location quotient measures a region's industrial specialization relative to the national level, comparing an industry's share of regional total employment against the industry's share of the national total employment. This reveals concentration of industries across the regions and helps to identify the most export-oriented industries in a region. In practice, LQ > 1 suggests that a regional economy is self-sufficient and may even be exporting goods and services of that particular industry. In contrast, LQ < 1 indicates that a region tends to import goods from other regions.

Table 2 points to several regions with considerable concentration in particular industries. Prague is especially worth noting with LQ > 2 in the IT sector, financial services, and activities requiring highly skilled workforce (such as R&D). Besides Prague, only the South Moravian region demonstrates high concentration in the IT sector and high-skills professions (with LQ > 1 for both J and M + N sectors). This result can be partially attributed to the location of Brno, the second largest city and a centre of education, research, and innovations. More cyclically sensitive industries, such as construction and transportation, appear to be rather equally distributed across regions. The Liberec, Pardubice, Vysocina and Plzen regions show significant concentration of manufacturing industries. The Vysocina region (LQ > 2), followed by the South Bohemia, Pardubice, Plzen and Olomouc regions (LQ around 1.5) have extraordinary concentration of the primary sector. It is worth noting that the Moravian-Silesian and Usti regions, which have gone through deep economic transformation over the last two decades owing to high concentration of mining and metallurgy, have similar structural features. This has substantially affected their socio-economic situation. Public services do not seem

Table 2. Location quotient in the Czech regions (2007) for selected industries (NACE)

NUTS3	A	B + C + D + E		F	G – U*					
		total	of which C		total	G + H + I	J	K	M + N	O + P + Q
PHA	0.070	0.474	0.264	1.134	1.401	1.173	3.049	2.128	2.039	1.059
STC	1.231	1.088	1.127	1.027	0.928	1.091	0.385	0.847	0.916	0.835
JHC	1.762	1.060	1.066	1.137	0.917	0.972	0.780	0.900	0.653	1.007
PLK	1.513	1.143	1.290	0.805	0.876	0.857	0.460	0.789	0.862	0.986
KVK	0.460	1.058	1.047	0.958	0.993	1.029	0.190	0.666	0.823	1.137
ULK	0.823	1.064	0.998	0.971	0.968	1.043	0.378	0.915	0.763	1.010
LBK	0.738	1.351	1.542	0.869	0.783	0.826	0.366	0.334	0.702	0.859
HKK	1.215	1.107	1.235	0.781	0.917	0.948	0.739	1.026	0.708	1.011
PAK	1.515	1.192	1.307	0.993	0.843	0.931	0.576	0.861	0.632	0.917
VYS	2.453	1.262	1.386	0.956	0.744	0.815	0.462	0.722	0.450	0.878
JHM	1.114	0.983	0.966	1.114	1.005	0.898	1.224	0.926	1.063	1.071
OLK	1.449	1.061	1.123	0.966	0.934	0.932	0.514	0.727	0.664	1.094
ZLK	0.381	0.623	0.682	0.513	0.451	1.004	0.236	0.227	0.342	0.490
MSK	0.679	1.059	0.998	0.898	0.979	1.033	0.554	0.636	0.881	1.076

* Note: NACE classification: A – Agriculture, forestry and fishing (primary sector), B + C + D + E – Manufacturing, mining and quarrying and other industry, C – Manufacturing, F – Construction (B-F secondary sector), G + H + I – Trade, transportation, accommodation and food service, J – Information and communication, K – Financial and insurance activities, M + N – Professional, scientific, technical and administrative activities, O + P + Q – Public administration, education, health and social work (G-Q tertiary sector)

Source: Czech Statistical Office, database of regional accounts, own elaboration.

to be notably concentrated across regions except for the Karlovy Vary region due to its specific position as a centre of the spa industry and tourism.

Some scholars (e.g. Chapple and Lester, 2010) attempted to find the essential characteristics of regional resilience. According to them, regions with highly skilled workers and a high rate of innovation prove to be both more resilient and flexible. As research and development (R&D) is a key component of innovation and a crucial factor in developing competitive advantages, an overview of innovative potential of the Czech regions is provided in *figure 2* using two indicators: R&D expenditure as a percentage of regional GDP (reflecting R&D intensity), and R&D personnel (in full-time equivalent, FTE) as a percentage of total (regional) employment (average for 2005-2007).

Figure 2 indicates a significant difference between regions regarding both their R&D intensity and R&D personnel. Prague and the South Moravian region clearly outperform the remaining twelve regions in both indicators due to high concentration of R&D activities. By contrast, the Karlovy Vary, Usti and Vysocina, followed by the Moravian Silesian, Hradec Kralove, South Bohemia, Olomouc, and Plzen regions fall behind in both indicators, which may be reflected in regional competitiveness and/or flexibility, essential for recoverability after a shock.

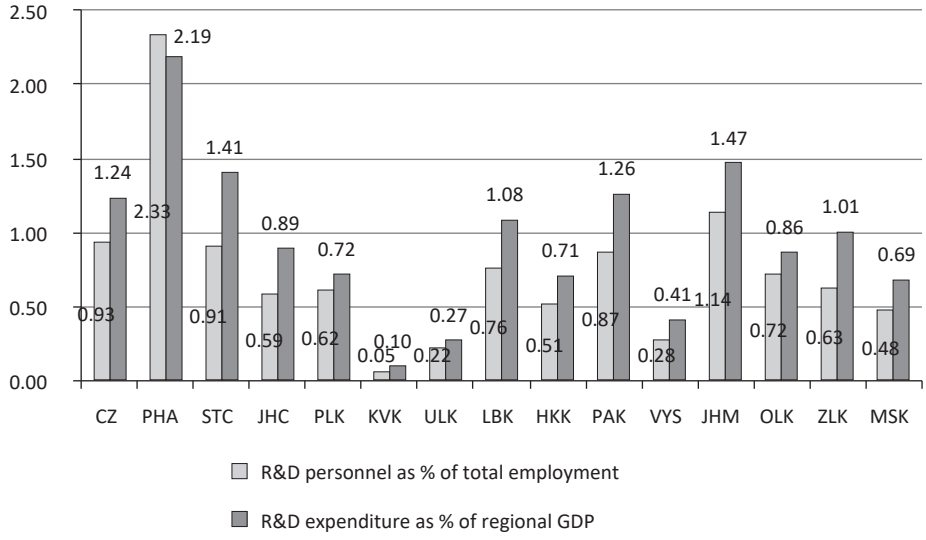

Figure 2. Innovative potential of the Czech regions (2005-2007, in %)

Source: Czech Statistical Office, database of regional accounts and public database, own elaboration.

3.2. Assessment of resilience: Resistance to an external demand shock

This chapter aims to answer the research questions posed in the previous section. At first, regional disparities at the onset of the downturn and recovery are investigated. At the national level, a peak in real GDP was achieved in 2008 (153.4),[4] and a trough in 2009 (146). The same is true for nine regions too. To illustrate the timing clearly, a timeline diagram is provided (see *fig. 3*).

The regions adjacent to the border with Germany, namely the Plzen, South Bohemia and Karlovy Vary regions (together with the Vysocina region) were the first to register the slowdown due to an earlier onset of the economic recession there. *The Usti and Karlovy Vary regions stand out among all the regions owing to their continuously declining output until a low was finally hit in 2013.*The same is true for the South Bohemia and Karlovy Vary regions in terms of employment. Employment shows greater volatility and regionally differentiated timings of peaks and troughs compared to output development. In absolute figures, most regions reached their peaks in employment in 2008 (see *fig. 3*). All regions but Prague and Central Bohemia experienced contractions in employment in 2009 (in absolute figures); some of them even hit a low then. By contrast, several regions reached peaks in total employment already in 2007. This holds for the Liberec, Hradec Kralove, Pardubice, Vysocina and Olomouc regions. Besides, most regions experienced a subsequent drop in employment within the analyzed period.[5]

[4] Expressed in volume indices (1995 = 100%), 1995 is set as the base year by the Czech Statistical Office to allow for analyzing long-term real output development.

[5] As the second downturn is not a subject of this investigation, it is not included in the timeline diagram and explored any further.

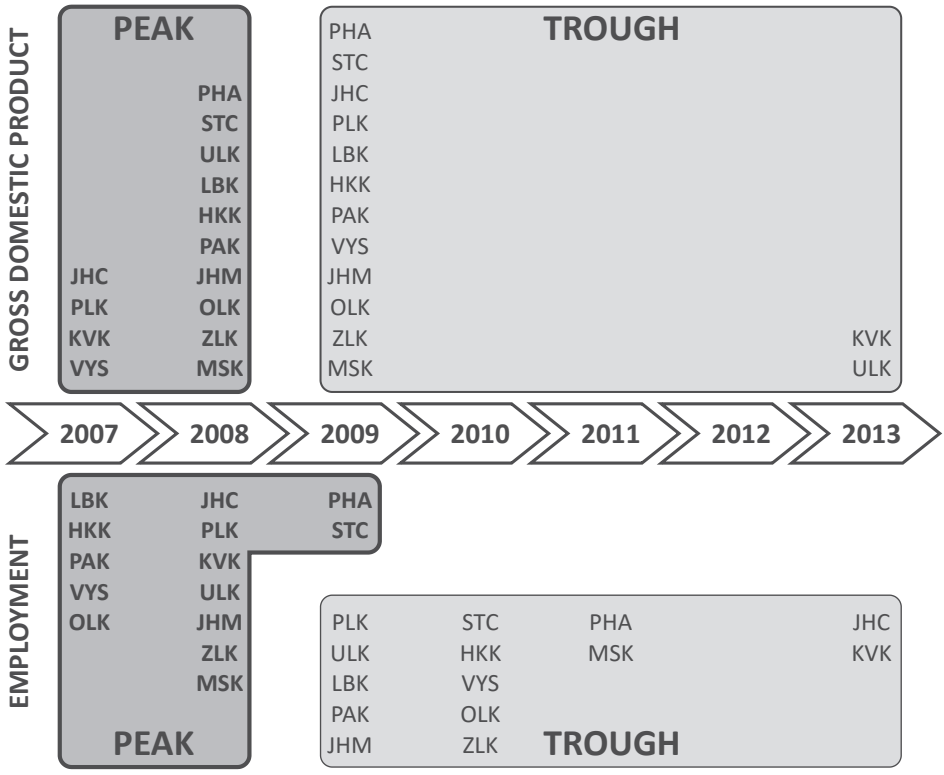

Figure 3. Timeline diagram of peaks and troughs in output and employment across regions

Source: own elaboration.

Turning now to the second research question, the sensitivity indices of relative output and employment contractions are provided to illustrate impacts of the global economic crisis of 2008 (see *Table 3*). Contractions are measured from peak to trough in percentage terms. Every region is assigned a specific time frame (see *fig. 3*).

As can be seen in *table 3*, *the most sensitive* regions in terms of GDP contraction in response to the global economic crisis appeared to be *the Karlovy Vary, Usti and Moravian-Silesian* regions, followed by Central Bohemia and the Liberec region. Prague and the Pardubice region showed a negligibly higher sensitivity too (sensitivity indices higher than one). In contrast, the Plzen and Zlin regions seemed to be relatively resistant, with the sensitivity indices 0.6 and 0.67 respectively; followed by South Bohemia and the Hradec Kralove region. Regions that were the most seriously affected in terms of employment dynamics are Karlovy Vary, Olomouc, Vysocina, and Zlin. The South Bohemia, Hradec Kralove, Moravian-Silesian, Liberec, Usti and Pardubice regions also experienced a higher drop in employment than was the national average. Interestingly, the Olomouc, Vysocina, Zlin, South Bohemia and Hradec Kralove regions di-

Table 3. Sensitivity indices of relative GDP and employment contractions

	GDP		Employment	
	Contraction (in %)	Sensitivity indices	Contraction (in %)	Sensitivity indices
CZ	–4.82		–3.09	
PHA	–5.50	1.14	–2.87	0.93
STC	–7.23	1.50	–1.28	0.41
JHC	–3.74	0.77	–4.64	1.50
PLK	–2.89	0.60	–1.90	0.62
KVK	–10.49	2.17	–11.37	3.68
ULK	–7.94	1.65	–4.10	1.33
LBK	–6.53	1.35	–4.22	1.37
HKK	–3.69	0.77	–4.49	1.45
PAK	–4.89	1.10	–3.95	1.28
VYS	–4.08	0.85	–6.84	2.22
JHM	–4.74	0.98	–2.35	0.76
OLK	–3.93	0.81	–7.36	2.39
ZLK	–3.25	0.67	–6.80	2.20
MSK	–7.54	1.56	–4.48	1.45

Source: Czech Statistical Office, database of regional accounts, own elaboration.

verged in terms of output and employment sensitivity. On the other hand, *the Central Bohemia, Plzen, South Moravian and Prague regions* appear to be *the least sensitive* in terms of employment contractions.

3.3. Assessment of resilience: Resistance and recoverability of regions

Having assessed the sensitivity of regions to the shock, let us discuss the third research question. Drawing on the argumentation of Hill et al. (2012), annual employment growth rate at the national level dropped by 2.67 p.p. in 2009, against the pre-crisis eight-year average annual growth rate; thus, the stress can be regarded as a national economic downturn shock (see *fig. 4*). To check whether a particular region can be called shock-resistant, the scale of the annual drop in percentage points is compared to the pre-crisis eight-year average annual growth rate. Every region is assigned its specific time frame according to the timeline diagram (see *fig. 3*).

Figure 4 shows considerable differences in pre-crisis growth rates. Prior to the crisis, Prague, the Central Bohemian and the Usti regions had higher employment dynamics than the national average. In the year of the shock or the year thereafter, all regions registered over 2 p.p. decline from their pre-crisis average annual growth rate. There are no significant differences in this finding whether the same time frame is used for all regions or every region is assigned its precise onset of the downturn. Therefore, no region can be classified as ‘shock-resistant’ in terms

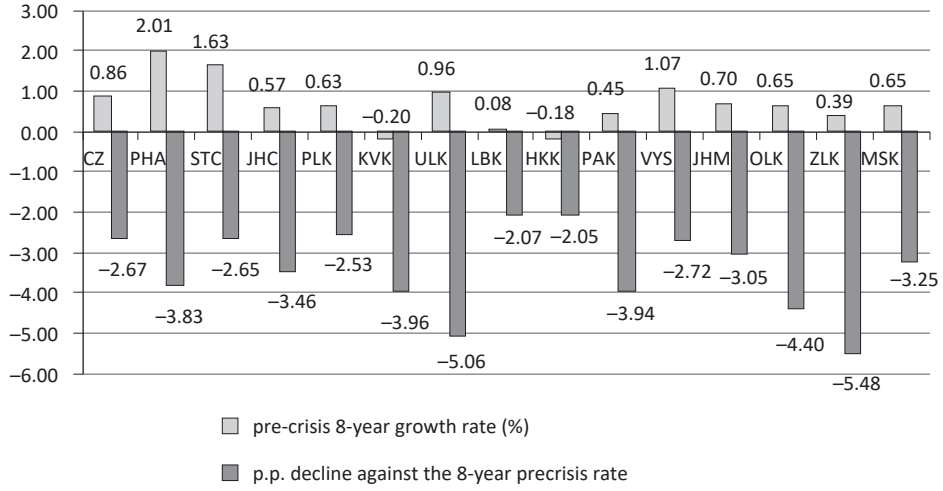

Figure 4. Annual decline in employment (in percentage points) at the onset of the shock against the pre-crisis eight-year average annual growth rate of employment (%)

Source: Czech Statistical Office, database of regional accounts, own elaboration.

of employment dynamics. The Zlin, Usti, Karlovy Vary, Pardubice and South Bohemia regions experienced the highest drop in annual employment growth rate against the eight-year annual growth rate. In contrast, the Liberec, Hradec Kralove, Plzen and Central Bohemia regions recorded a lower decline than the national average. It is important to bear this in mind when interpreting recoverability of these regions. Surprisingly, in the Hradec Kralove and Karlovy Vary regions, average annual employment growth rates over the eight-year period prior to the crisis had been negative.

Finally, turning to the last question regarding recoverability of regions, let us study *figure 5*.

Figure 5 implies that the regions have differentiated capacity to recover from the analyzed shock. Taken together, two clusters of regions emerge. The first one includes Prague, the South Moravian, Moravian-Silesian, Central Bohemia and Usti regions. As these regions reached the national pre-crisis average annual growth rate within four years, they can be regarded as 'resilient' in light of the adjusted methodology of Hill et al. (2012). The inclusion of the Usti region in this group is unexpected as usually it belongs to a group of regions with a relatively unfavourable socio-economic situation, especially due to the trends of its industrial restructuring. On the other hand, the region benefits from its strategic location at the German border, at the crossroad of important traffic routes, and from high inflow of foreign direct investment.

Within the second cluster (i.e. regions which did not resume the national pre-crisis growth rate), two subgroups can be identified. The first includes regions showing diverse (but relatively positive) capacity to recover, such as the Hradec Kralove, Zlin, Vysocina, Liberec and Pardubice regions. The second consists of

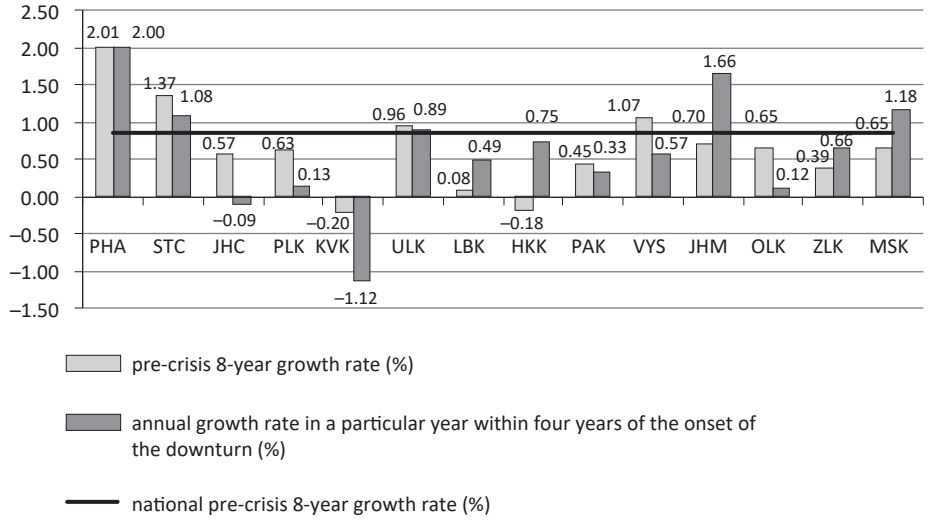

Figure 5. Annual growth rate within four years of the onset of the downturn against the pre-crisis eight-year average annual growth rate (%)

Source: Czech Statistical Office, database of regional accounts, own elaboration.

regions struggling to approximate the pre-crisis employment growth rate within four years. This group is rather heterogeneous: the Plzen region has generally outstanding macroeconomic results, while the Olomouc, South Bohemia and Karlovy Vary regions lag behind in economic performance. The common denominator of the regions with this lower capacity to recover appears to be high concentration of the primary sector (see table 2) and relatively low innovative potential (see fig. 2).

Discussion

This article has proved that generally:

- The Czech regions were more sensitive in terms of employment than GDP development.
- Employment responded to the shock with time delays, i.e. troughs in employment were recorded later than in output in some regions.
- Employment grew at a slower pace even in times of economic expansion.

Returning to the questions posed at the beginning of this article, it is now possible to draw the following conclusions.

1. Regional disparities at the time of the onset and the recovery were confirmed (see *fig. 3*).
2. The results regarding the regions' sensitivity are summarized in *figure 6*.

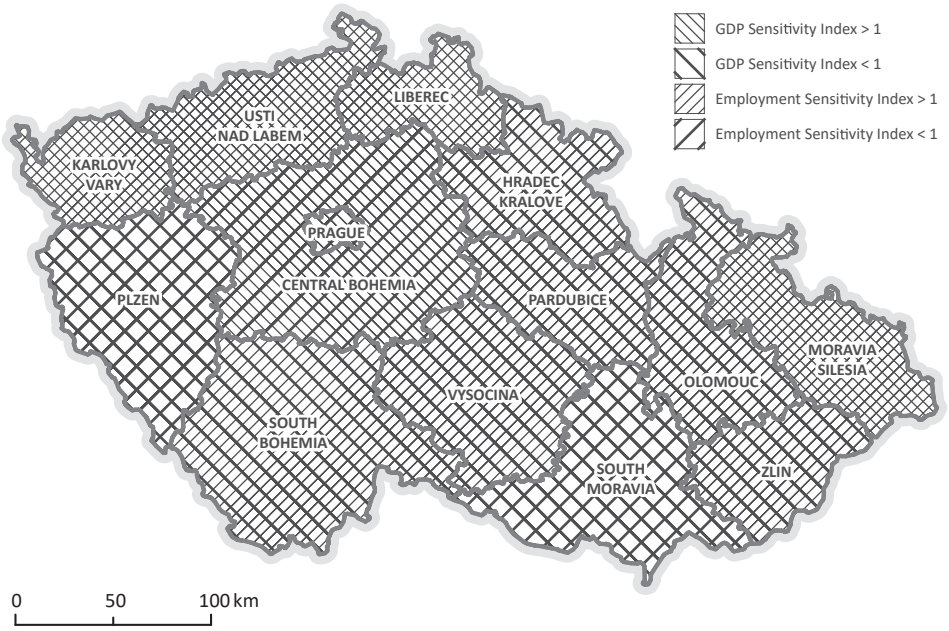

Figure 6. Scheme of regional differences in sensitivity to the analyzed shock

Source: own elaboration.

Undoubtedly, the Czech regions varied in their capacity to withstand the shock. The Karlovy Vary, Usti, Moravian-Silesian and Liberec regions suffered much more severely in terms of both the output and employment dynamics. In comparison, the South Moravian and Plzen regions proved to be more resistant to the shock. In terms of employment, the Central Bohemia region and Prague can be called resistant too.

3. As for the nature of the shock, the global financial and economic crisis proved to be a national economic downturn shock. Because all regions registered over 2 p.p. decline from their pre-crisis average annual growth rate in the year of the shock or the year thereafter, none of the Czech regions was found 'shock-resistant'. Moreover, all regions were negatively affected as they all registered significantly greater annual drop in total employment in the year the shock began, against the eight-year average annual growth rate prior to the crisis (see *figure 4*).

4. It is more difficult to establish firm data on recoverability of the regions. The data processed above show that a slight adjustment in the procedure may lead to significantly different results (e.g. different outcomes when average growth rates over a four year period calculated as a geometric mean are used rather than annual growth rates in individual years after the onset of the downturn). Besides, comparing the two methods, by Hill et al. (2012) and Martin (2012), revealed that a difference in terminology and reference values may lead to contradictions. From the point of view of employment growth rates, all regions were negatively affected by the shock (see figure 4), whereas sensitivity indices of relative contrac-

tions (see table 3) show that several regions were resistant. To get better insight into this matter, the Plzen region may serve as an illustrative case. It was the only one among the regions with high employment in the manufacturing industry to resist the shock (see table 3). On the other hand, as it did not resume its pre-crisis employment growth rate fast enough, it was ranked among 'non-resilient' regions (see figure 5). However, although these methods differ in some findings, there are regions considered resilient using both methods: Prague, the Central Bohemia and South Moravian regions. It is not surprising taking into account their industrial structure and rather high innovative potential (see *fig. 2*). The least resilient area was the Karlovy Vary region which had the lowest innovative potential and, indisputably, the highest sensitivity and the lowest capacity to recover.

In terms of recoverability, the industries requiring highly skilled workforce, such as the IT sector and other hi-tech activities (concentrated in regional centres such as Prague and Brno) appear to be important. Regions with the highest employment in the manufacturing industry (the Liberec, Zlin, Vysocina, Pardubice regions) proved to be rather sensitive to the shock. In contrast, they recovered relatively fast (apart from the Plzen region). Concentration of R&D as a key factor of innovative activities seems to be of special importance to regional resilience.

Conclusions

This article has analyzed economic resilience of the Czech regions at NUTS3 level to the global economic crisis of 2008. The presented results are significant in at least two major respects. Firstly, they demonstrate the danger of terminological and methodological discrepancies that may lead to confusing conclusions. Moreover, they confirm that findings depend on both the selection of particular indicators and on setting their reference values. Secondly, they show that diversification and a particular industrial structure, often assumed to be crucial for regional resilience, cannot explain it fully. This does not come as a surprise, however. Apparently, the same sectors can perform differently in different regions; besides, the relative role of industrial structure varies over time, from one recession-recovery cycle to another. Thus, an analysis of numerous region-specific factors is needed to account fully for the presented results. There may be differences in inter-firm interdependencies, in the particular market segments they supply, their technological sophistication, the skills of the workforce, the functional nature of the firms, their profitability as well as a specific institutional context, such as established practices, the operation of the labour and financial markets, the nature of policy interventions etc. However, an in-depth analysis of each of the numerous regions is beyond the scope of this article. This is an important issue for future research. Moreover, it would be interesting to assess major determinants of regional resilience capacity in terms of other aspects than purely economic ones (e.g. socio-demographic capacity of the regions). Further studies which take these variables into account will need to be undertaken. A precise ranking of regions, using a greater number of indicators, would be worthwhile.

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