

Measuring Regional Resilience to Economic Shocks by Index

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The article deals with the analysis of the theoretical and practical aspects of measuring regional resilience to economic shocks. While the concept of regional resilience to economic shocks is still at the development stage, and the method of measuring regional resilience, which is grounded methodologically and is generally accepted, is still missing, the article presents a unique approach of the authors to the concept of regional resilience to economic shocks including the elaboration of the definition of regional resilience to economic shocks, the description of the capabilities to determine the regional resilience in the Resilio model, the specification of their quantitative and qualitative characteristics, and the introduction of the index of the resilience of regions to economic shocks (Resindicis). The rapid development of the globalization processes poses new challenges to the instruments of economic analysis and strategic planning. Different techniques can be used for obtaining the required information on building the regional resilience-enhancing strategies. Each of them has its own advantages and disadvantages. In order to find out the strengths and the weaknesses of measuring resilience by Resilio, the newly developed index was empirically tested with regard to the data of 10 Lithuanian districts in the period of 2006–2015. The assessment results, as well as the advantages and disadvantages of using the Resilio model are presented in this article. The newly developed Resindicis, introduced in the article, represents an objective for having a convenient tool which could be used for economic analysis, strategic planning and justification of solutions aimed at enhancing regional resilience.

Keywords: *Regional Resilience; Economic Shocks; Index.*

Introduction

The national economic and social system is comprised of regional economic and social systems. The overall national economy depends on the country's regions' economic viability, ability to grow, and resilience to changes that arise from the external environment. Negative circumstances emerging in the international and national economic setting cause a complicated economic status in a private as well as in a public sector, and consequently the entire national economy becomes unbalanced; this way the country turns vulnerable and not sufficiently resilient to economic shocks. Every region, as well as the national economy, incurs losses arising from the economic shock that has been triggered by the crisis. Statistics show that the financial and economic crisis of 2008 was the biggest crisis throughout the entire period of the existence of the European Union. On a global scale, the crisis has caused about \$ 15 trillion of damage. The effect of financial and economic crises ranges from a negative impact on a country's economic and social well-being, to generating obstacles for a sustainable development of country's regions. The increase in unemployment rate, the decline in purchasing power and consumption of population, the growing insolvency of population and companies, the loss of export markets, the increase in the government debt, the loss of confidence in the markets and financial system, the emergence of social tensions, the dissatisfaction with the

government policies and a continuing threat of political instability, as well as emigration and the negative demographic trends exposed by the emigration are only a few highlighted consequences of the economic crisis, which have a negative impact on economic development and pose a real threat to the country's future and its economic viability. However, not all regions have experienced an economic downturn. Moreover, regional economies differed not only in terms of vulnerability but also in terms of recovery. Some regions were not affected by the economic shock, others recovered after one or several years, while others have not reached the pre-crisis level yet. Constantly changing economic conditions that create new demands, striving for a better quality of life, an increasingly hostile competition of regions with regard to human capital, investment, technology and other similar factors that define economic development have forced the regions to strive to become capable of preventing and withstanding the economic and other diverse shocks, as well as recovering from it. Namely, there has emerged a need for the regions to turn resilient to economic shocks.

Only a resilient region indicates the ability to ensure competitiveness, economic stability and high quality of life both currently, and in the future situations; thus, the need to enhance the resilience of regions to economic shocks becomes inevitable, and the research of this concept turns imperatively relevant and timely.

Despite the growing interest in the issues of regional resilience to economic shocks at the supranational and national level, this problem still attracts less attention. So far, only few regions and even countries have developed a strategy for regional resilience to economic shocks and an action plan for it. In Lithuania, it is only recently that the issues of economic resilience have received more attention at the strategic and political level; however, only more in the form of starting academic and political discussions rather than developing strategic documents.

First of all, for the reinforcement of the resilience of regions to economic shocks, and for the cultivation of efficient resilience-enhancing strategies and measures it could be expedient to measure the prevailing regional resilience (namely, the levels of vulnerability and recovery), to identify the capacities that drive regional resilience and shape its skills to maintain resilience, and to distinguish the strengths and the weaknesses of the region. Methodological measures that allow to obtain precise and proper information on regional resilience, to assess the dynamics of resilience and the efficiency of current strategies are increasingly highlighted as some of the most important strategic planning tools and a prerequisite for enhancing regional resilience.

Although global scientists, politicians and policy makers are becoming more and more interested in the issues of regional resilience to economic shocks (in Lithuania, although, this complicated issue has been particularly under-investigated); however, the theoretical scientific reasoning of this important question still stays as one of the most complicated elements of the concept of resilience. Scientific literature reveals some rudiments of modelling the resilience of regions to economic shocks; nevertheless, so far there has been no comprehensive analysis of this phenomenon due to the diversity, variety and scale of the regions, the economic shocks and their impact. A high need prevails for a methodologically grounded model that would distinguish main capacities and factors that build regional resilience to economic shocks and would describe their mutual relationship, as well as the relationship with general resilience. The insufficiency of the analyses of the concept of regional resilience to economic shocks at the regional level has evolved as one of the main impediments hindering both the complex evaluation of the existing regional resilience, and the preparation for and coping with the future economic shocks.

The aim of this scientific research is to elaborate the description of regional resilience to economic shocks and to develop an assessment methodology that with the help of the identified regional resilience determining capacities and factors would enable to calculate the index of the resilience of regions to economic shocks (*Resindicis*).

Literature Analysis

The economy is characterized by constant fluctuations, that in economic theory are named economic cycles. Most frequently, the fluctuations in economic cycles are caused by economic shocks, that are described in scientific literature as accidental, unforeseen events or stochastic processes that arise in the region's (national) economy or outside its boundaries. There are various causes of

economic shocks (such as the global economic crisis of 2008, the conflict between the Ukraine and Russia, the refugee flows to Europe from Africa and the Middle East) highlighted: natural disasters, political unrest, changes in the demographic situation, technological advances, economic instability and other events. Considering that each economic shock is unique and has its own specifics, differently affects various objects, and differs in its operating conditions and environmental factors, each study must elaborate its clear definition. The research conducted by the authors of the present article makes it possible to describe *the economic shock* as an unplanned change, an event or a phenomenon of the conditions of activity, of economic, political, social and/or natural environment, in both regional and national and/or international economy, which, in case it is not addressed or the current developmental strategy is not maintained, will have a sudden and serious harmful and/or beneficial impact on the regional economic development. The authors of this article recommend referring to this concept of economic shock when measuring regional resilience to economic shock. It should be noted that although the scientific and strategic documents more often emphasize a negative impact of the economic shock on regional economic development; nevertheless, when changes caused by the environment will start to be viewed as new opportunities, the effect of economic shock on the economic development of regions will be more often evaluated from a positive perspective. Since there is a wide diversity of economic shocks and a plenty of their determinants, each economic shock should be viewed as a separate object of study, having specific nature, time, intensity and impact. In addition, it is important to emphasize that the effect of economic shocks on the development of regional (national) economy may be negative (damage made or loss incurred), and also positive (new opportunities and measures for enhancing economic growth).

The term "resilience" comes from the Latin word *resilio/resilire*, which means "rebound". In the latest scientific literature, the concept of resilience is extensively used in different fields of research. So far, there is still no generally accepted definition of resilience in the economic context. The analysis of scientific literature (Zhou *et al.*, 2010; O'Brien & Wolf, 2010; Cutter *et al.*, 2008) has shown that the concept of resilience can be applied to various entities: an individual, a community, an organization, a company/enterprise, a city, a region, a country and the whole system. In order to analyse the issues of resilience it is important to define precisely in what context it will be dealt with. If the concept of resilience is explored in the context of the subject, it is perceived as a rapid recovery from stress, tension or other shock. If the concept applies to the system, the analysis is focused on a continuous functionality (maintenance of the operation), in the event of a shock, the ability to predict the risk of potential shocks, to prepare for the shock, to withstand extreme challenges of the shock, to recover from the shock and to reorganize or rearrange the structure after the shock.

Theoretical analysis of the concept of resilience (Bene *et al.*, 2014; Martin, 2012; Simmie & Martin, 2010) revealed that resilience is easily perceived as a process rather than a result, as the resilience itself (as a process)

can be managed: to forecast and measure capacities, to adapt to changes and to survive. Resilience is perceived as a variable dimension, because in order to recover its initial status, the system has to change. The change takes place through the recovery after the shock, through “absorbing” the consequences of the shock and adaptation. The system’s resilience depends on the overall components of the system, which, while responding to the changes in other components, are able to change or adapt. The research conducted by the authors of the present article shows that for measuring regional resilience it is purposeful to analyse the *resilience* with regard to capacities, and to define resilience as a continuing process, combining a series of capacities and capabilities directed towards the sustainability and development of operation in the event of present or future external or internal shocks.

Lately, the climatic and hydrometeorological phenomena are considered as the most damaging to the economic system; nevertheless, the damage caused by economic shocks also creates huge costs) and their consequences affect almost every citizen in the region. This only justifies the relevance and timeliness of the problem in question.

The resilience of regions to economic shocks, as a separate field of research, was started to be more thoroughly explored at the beginning of the 21-st century. The first and main representatives of this field of research (Martin, 2012; Foster, 2011; Simmie & Martin, 2010; Hill *et al.*, 2008) that transferred the concept of resilience into the regionalization science analysed regional resilience to economic shocks through the response of the regional economic system to the economic shock in order to maintain a continuous development of the region’s economy. According to Simmie, Martin (2010), regional resilience to economic shocks explains the ability of the region to recover successfully from the economic shock that was incurred, regardless of its development before the economic shock. The resilience of regions to economic shocks is a recurring process in which the economic shock and the process of the region’s recovery from the economic shock can lead to changes in regional economic structures and functions, which in turn can influence the resilience and strength of the regions by ensuring a path after the economic shock.

Analysis of the scientific literature (Davies, 2011; Hudson, 2010; Ficenc, 2010; Pendall *et al.*, 2010; Simmie & Martin, 2010; Hill *et al.*, 2008) has revealed that the response of the region’s economic system to the economic shock, i.e. the region’s capacity to maintain resilience in the time perspective, manifests through its capability to withstand the external pressure in order to maintain a continuous development of the region’s economy; its capacity to respond positively to external changes, and its capacity to adapt in the long-term perspective and to learn. This justifies the approach that regional resilience to economic shocks is a strategy needed to ensure the regional economic development, whereas the change in regional economic development reveals itself as a resilience evaluation tool.

The conducted study of the concept of regional resilience to economic shocks allowed the authors of this article to formulate the following *definition of regional resilience to economic shocks*: this is a mutual ability and possibility of the regional economic entities to employ

dynamic capacities and regional infrastructure and to capacitate the whole regional economic and social system to cultivate the anticipated economic development of the region in the present and future situations, and to remain unaffected or less impaired by the economic shock and, after that shock, as soon as possible to reach the economic development status of the region before the shock by executing a strategy for renewal, recovery, or reorganization. It is recommendable to use this definition as a methodological basis for conducting both theoretical and empirical analysis of the resilience of regions to economic shocks.

In scientific literature which deals with the study of the effect of economic shocks on national and regional economies, there are various impacts of the economic shock distinguished. This is determined by a variety of economic shocks and a multi-component nature of the economic and social system. Glinskiene, Petuskiene (2009) emphasized that the global financial shock impacted the economies of both the developing countries and the most advanced and powerful countries in the world, as well as all political, economic, social processes and entities. The European Commission (2009), Glinskiene, Petuskiene (2009) emphasized that every economic shock strongly affects the labour market and emigration flows. Historical data of the economic shock of 1929–1933 show that it led to the capital concentration process and the strengthening of monopolies, when the monopolistic associations actively expressed their will to the national government. Another area where the changes occurred due to the global economic shock involves the decline in the cash flow sent by emigrants to their country. Despite the diversity of the effects of the economic shocks on the economy, the following consequences, negatively affecting economic development and posing a real threat to the future of the state and its viability, are mentioned most frequently: these are the growth of unemployment rate, the decrease in purchasing power and consumption of the population, the increasing problems of insolvency of population and companies, the loss of export markets, the growth of the debt of the overall government sector and the paralysis of financial capacity, the loss of confidence in the markets and the entire financial system, the emergence of social tension, the dissatisfaction with the policies pursued by the government and the continuing threat of political instability, also the emigration and its negative demographic trends.

The cost of economic shocks is huge; thus, when measuring their impact on the development of regional economies it is necessary to consider the specificity of the regions and the level of their economic development. It is advisable to approach each region as an individual object, and, also, for the measuring of the impact of the economic shock on the development of regional economies it is necessary to assess the impact of the economic shock on all entities of the region’s economy, i.e., a complex assessment is very important. The availability of appropriate information which reflects the real situation enables strategic decision-makers to choose the right solution for the regional economic development, and to withstand more easily the unexpected economic changes in order to minimize the losses.

Scientific literature distinguishes various assumptions regarding the formation of regional resilience to economic shocks. Rose (2004) argues that regional resilience is built by innate abilities and adaptive capacities. A combination of such capacities and their interface with a larger economic system determines the regional resilience to economic shocks. The empirical data of Davies, Tonts (2010) show that regional resilience to economic shocks is formed by a combination of the region's main strengths. This proves that regional resilience is dependent on the region's history and can be created in accordance with the region's economic structure, the nature of a former economy, the restructuring of skills and resources, and the technological potential (Boschma & Martin, 2011; Simmie & Martin, 2010). After examining the impact incurred by several European regions after the financial and economic crisis and downturn in 2008, Davies, Tonts (2010) found that such factors as the size of the market, access to a larger external market, the contribution of natural resources and physical and human capital play an important role in shaping the changeable impact. First of all, weaker regions or the regions characterized by a relatively poor operational activity were more severely affected by the economic shock. In addition, it is more likely that they will incur considerably more harmful long-term effects after the economic shock, as in such regions even a relatively small loss of jobs or businesses results in a greater reduction in the demand for goods and services from local businesses. This is proved by the scientific research (Hill, 2011) exploring regional resilience in the event of natural disasters. The studies (Davies & Tonts, 2010) reveal that the vulnerability of the region to negative economic shocks is also related to the specialization of its sectors, although the degree of regional specialization in Europe has declined since the 1950s. According to Bristow (2010), this is supported by the theory on the evolutionary concept of regional resilience, which highlighted the advantages provided by different regional economies. Diversity is essential in complex and adaptable systems, also from the perspective of both the absorption of disturbances, recovery and the reorganization of the system after the disturbances (Levin *et al.*, 1998). The studies show (ECR2, 2014; Davies & Tonts, 2010) that the regions which specialize in limited fields of sectors are particularly susceptible to economic shocks within the sectors and retain the risk of a permanent reduction in the number of enterprises and jobs or a negative intermediate effect. A more diverse economic rather than a more specialized structure provides regions with a greater resilience to economic shocks, because the risk is effectively distributed within the regional business structure, although this can be limited by a high level of the cross-sectoral interfaces.

A heated debate both at the academic and strategic level is taking place upon the issue of why some regional economies recover themselves, while others are fluctuating. Why some regions are more vulnerable than the others. There is no distinct answer; nevertheless, scientists agree that an important role is played not only by the economic structure, economic capacity and viability of the region, geographic conditions, historical development, psychological climate of the population and other conditions, but also by the implemented resilience of regions to economic shock-enhancing strategies and management.

When developing strategies, the regions can choose to refer to knowledge, reasonableness and learning experience. Therefore, regional resilience to economic shocks and recovery rates could be particularly enhanced by proper planning. When analysing regional response to economic shocks Martin (2012) identified the following four interconnected strategies to ensure regional economic development: these are Resistance, Recovery, Readjustment and Renewal.

Simmie, Martin (2010) argue that adapting and changes are the key solutions for regional economic development. Bristow (2010) agrees that the development of regional economies depends on the strategy chosen for the economic development. The author emphasizes that the readjustment can be understood as an ability to respond to the economic shock based on the past, at least in the short term, choosing a pre-thought-out model of regional economic development that could have been successful before the shock. Resilience through ability to adapt occurs through opportunities or solutions that have been successfully adopted before.

Studies have shown that despite the existence of various strategies to overcome the shock there is no universal strategy that would be suitable for all regions. Both the specificity of regions, as well as the nature of economic shocks differ, so the strategy for each region needs to be developed separately and to be adapted to it, considering regional strengths, weaknesses, available and potential resources and capacities, specificity of the shock, macroeconomic and political situation at the national and international level, and global trends.

Studies have shown that the essence of the conception of regional resilience to economic shocks is more precisely revealed not by the definition of regional resilience to economic shocks, but, in particular, by the aspects that determine it. The scientific literature (Briguglio *et al.*, 2006; McDaniels *et al.*, 2008) distinguishes an abundance of factors that ensure the system's, community's and regional resilience to internal and external shocks. When exploring the issues of regional resilience to economic shocks the researchers (Bristow, 2010; Simmie & Martin, 2010) identified specific factors that ensure particularly regional resilience to economic shocks: these are Learning and the concept of a "learning region"; Modern production base with a modern infrastructure; Experienced, skilled, innovative and entrepreneurial workforce; Strong regional innovation system; Strong and available financial system; Modern and productive infrastructure; Competitiveness and the existence of competition which would contribute to regional vitality and increase the ability to adapt quickly and easily to new conditions through different business networks in the future; Diversified economic base that implies that each regional economy does not exclusively rely on one industry; Scientific institutions that maintain strong links with the local economy; Local policy, favourable and open for industry and innovation; Management system that can maintain and promote the presence and interoperability of all these factors.

It should be noted that for ensuring regional resilience to economic shocks it is not enough to have only regional determinants of resilience, especially when the importance and changes of each factor differ over time in each region

(Hudson, 2010). Appropriate processes, structures and conditions must be applied as well (Chapple & Lester, 2007), which would contribute to a timely implementation of policies and strategies. Pike et al. (2010) highlighted the important role of social relations between the capital, labour, state, civil society, government, and politics. Moreover, according to various scholars (Foster, 2011; Bristow, 2010), each region should have certain qualities in order to maintain resilience to economic shock: ingenuity, operational efficiency, overcapacity, diversity, innovative learning, interconnectivity, robustness and speed.

In scientific literature, especially in the context of regional development based on the concept of regional resources, the emphasis is placed on the fact that, in a changing environment, the success of regional economic development is increasingly determined not by static factors and resources, but by dynamic capacities. According to scientists (Pihkala *et al.*, 2007; Harmaakorp, 2006), dynamic capacities imply the ability to cope with a rapidly changing environment. They show the capability to achieve new and innovative forms of development and a competitive advantage. This is especially important in addressing the economic shock.

The study of the conception of regional resilience to economic shocks, as well as of the presuppositions for the resilience formation enabled to distinguish the following main capabilities to ensure regional resilience to economic shocks: insight and management capacities, knowledge and innovation capacities, learning capacities, networking and cooperation capacities. An appropriate and fully developed infrastructure is very important for the implementation of these capabilities in the economic and social infrastructure of the region. The multiple research by many experts (Juceviciene & Suchankaite, 2015; Jucevicius & Liugailaite-Radzvickiene, 2014; Komninos, 2011) allowed the authors of the present article to define the *insight capacities* as the regional economic entities' mutual ability and possibility to proactively forecast possibilities for economic development, economic shocks, other threats, obstacles and problems, and to respond flexibly, as well as to prepare properly for the above mentioned factors; also, if necessary, to develop a new strategy for recovery, renewal or readjustment based on strategic insights and management capabilities. It should be noted that for an effective use of the insight, *governance capacities* are important as well, which are understood as the mutual abilities and possibilities of the regional economic entities for a timely and organized implementation of strategic and/or structural changes. Other studies (Anttiroiko *et al.* 2013; Bakiji *et al.*, 2013, Jucevicius & Galbuogiene, 2012) allowed the authors of this article to identify *knowledge and innovation capacities* in the context of resilience to economic shocks as mutual abilities and possibilities of the regional economic entities to share the most recent knowledge, and to develop and to use innovation and the functioning innovation network/infrastructure in such a way that innovation activities in the region would create economic value and competitive advantage now and in the future, and would ensure the region's sustainable economic development, and would also allow to avoid economic shocks and, if necessary, to choose a new and innovation-based development strategy for recovery, renewal and

readjustment. The analysis of researchers' works (Onag *et al.*, 2014; Edwards *et al.*, 2014; Florida 2013) allowed the authors of the present article to identify *regional learning capacities* in the context of regional resilience to economic shocks as the implemented mutual abilities of the regional economic entities and established opportunities for a continuous learning and raising personal and collective competence, so that the personal and collective knowledge, acquired during the learning process, as well as the existing and acquired competence and experience would be used to create economic value and ensure regional economic development, now and in the future, in order to avoid economic shocks, and, if necessary, to develop a new development strategy for recovery, renewal and readjustment, based on the knowledge gained, competence and experience. Having analysed the research studies (Gaule, 2014; Kickbusch & Gleicher, 2014; Jucevicius & Kinduris, 2011), the authors of this article defined *networking capacities* in the context of the resilience of regions to economic shocks as mutual abilities and possibilities of regional economic entities to establish an interconnected networking and social capital, with the help of which collective decisions are made and actions are implemented, based on the entities' existing knowledge, available information, competence, resources, and learning, aimed at ensuring sustainable development of the regional economies, now and in the future, and at avoiding economic shocks, and, if necessary, at choosing a new development strategy for recovery, renewal and readjustment based on the networking capacity indicators. *Cooperation capacities*, in the context of regional resilience to economic shocks, are understood as mutual abilities and possibilities of the regional economic entities to carry out, to coordinate, to lead and to manage activities and the implementation of collective decisions aimed at ensuring sustainable development of the regional economies now and in the future, avoiding economic shocks, and, if necessary, implementing a new strategy for recovery, renewal and readjustment based on the cooperation capacity indicators. The findings of the scholars' research (Gainova *et al.*, 2013; Snieska & Zykiene, 2010; Sinkiene, 2009; Snieska & Bruneckiene, 2009) confirmed the importance of *infrastructure and physical resources* for the development of regional economies and enhancing resilience to economic shocks.

Studies revealed that the evaluation of an individual factor does not display the overall problem issue of the resilience of regions to economic shocks. A detailed analysis of regional resilience to economic shocks needs a systematic examination of the interconnected factors that determine regional resilience to economic shocks, since the sum of the impact of these factors affects the overall regional resilience to economic shock. It is important to emphasize that the impact of one or another factor may also be negative, but the region can remain resilient to economic shock if a negative impact can be compensated by a positive effect of another factor. Referring to the fact that regional resilience to economic shocks is determined by a variety of related factors that influence one another and the overall resilience of the region, the problem of regional resilience should be considered in a complex manner.

Methodology

In order to identify a resilient region more precisely, it is necessary to understand the factors that determine resilience. Various researches allowed to develop the *Resilio* model (Figure 1) which distinguishes the main capacities and their groups that determine the region's resilience to economic shocks, and to combine them into groups with regard to their interrelations and the effect upon the overall resilience of the region. In the *Resilio* model all factors that determine regional resilience are divided into six groups which, in turn, involve the subgroups of factors (Table 1).

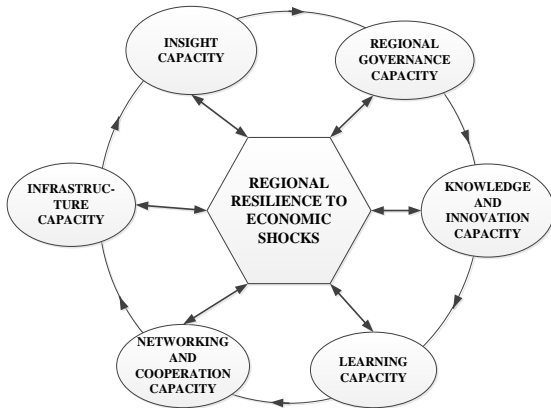


Figure 1. Model of Capacities of Regional Resilience to Economic Shocks (the *Resilio* Model)

The model variables suggest the following assumptions:

- Insight capacity allows proactive anticipation of development opportunities, economic shocks, other threats, obstacles and problems, also a flexible response to them and proper preparation, and, if necessary, development of a strategy for recovery, renewal or readjustment.
- Regional Governance capacity allows a timely and organized implementation of strategic and/or structural changes.
- Knowledge and Innovation capacity allows to use knowledge and innovation to create economic value, to prepare for the economic shock or for its prevention and recovery after the shock.
- Learning capacity allows for a continuous learning and improvement of competence which would be used to ensure a sustained economic development of the regional economy now and in the future.
- Networking capacity allows to combine a diversity of knowledge, competencies, resources and opportunities; while Cooperation capacity allows to implement, to coordinate and to manage collective activities, and to implement decisions for the prevention of economic shocks or for the elimination of their consequences.
- Regional Infrastructure provides opportunities for an efficient, prompt, flexible and timely employment of dynamic resources.

Referring to the fact that regional resilience is a multi-criteria concept and it is appropriate to measure its implementation by both qualitative and quantitative indicators, Table 1, based on the *Resilio* model, identifies the qualitative characteristics and quantitative indicators of the capacities that determine regional resilience to economic shocks.

Table 1

Qualitative and Quantitative Characteristics of Capacities Determining Regional Resilience

Capacity Factors Determining Regional Resilience	Qualitative Characteristics Of Capacity Factors	Quantitative Indicators Defining Capacity Factors
1. Factors of the Insight Capacity Group Strategic insight 1.1. Understanding of the background of the development of regional economy; 1.2. Anticipation of the ongoing changes in the environment; 1.3. Constancy in the pursue of the vision of regional economic development. Economic viability 1.4. Sustainable growth of regional economy; 1.5. High level of entrepreneurship in the region; 1.6. Receptivity and integrity of the regional economy in the national and supranational economy; 1.7. Investment attractiveness of the region; 1.8. The region's purchasing power and the level of material well-being; 1.9. The region's appeal for living and working.	1.1.1. Regional authorities, businesses and organizations are aware of the factors that determine the region's economic development and their interrelationship; 1.1.2. Regional authorities, businesses and organizations are aware of the political, economic and social trends in the external environment and their impact on the regional economic development; 1.2.1. Regional authorities, businesses and organizations are capable of forecasting the ongoing changes in the environment: – constantly monitor and analyse the environment, changes and trends; – share important information about the ongoing changes in the environment; 1.2.2. Environmental changes and economic shocks are seen as new opportunities; 1.3.1. A long-term strategic development of the regional economic development is ensured; 1.3.2. Strategic documents of the region, companies and organizations reflect the probable challenges in the nearest future and alternative scenarios for dealing with them; 1.3.3. Regional authorities, companies and organizations make strategic investment in order to prepare to deal with potential economic shocks in the future.	1.4.1. GDP per capita, by purchasing power standards; 1.4.2. Share of the region's GDP in the country's GDP; 1.5.1. Number of economic entities operating per 1000 inhabitants; 1.5.2. Number of bankrupt enterprises per 1000 operating companies; 1.5.3. Share of newly registered companies, compared to the operating entities; 1.5.4. Unemployment rate; 1.6.1. Share of exports of goods of the local origin in the region's GDP; 1.6.2. Revenue from export per capita; 1.6.3. Share of the exporting companies; 1.6.4. Share of internationally known companies or their divisions; 1.7.1. Direct foreign investment per capita; 1.7.2. Index of the direct foreign investment attraction; 1.7.3. Tangible investment per capita; 1.7.4. Index of the material investment attraction; 1.8.1. Average gross monthly earnings; 1.8.2. Household savings per capita; 1.8.3. Ratio of the difference between the residents' income and the country's capital region; 1.9.1. Share of the working age population; 1.9.2. The population's domestic and international migration balance per 1000 inhabitants.

Capacity Factors Determining Regional Resilience	Qualitative Characteristics Of Capacity Factories	Quantitative Indicators Defining Capacity Factors
<p>2. Factors of the Regional Governance Capacity Group</p> <p>Management efficiency 2.1. Operational efficiency of the regional government; 2.2. Regional government's competence and experience of working under the pressures of economic shock; 2.3. Transparent cooperation between the public and private sectors; Financial possibilities 2.4. Attractiveness of the business environment; 2.5. Financial system that ensures the access to financial resources; 2.6. Financial stability and capacity of the regional government; 2.7. Social burden for the region.</p>	<p>2.1.1. Strategic decisions are made and measures are implemented quickly and efficiently, at the right time and to the right extent, at a reasonable cost and with minimal errors; 2.1.2. Strategic decisions are made when grounded on a comprehensive analysis, on the results of the effects of decisions, and on good practice; 2.2.1. The competence of public authorities in managing various resources (human, financial, etc.) is sufficient; 2.2.2. Public authorities are characterized with leadership and coordination skills; 2.2.3. A strategic plan for regional resilience to economic shock is in place and being implemented; 2.3.1. Transparent and active cooperation between the public and private sectors; 2.4.1. Business administration is not burdened with bureaucratic procedures; 2.4.2. Public services are tailored to business needs; 2.4.3. Uncomplicated business start-up conditions; 2.5.1. Ability to access external sources of funding; 2.5.2. Investment attraction programs and measures are in place in the region.</p>	<p>2.6.1. Taxes paid and credited to municipal budgets per capita; 2.6.2. Municipal budget expenditure and income ratio; 2.6.3. General government gross debt compared to regional GDP; 2.7.1. Share of people living in households facing economic difficulties; 2.7.2. Average annual ratio of recipients of social benefits to all residents; 2.7.3. Number of social risk families per 1000 inhabitants; 2.7.4. Pension beneficiaries per 1000 persons of working age.</p>
<p>3. Factors of the Knowledge and Innovation Capacity Group</p> <p>Research and innovation 3.1. The investment of business and government sector in research and innovation; 3.2. Active science and business cooperation; Innovation encouraging environment 3.3. A functioning innovation system; 3.4. Positive attitude towards research and innovation.</p>	<p>3.1.1. Regional companies, organizations and public authorities invest in scientific research and experimental development; 3.1.2. Regional companies introduce innovation; 3.1.3. Regional companies are capable of applying complex installations, readjusting to new business models and the development of new products; 3.1.4. A positive balance between middle and high technology products; 3.1.5. Companies participate in international R&D networks; 3.2.1. Regional companies, organizations and public authorities closely cooperate with science and study institutions; 3.2.2. Science and study institutions are characterized by entrepreneurship and commercialization of knowledge; 3.2.3. Innovative companies actively cooperate with other companies; 3.3.1. The innovation support service system is available to regional companies; 3.3.2. The innovation promotion system is oriented towards motivating companies to carry out innovative activities and strengthening of innovative capacities; 3.3.3. A developed intellectual property protection system; 3.3.4. Regional authorities carry out innovative projects individually or with partners. 3.4.1. Regional authorities, companies, organizations are aware of the importance of research and innovation for regional development. 3.4.2. Regional development issues and the economic value generated by enterprises are based on innovation; 3.4.3. The focus is laid on results that generate the highest value added.</p>	<p>3.1.1. Ratio of R&D expenditure to GDP; 3.1.2. Expenditure on R&D in higher education and government sectors; 3.1.3. Share of corporate funds in the total R&D expenditure; 3.1.4. Added value created by the company; 3.1.5. Share of companies that have implemented innovations; 3.1.6. Share of companies that have implemented technological innovations; 3.1.7. Export of high-tech goods, compared to overall exports, %; 3.1.8. Share of expenditure for innovative activities in circulation; 3.1.9. Value added created in a company involved in professional, scientific and technical activity, per an employee; 3.1.10. Share of new innovative SMEs from all SMEs; 3.1.11. New innovative products put on the market; 3.3.1. Applications submitted to the European Patent Office (EPO) per 1,000,000 inhabitants; 3.3.2. Employees involved in R&D in the higher education and government sectors.</p>
<p>4. Factors of the Learning Capacity Group Learning system</p> <p>4.1. Advanced systems for science and education, lifelong learning and continuous perfection; 4.2. The identity of a learning and knowledge region; Flexibility and competence of the labour market 4.3. Skilled, innovative and entrepreneurial workforce;</p>	<p>4.1.1. A fully developed and accessible infrastructure for science and education, lifelong learning and continuous perfection; 4.1.2. The learning/training and qualification improvement programs meet modern market needs and qualitative requirements; 4.2.1. Regional authorities shape and implement the image of the region as a learning and knowledge region; 4.2.2. Regional authorities, business companies and organizations consider human resources as the most important capital;</p>	<p>4.1.1. Number of people pursuing higher education (students at universities and colleges) per 1000 inhabitants; 4.1.2. Rate of lifelong learning (share of working population who attended trainings in the recent year); 4.2.1. Share of population with higher education; 4.2.2. Share of the region's employees able to speak one or several foreign languages; 4.4.1. Average consumption expenditure per household member per month for education.</p>

Capacity Factors Determining Regional Resilience	Qualitative Characteristics Of Capacity Factories	Quantitative Indicators Defining Capacity Factors
4.4. Regional employees, striving for knowledge and characterized by a high willingness to learn.	4.3.1. The region has functioning programs and tools for the staff's continuous improvement of qualifications and competence; 4.3.2. Companies fully or partly pay for the staff's qualification improvement courses; 4.3.3. The labour market competence is adequate to the market needs; 4.3.4. A prevailing focus on professionalism and quality; 4.4.1. The region recognizes the importance of a lifelong learning; 4.4.2. The employees are actively involved in the qualification improvement and competence development courses and programs.	
5. Factors of the Networking and Cooperation Capacity Group 5.1. An established mechanism of cooperation and feedback between government and business; 5.2. Integration into the international and national value generating chains and networks.	5.1.1. Regional authorities, businesses companies and organizations recognize that cooperation and partnerships help to deal with problems effectively; 5.1.2. Regional authorities, business companies and organizations are capable of working in a team; 5.1.3. The holders of relevant competences and the diaspora are involved in the regional development issues and problem solving; 5.1.4. The concept of shared value is understood and implemented in the region; 5.1.5. Regional authorities, companies and organizations have commonly available information systems that allow the exchange of information; 5.1.6. Relevant regional information is disseminated through integrated applications, information platforms and other ICT-based methods; 5.2.1. Clusters are active and intensive clustering processes are taking place; 5.2.2. Regional economic entities have established long-term contacts with international companies and organizations.	
6. Factors of the Regional Infrastructure Group The system of a modern and productive infrastructure 6.1 Development of the network of the information and communication technology; 6.2. Accessibility of the region; 6.3. Energy independence. Coherence 6.4. Implementation of sustainable development principles in the region; 6.5. Attraction of the region to tourists; 6.6. Regional pollution.	6.1.1. The region has a developed and accessible Internet connection; 6.1.2. Regional authorities, companies and organizations extensively use the information and communication technology network and various information systems; 6.2.1. The region has a developed and efficiently functioning transport system, ensuring the convenience of national and international transport; 6.3.1. The creation of economic value is increasingly based on renewable energy sources; 6.4.1. Strategic decisions made are based on the combination of environmental, economic and socio-cultural dimensions; 6.4.2. Regional authorities, companies and organizations, as well as the public are investing in solutions that reduce environmental pollution and increase its protection; 6.5.1. Natural resources are protected and sustained in the region and the tourism and cultural infrastructure is being developed.	6.1.1. Households with internet access; 6.1.2. Density of broadband coverage (DSL), fiber-optic Internet; 6.1.3. Percentage of people who used the Internet every day in the last three months; 6.1.4. Companies using IT; 6.1.5. Share of companies operating in the information and communication activities; 6.2.1. Road density (national and local); 6.2.2. Share of local roads with improved pavement; 6.2.3. Number of customers transported by air; 6.3.1. Share of renewable energy in the total energy consumption; 6.3.2. Share of energy used in the GDP structure; 6.4.1. Investment of manufacturing enterprises in the production process to ensure environmental protection; 6.5.1. Accommodation of guests in accommodation establishments per 1000 inhabitants; 6.5.2. Number of tourists per 1000 inhabitants (the number of tourist information centre visitors per 1000 inhabitants); 6.5.3. Value added created by tourism activity, compared to the overall value added created in the region; 6.6.1. Emission of pollutants into the atmosphere from stationary sources of pollution in 1 sq. km; 6.6.2. The amount of gases, causing the greenhouse effect, emitted into the atmosphere, by thousand t CO2 equivalent; 6.6.3. Taxes paid and credited into municipal budgets for environmental pollution per capita.

The identified qualitative and quantitative characteristics of capacities are important for the measurement of regional resilience to economic shocks by index (*Resindicis*). The index has been chosen as a method of assessment, as according to the works of researchers it is the most appropriate means for describing a multifunctional concept. *Resindicis* is formed in the following stages: 1. Rationing the factor indicator values of regional resilience to economic shocks; 2. Allocation of weight coefficients to capacity groups; 3. Formation of the index function for regional resilience to economic shocks;

4. The calculation of the index. Studies have shown that indices can be expressed in additive or in functional mathematical expressions; however, an additive expression has been chosen for *Resindicis*, since the formation of a functional equation is limited by the dependence of the sub-index selection and the result on the number of observations. Each capacity that determines resilience of the region and its characterizing factor are expressed in terms of the quantitative and qualitative indicators; however, only quantitative indicators are included into *Resindicis* (65 indicators in total). Factors of the

Networking and Collaboration capacity group are not included.

The measuring of the regional resilience to economic shocks has been conducted according to the example of the data from 10 Lithuanian counties. The analysis covers the period of 2006–2015. For the estimation of *Resindicis* of these Lithuanian counties, the standard deviation from the mean data normalization method is used, which indicates the deviation of results from the mean. In order to measure

the resilience of Lithuanian counties more accurately, when calculating *Resindicis*, equal weight coefficients are applied to all the resilience-determining capacities, i.e. factor groups.

Results

Figure 2 introduces *Resindicis* of Lithuanian counties in 2006–2015.

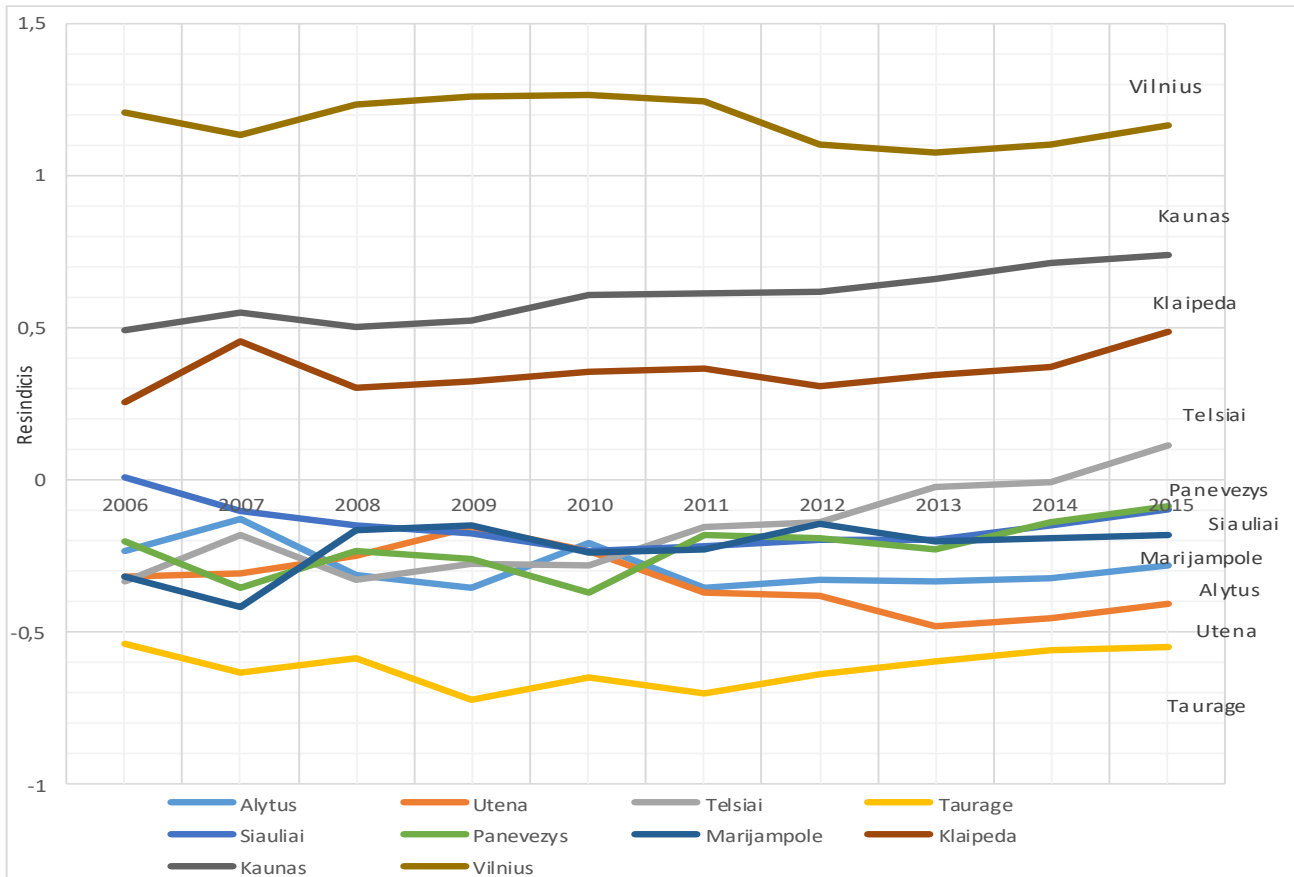


Figure 2. *Resindicis* of Lithuanian counties in 2006–2015

Resindicis provides an opportunity to rank the counties according to the county’s resilience determining capacity. Figure 2 reveals that only the strongest counties possessing the resilience determining capacity have risen above the national average level; these are Vilnius, Kaunas and Klaipeda. All the remaining counties are below the average. Only Telsiai County managed to reach the average level in 2013.

Both the findings in scientific literature and the conducted empirical research do not allow to classify the regions into groups by the *Resindicis* coefficient values. This would require to perform a more comprehensive estimation and include more data which would justify the value scale of resilience indices and the reliability of their calculation. *Resindicis* enables just to define the region’s position by the resilience determining capacity within the total regional hierarchical system.

Determining the exact causes of changes of Lithuanian counties in *Resindicis* according to individual capacities is quite complicated due to the changes in annual situations,

not only in the analysed but also in the compared regions. However, in order to determine the influence of the factors examined on the overall *Resindicis* of the region, based on the resilience determining capacity indices and ranks of all counties in the period of 2006–2015, Pearson correlation coefficients (between *Resindicis* and the resilience determining capacity indexes) (Table 2) and Kendall rank correlation coefficients (based on the ranks) (Table 3) were calculated.

Table 2

Pearson Correlation Coefficients of Capacities Determining the Resilience of Lithuanian Counties in 2006–2015

	<i>Resindicis</i>	Insight capacity	Regional government management capacity	Knowledge and Innovation capacity	Learning capacity	Infrastructure
<i>Resindicis</i>	1	0.905	0.444	0.941	0.978	0.947
p – value		0.00	0.00	0.00	0.00	0.00
Insight capacity	0.905	1	0.359	0.859	0.845	0.786
p – value	0.00		0.00	0.00	0.00	0.00
Governance capacity	0.444	0.359	1	0.193	0.399	0.413
p – value	0.00	0.00		0.00	0.00	0.00
Knowledge and Innovation capacity	0.941	0.859	0.193	1	0.902	0.857
p – value	0.00	0.00	0.00		0.00	0.00
Learning capacity	0.978	0.845	0.399	0.902	1	0.911
p – value	0.00	0.00	0.00	0.00		0.00
Infrastructure	0.947	0.786	0.413	0.857	0.911	1
p – value	0.00	0.00	0.00	0.00	0.00	

Resindicis strongly positively correlates with the learning capacity (0.978 points), infrastructure (0.947 points), knowledge and innovation capacity (0.941 points) and insight capacity (0.905 points). In spite of *Resindicis* weak correlation with the management capacity (0.444 points), it is possible to conclude that the Pearson correlation coefficients confirm that all capacities identified in the *Resilio* model can be considered as causal factors of regional resilience.

Table 3

Kendall Rank Correlation Coefficients of Capacities Determining the Resilience of Lithuanian Counties in 2006–2015

Factor groups	2006–2015 (n = 100)	
	W	p – value
<i>Resindicis</i> rank, compared to insight capacity ranks	0.657	0 (<0.05)
<i>Resindicis</i> rank, compared to governance capacity ranks	0.466	0 (<0.05)
<i>Resindicis</i> rank, compared to knowledge and innovation ranks	0.689	0 (<0.05)
<i>Resindicis</i> rank, compared to the learning capacity ranks	0.748	0 (<0.05)
<i>Resindicis</i> rank, compared to the infrastructure ranks	0.665	0 (<0.05)

Based on the compatibility of ranking the regional resilience determining capacities with *Resindicis*, it is possible to maintain that the highest compatibility exists with the ranks of the learning capacity (0.748 points), infrastructure (0.665 points), knowledge and innovation capacity (0.689 points), and insight capacity (0.657 points).

The obtained Kendall rank correlation coefficients do not contradict and only confirm the results and conclusions of the Pearson correlation coefficients. Thus, based on the Pearson and Kendall ranking correlation coefficients, it is possible to conclude that the incorporation of qualitative and quantitative methods in the assessment of regional resilience specifies the results.

The conducted empirical research on resilience of Lithuanian counties led to distinguishing six groups of counties with regard to resilience, dispensing with the identification of the scale of resilience index values (Table 4).

Table 4

Classification of Lithuanian Counties by Resilience and their Characteristics

Group	County	Resilience level	Characteristics	Resilience level according to other scientists			
				Cuisong, Zhenchun, 2008	IBM, 2009	Resilience Capacity Index, 2015	Briguglio et al., 2006, Hill et al., 2008
I	Vilnius	Very strongly resilient	These are the regions whose resilience is really much higher than the national economic resilience.	Strongly resilient territory	Platinum resilience	Very high resilience	Economically resilient
II	Kaunas, Klaipeda	Strongly resilient	These are the regions whose resilience is much higher than the national economic resilience.		Golden resilience	High resilience	
III	Telsiai	Relatively strongly resilient	These are the regions whose resilience is higher than the national economic resilience; however, the resilience is determined by one or several prevailing resilience determining capacities or their factors.		Silver resilience	Average resilience	
IV	Panevezys, Alytus	Moderately resilient	These are the regions whose resilience corresponds to the national economic resilience.	Moderately resilient territory	Bronze resilience	Low resilience	Resilient
V	Siauliai, Marijampole	Weakly resilient	These are the regions whose resilience is lower than the national economic resilience.			Very low resilience	
VI	Taurage, Utena	Very weakly resilient	These are the regions whose resilience is significantly lower than the national economic resilience.	Poorly resilient territory	Bronze resilience	Very low resilience	Non-resilient

The empirical research allowed to classify Lithuanian counties into six groups according to resilience: very strongly, strongly, relatively strongly, moderately, weakly and very weakly resilient. This regional resilience classification is based on the shared hierarchical

positioning of the counties from the time perspective and on the comparison to the national economy (national average). The emergence of Telsiai County was determined by the fact that the resilience of regions that belong to this county exceeds the national economic

resilience; however, differently from the other groups, it is determined by a single or several prevailing resilience determining capacities or capacity-forming factors (in case of Telsiai County it is mainly export and investment).

Conclusions

1. The conducted theoretical study of the conception and content of resilience disclosed the aspect of its multiplicity. The analysis of various theoretical approaches to regional resilience, of its formation process and its content allowed to assume the treatment of resilience as of a continuous process that combined a series of capacities and possibilities targeted at the region's economic continuity and development during economic shock. It has been demonstrated that the understanding of regional resilience as of a process and the inclusion of the aspect of capability to manage resilience into the conception of regional resilience to economic shocks allows to assess regional resilience from the dynamic point of view and over the course of time.

2. When conducting regional resilience studies, it is important to determine the impact of economic shock on regional entities; however, it is equally important to identify how and in what way the regional development is affected. The review of scientific literature has revealed the two following types of the effect of the economic shock on economic development: a negative one (causing regional economic damages), and a positive one (providing regional economies with new opportunities); it can also have a direct or an indirect influence on individual regional economic entities and the entire regional economy during the periods of the pre-shock, the shock itself, and the after-shock (before reaching the pre-shock level). The present thesis has demonstrated that resilience is a strategy to ensure the region's economic advancement; and the change of regional economic development is being considered the resilience assessment means.

3. The analysis of the theoretical models of regional resilience that has been described in scientific literature has allowed to assume that the study of a single resilience determining factor is incapable to reveal the problem issue related to the resilience of regions to economic shocks. The facts that all regional economic entities are affected by the economic shock, and the regional approach is considered a substantial interconnected economic system make it inevitable to assess this issue in a manifold manner. The manifold research allowed to distinguish the following methodological features of the assessment of regional resilience to economic shocks:

- A single resilience illustrating factor (indicator) is insufficient to reveal the scope of the issues related to regional resilience to economic shocks; thus, the resilience has to be evaluated with the help of a complex of factors (indicators).

- Methodological principles for the identification of resilience determining capabilities and factors contribute to the increase of the assessment reliability.

- Identification of specific capabilities and factors that comprise regional resilience ensures a higher assessment reliability.

- Incorporation of the aspects that determine regional resilience into the calculation of the index provides a methodological evidence for the regional resilience assessment with the help of the index.

- The analysis of vulnerability and recovery that is incorporated into the regional resilience evaluation demonstrates the region's ability to be resilient over the course of time.

- The comparison of regional resilience with economic and social development ensures a higher reliability of the assessment result interpretation.

4. The present article has established and substantiated that the region's resilience to economic shocks is determined by many interconnected factors that equally affect each other. Resilience can be measured by variant combinations of a diverse selection of the resilience factors and their integration into a single system; this way the need for the identification of the general and specific factors that determine regional resilience to economic shocks is justified. The studies conducted on resilience models and indices allowed the researchers to distinguish the following key areas of regional resilience assessment that are most widely identified in scientific literature: Social capital, Human capital, Physical capital, Financial capital, Natural capital; it also allowed to confirm the importance of methodology for the selection of capacities and factors that determine regional resilience, and the combination of these capacities and factors into a single system. As well, it proved the need for the resilience to be assessed in a complex manner. The analysis of the conception of the resilience of regions to economic shocks and the formation of presumptions allowed the researchers to distinguish the following key capacities for ensuring regional resilience to economic shocks: Insights and Governance, Knowledge and Innovation, Learning, Networking and Collaboration. An appropriately developed region's infrastructure is essential in order for these capacities to be implemented in regional economic and social system; the present article has repeatedly evidenced the importance of an appropriately developed region's infrastructure for the economic development of the region and its resilience to economic shock.

5. The empirical study revealed the advantages and disadvantages of the assessment methodology of the resilience of regions to economic shocks (based on the *Resilio* model and *Resindicis*). The key advantages of this methodology are as follows: a) facilitation of a complex assessment of regional resilience to economic shocks with regard to other regions and over the course of time; b) possibility to include quantitative indicators as well as qualitative assessment in the resilience determination (by assigning weight coefficients); c) convenience of regional resilience expression (by one number); d) possibility to analyse regional resilience in comparison with the analysed regions' group's (country's) average, or from the point of view of the strongest and the weakest region; e) feasibility of the identification of the most resilient region, of the most vulnerable one, and the one to recover fastest; f) facilitation of the different-level analysis of the resilience of regions, i.e. the analysis of the overall resilience, or from the point of view of individual capacities or factors;

g) possibility to assess regional resilience from the static perspective (with the help of resilience determining capacities and factors), and from the dynamic one (based on the change in *Resindicis*, compared to the base year); h) possibility to identify the impact of distinct regional resilience determining capabilities and factors upon the overall resilience; i) facilitation of the identification of the region's resilience-enhancing strengths and weaknesses, and of the evaluation of the efficiency of the application of regional resilience-enhancing strategies and measures. The main disadvantages of the methodology are as follows: a)

new potential risks of economic shocks are not considered; b) gives no explanation of the influence of the change of individual resilience determining capacities and factors upon the overall regional resilience.

6. The empirical research that was carried out allowed to state that the methodology that was developed for the evaluation of the resilience of regions to economic shocks (according to the *Resilio* model and *Resindicis*) is an appropriate tool for the assessment of regional resilience, economic analysis, forecasting, strategic planning, and the effectiveness of the resilience-enhancing strategies.

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