Assessing the economic resilience in central and eastern EU countries. A multidimensional approach

Mihaela Ifrim[a], Maria Lazorec[b] Carmen Pintilescu[c]

[a]*Assoc.Prof., Faculty of Economics and Business Administration, "Alexandru Ioan Cuza" University of Iasi, Romania*
E-mail: mihaela.ifrim@uaic.ro
[b] *PhD student, Doctoral School of Economics and Business Administration, "Alexandru Ioan Cuza" University of Iasi, Romania*
E-mail: maria_crasnean@yahoo.com
[c] *Professor, Faculty of Economics and Business Administration, "Alexandru Ioan Cuza" University of Iasi, Romania*
E-mail: carmen.pintilescu@uaic.ro

Abstract

The concept of economic resilience has become a key topic in the economic literature since the crisis of 2008 and the current sanitary crisis brought back to the attention of researchers the need to identify the elements that allow the absorption of a shock and the economic recovery. In the paper, we study the economic resilience assessed by real GDP growth rate and employment rate for eleven CEECs, using annual data from 2000 to 2019. We include in our model 21 variables that reflect the economic, social and institutional dimensions for emphasizing the specificities of CEE countries. The empirical results show that most of CEE countries proved to be resilient either in both their economic output and employment (Croatia, Czech Republic, Hungary, Romania, Slovenia), or in one of these (Bulgaria, Lithuania, Slovakia). Only two countries appear to not have recovered in GDP growth rate and Employment rate (Estonia and Latvia). The analysis of countries specificities, using the principal component regression, highlighted that the social, economic and institutional framework of each country generated distinct responses in terms of resilience. The strengthening of the institutional dimension and the importance of education represent essential factors for the growth of economic resilience.

Keywords: economic resilience, principal component regression, CEE economies.

Jel Codes: O11, C38, C50

1. Introduction

The COVID pandemic brought to the attention of researchers and governing bodies the topic of resilience and the need to identify the elements which allow the absorption of a shock and economic recovery. The concept of resilience has become a key topic in the specialty studies in the economic field, especially after the 2008 global crisis. Numerous specialists analysed the response of a system to a shock and the ability of an entity to recover successfully following a disturbance.

In the case of Central and Eastern European countries, the 2008 crisis generated lots of debates concerning their ability to return to the ascending trend of economic growth, the time needed for this recovery as well as the reaction to similar shocks.

These countries launched in 1990 profound economic and institutional reforms in order to pass to a system based on market economy. The privatization measures of the state-owned enterprises and the price liberalization generated in the first years of transition towards the market economy high unemployment rates and produced significant structural changes on the labour market. Subsequently, in the light of their adherence to the European Union, these countries had to implement numerous legislative and economic changes while an important goal of their economic policy was to ensure real convergence with the more developed economies of the European Union.

Due to these profound structural changes in the case of CEE countries, the study of economic resilience should integrate the specificities of their economies and take into consideration both the economic and social and institutional dimensions. A multidimensional approach is to be considered in such a study.

In this paper, we will integrate the economic, social and institutional dimensions in the analysis of economic resilience for the 11 countries (Poland, Romania, Bulgaria, Hungary, Latvia, Lithuania, Estonia, Croatia, Czech Republic, Slovenia and Slovakia). Even if there is no consensus in the specialty literature regarding the measuring

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of economic resilience, most of the studies analyse resilience by following up the evolution of employment and national production. Employment which counts the number of people employed in a country is less likely to be revised (Coyle, 2014) but it also has a social value (Sensier et al., 2016) namely in the case of CEE countries which had known the unemployment phenomenon before the 1990s. GDP is one of the key economic indicators for exploring the performance of CEE countries and for assessing the economic well-being and it is used to measure entry and exit from recession. Given the importance of employment on the labour market and the economic growth for CEE countries, we will use the real GDP growth rate and Employment rate to measure economic resilience.

Following the definition of the capacity of an economy to resist and recover from an economic shock (Sensier et al., 2016; Martin, 2012), we will assess in the current paper the resilience of CEE economies. In order to identify the main factors of influence on economic resilience we will integrate three key dimensions for CEE's economies: economic, social and institutional. These dimensions will be measured by means of registering 21 indicators for the 11 countries, taking into consideration the period 2000-2019, when these countries could be thought of as market economies.

In its first stage, the methodological approach implies to identify the resilience capacity of the economies of CEE countries. For the explanation of differences among these countries, in the following stages we will include in the analysis the 21 statistical variables which reflect the economic, social and institutional dimensions and we will perform an analysis of countries specificities, using the principal component regression. The principal component regression is used for reducing the large number of explanatory variables in a regression model down to a small number of principal components.

The paper is structured as follows: in Section 2 we present a survey of the literature on economic resilience. Section 3 describes the data and the methodology used for the estimation of economic resilience. In Section 4 we present the empirical analysis for the 11 CEE countries members of the European Union, while the last section presents the main conclusions.

2. Literature Review

Economic resilience has become one of the most popular terms after the 2008 crisis, being labelled as a buzzword in the mainstream agenda of international development (Boin et al., 2010). In fact, in their public speeches, the policy-makers often pretend that the proposed measures are in the spirit of "building resilience" or "building a resilient economy" (Martin and Sunley, 2015; Juncos, 2017; Korosteleva, 2020). Economic resilience is defined as the "the ability to recover from or adjust to the negative impacts of external economic shocks" (Briguglio et al., 2009), being a sum of the following reactions such as "self-organisation, adaptation, transformation and survival" in front of a crisis (Humbert and Joseph, 2019). Briguglio et al. (2009) identify three meanings of economic resilience, namely shock-counteraction, shock-absorption and the ability to avoid these shocks. By making a comparison between the meanings of economic resilience and the possible reactions of a body towards a virus infection, these could be translated as rapid recovery after infection, virus resistance following an immunization or avoidance of infection (Briguglio et al., 2009).

In the literature, a country is considered "resistant" to an economic shock if the growth rate of GDP or employment remains positive during the period of the shock. The countries that have known significant decreases in these indicators are considered "recovered" if they succeed to register the level before the shock occurrence and "not recovered" if they have started to experience a surge in their economic activity or an ongoing decline (Sensier et al., 2016; Martin, 2012).

Resilience is not conditioned by the economic power of a region or of a country. Less economically developed regions may react better and quicker to the shocks (Sensier et al., 2016). The reactions to various exogenous shocks may differ even in the case of the same actors. When comparing the economic resilience after the 1990 and 2008 crises, Sensier et al. (2016) notice different responses in time for the same regions.

There is no single way of evaluating the economic resilience degree of a region or a country. Several ways to measure the regional economic resilience have been identified, such as the narrative case studies, the resilience indices, the statistical time series model or the causal structural models (Martin and Sunley, 2015). The empirical studies available are as heterogeneous as possible from the point of view of the research methods and measuring indices proposed. Still, more often than not, measuring economic resilience involves the follow-up of the employment and production evolution. Sensier et al. (2016) analyse the distribution of economic resilience by regions of the European Union, after the 2008 crisis, based on the employment level and GDP, providing at the same time a detailed explanation regarding the use of these indicators. Employment and output are also measured

in the empirical analysis of regions' resilience in the UK (Fingleton et al., 2012). When analysing economic resilience of ten European states after the 2008 crisis, Davies (2011) uses regressions to set up correlations between regional unemployment rates in 2009 and 2010, as indicator of regional resilience, and GDP per capita in 2007, regional unemployment rate in 2007 and population density in 2005. Individual employment lies at the basis of the study on resilience conducted in Doran and Fingleton (2015) for the European states, while the results indicated that the more educated individuals are more resilient than those having a reduced educational level. Giannakis and Bruggeman (2020) build the resilience indicators also based on the changes of employment in Europe's regions, showing the importance of migration and agriculture. Pontarallo and Serpieri (2020) propose a composite synthetic regional economic resilience indicator which includes, alongside the GDP per capita and employment rate, productivity, while Briguglio et al. (2009) propose a resilience index built on four variables - macroeconomic stability, microeconomic market efficiency, good governance and social development. The economic dimension, the social dimension and the environmental dimension are considered to be the pillars of regional resilience in Rizzi et al. (2017). Boorman et al. (2013) use 52 variables grouped in 10 sub-indices (among which, fiscal and monetary policy soundness, government effectiveness, export diversity, private debt) in order to measure economic resilience of 130 states. The County Economic Resilience Index proposed in Kahsai et al. (2015) includes industrial diversity, income diversity, entrepreneurial activity and business dynamics, scale and proximity, human and physical capital.

When conducting an exploratory analysis of the employment trends in the Italian regions during the period 2007-2011, Faggian et al. (2017) indicate the importance of industrial vocation and population size when defining the resilience of a region, while Di Caro (2014) supports that manufacturing activities can explain the superior resilience of certain regions. Using a Bayesian model averaging (BMA) and choosing a more disaggregated level analysis of the factors that influence economic resilience in the Euro-area countries, Jolles et al. (2018) conclude that the well-functioning of the market has the most important role. Public administration and tertiary education are shown, based on a quantile regression, as factors positively influencing the regional resilience in seven Eastern European countries (Oprea et al., 2020). The study performed in Williams et al. (2013) for Thessaloniki City Region in Greece underlines the importance of entrepreneurship for economic resilience, while the social capital is highlighted as a major aspect of resilience in the case of Pomorskie Region in Poland (Sagan and Masik, 2014).

3. Data & Methodology

In this paper, we study the economic resilience in eleven Central and Eastern European countries, namely Poland, Romania, Bulgaria, Hungary, Latvia, Lithuania, Estonia, Croatia, the Czech Republic, Slovenia, and Slovakia. We use data from 2000 to 2019, which correspond to the period when these countries could be considered as market economies following the transition period after the 1990s. The data sources are the World Bank, EUROSTAT, OECD, Econstats, The Global Economy, Country Economy, Worlds Economic Forum, and Worldwide Governance Indicators (WGI).

Measuring economic resilience and identifying its main influence factors is not an easy task due to the numerous levels it entails. This feature implies a multidimensional approach of economic resilience, which needs to capture a higher number of factors influencing resilience and which are at the same time in close connection with the economic policies specific to CEE countries. Our analysis joins the direction proposed by Briguglio et al. (2009), suggesting the analysis of economic resilience of CEE states and the identification of its main influence factors.

In order to measure economic resilience, we considered, in line with several recent studies, two quantitative measures of resilience that focused on economic growth and labour market aspects (Sensier et al., 2016; Fingleton el al., 2012; Di Caro, 2014; Kitsos and Bishop, 2018). For economic growth we used the *GDP growth rate* and for the labour market we used the *Employment rate*.

The factors of influence measured by means of 21 statistical variables are grouped in three dimensions: economic dimension, social and institutional dimension. The presentation of the statistical variables by the three dimensions and their definition is performed in Appendix 1.

The methodological approach used in the paper implies in the first stage the identification of the resilience capacity of CEE economies, and resilience and recovery respectively, following an economic shock.

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3.1. Econometric models

For the econometric models for each country, we applied the principal component regression. In a first stage, we use the Principal Component Analysis (PCA) in order to select a reduced number of components that explain as much of the original variation in the data as possible. In the second stage, we used the extracted components as independent variables in the two econometric models for each country, taking into consideration as dependent variables *GDP growth rate* and the *Employment rate*.

3.1.1. Selection of factors

For the selection of a reduced number of components which explain at least 70% of the total variance, we applied PCA, using the VARIMAX rotation method. The variables that explain the formation of these components are those variables with the highest factor loadings, higher than 0.7, as an absolute value. The components extracted and the variables which explain their formation are presented in the table below:

Table 1. Number of factors, percent of the variance explained by each factor and the statistical variables which explain each factor

Countries	Factors and % of variance explained	Variables which explain the factors and the sign of influence
Bulgaria	Factor 1 (45.26%)	Life_exp_birth_total (+), National_debt (-), Agric_for_fish (-), Freedom_trade (+), Education_Index (+), Labor_market_reg (+), Pop_educ_level (-), Serv_value_ad (+), Income_Index (+)
	Factor 2 (19.916%)	FDI (+), Infl_cons_prices (+), Govern_Effect (-)
	Factor 3 (12.090%)	Reg_Quality (+)
Czech Republic	Factor 1 (45.823%)	Life_exp_birth_total (+), Rule_Law (+), Size_Government (+), Education_Index (+), Legal_Syst_Prop_Rights (+), Labor_market_reg (+), Pop_educ_level (-), Gover_deficit (+), Income_Index (+)
	Factor 2 (13.335%)	Voice_Accountability (+), Pol_Absence_Violence (+), Govern_Effect (+)
	Factor 3 (12.159%)	Industry (-), Reg_Quality (+), Serv_value_ad (+)
Croatia	Factor 1 (62.899%)	Life_exp_birth_total (+), National_debt (+), FDI (-), Industry (-), Agric_for_fish (-), Infl_cons_prices (-), Rule_Law (+), Freedom_trade (+), Size_Government (+), Education_Index (+), Labor_market_reg (+), Pop_educ_level (-), Serv_value_ad (+)
	Factor 2 (12.430%)	Pol_Absence_Violence (+), Reg_Quality (+), Income_Index (+)
Estonia	Factor 1 (60.804%)	Life_exp_birth_total_y (+), Pol_Absence_Violence (-), Govern_Effect (+), Rule_Law (+), Control_Corruption (+), Freedom_trade (-), Education_Index (+), Legal_Syst_Prop_Rights (+), Labor_market_reg (+), Income_Index (+)
	Factor 2 (15.689%)	National_debt (+), FDI (-), Infl_cons_prices (-), Reg_Quality (+)

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Latvia	Factor 1 (52.301%)	Life_exp_birth_total_y (+), National_debt (+), Industry (-), Agric_for_fish (-), Govern_Effect (+), Reg_Quality (+), Rule_Law (+), Control_Corruption (+), Education_Index (+), Labor_market_reg (+), Pop_educ_level, Serv_value_ad (+), Income_Index (+)
	Factor 2 (16.101%)	FDI (+), Infl_cons_prices (+)
	Factor 3 (10.028%)	Gover_deficit (+)
Lithuania	Factor 1 (52.336%)	Agric_for_fish (-), Govern_Effect (+), Rule_Law (+), Education_Index (+), Legal_Syst_Prop_Rights (+), Pop_educ_level (-), Income_Index (+)
	Factor 2 (15.364%)	Life_exp_birth_total_y (+), National_debt (+), FDI (-), Industry (-), Voice_Accountability (+), Control_Corruption (+), Serv_value_ad (+)
	Factor 3 (14.201%)	Freedom_trade (+), Gover_deficit (+)
Poland	Factor 1 (47.752%)	Life_exp_birth_total_y (+), National_debt (+), Agric_for_fish (-), Infl_cons_prices (-), Freedom_trade (+), Education_Index (+), Labor_market_reg (+), Pop_educ_level (+), Income_Index (+)
	Factor 2 (18.045%)	Voice_Accountability (+), Pol_Absence_Violence (-), Rule_Law (+)
	Factor 3 (11.859%)	Industry (+), Legal_Syst_Prop_Rights (+), Serv_value_ad (-)
Romania	Factor 1 (54.733%)	Life_exp_birth_total_y (+), Agric_for_fish (-), Infl_cons_prices (-), Reg_Quality (+), Rule_Law (+), Control_Corruption (+), Freedom_trade (+), Education_Index (+), Legal_Syst_Prop_Rights (+), Labor_market_reg (+), Pop_educ_level (-), Income_Index (+)
	Factor 2 (13.569%)	National_debt (-), FDI (+), Size_Government (+)
	Factor 3 (12.301%)	Industry (-), Serv_value_ad (+)
Slovakia	Factor 1 (42.163%)	Life_exp_birth_total_y (+), FDI (-), Agric_for_fish (+), Infl_cons_prices, Freedom_trade (+), Education_Index (+), Legal_Syst_Prop_Rights (-), Pop_educ_level (-), Serv_value_ad (+), Income_Index (+)
	Factor 2 (26.517%)	National_debt (-), Industry (+), Govern_Effect (+), Reg_Quality (+), Control_Corruption (+), Size_Government (+), Labor_market_reg (+)
	Factor 3 (10.015%)	Voice_Accountability (+)
Slovenia	Factor 1 (53.192%)	Life_exp_birth_total_y (+), Agric_for_fish (-), Infl_cons_prices (-), Voice_Accountability (-), Govern_Effect (+), Education_Index (+), Legal_Syst_Prop_Rights (+), Labor_market_reg (+), Pop_educ_level (-), Income_Index (+)
	Factor 2	FDI (+), Size_Government (+), Gover_deficit (+)

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	(15.773%)	
	Factor 3 (10.250%)	National_debt (-), Control_Corruption (+)
Hungary	Factor 1 (57.006%)	Life_exp_birth_total_y (-), Infl_cons_prices (+), Voice_Accountability (+), Govern_Effect (+), Reg_Quality (+), Rule_Law (+), Control_Corruption (+), Legal_Syst_Prop_Rights (+), Pop_educ_level (+), Gover_deficit (-), Income_Index (-)
	Factor 2 (15.333%)	National_debt (-), Agric_for_fish (+), Education_Index (-), Labor_market_reg (-)

The results obtained highlight that factor 1, which explains the highest percent of the total variance, higher than 45% for all the countries, especially includes social and economic variables for most countries. The countries for which factor 1 also includes institutional variables are Estonia, Latvia, Lithuania, Romania, Slovenia, Hungary. For the majority of the countries, factors 2 and 3 are formed prevalently of variables specific to the institutional and economic dimensions.

3.1.2. Regression coefficients

The factors extracted following PCA are used as independent variables for the two econometric models, using as dependent variables *GDP growth rate* and the *employment rate*.

The estimations obtained for each country, for the model in which the GDP growth is the dependent variable, are presented in table 2.

Table 2. The regression coefficients for the model with the dependent variable *GDP growth rate*

Country	F1	F2	F3	F statistic
Bulgaria	-1.059* (0.591)	0.818 (0.591)	0.008** (0.591)	1.711
Czech Republic	-0.181 (0.610)	-0.353 (0.610)	-1.083* (0.610)	1.191
Croatia	-0.925 (0.737)	-0.434 (0.737)		0.962
Estonia	-1.294 (1.326)	0.057 (1.326)		0.477
Latvia	-2.157*** (0.533)	2.556*** (0.533)	4.472*** (0.533)	36.594***
Lithuania	-0.740 (0.961)	-2.283** (0.961)	2.526** (0.961)	4.381**
Poland	-0.058 (0.202)	-1.136*** (0.202)	0.693*** (0.202)	14.512***
Romania	-0.566 (0.720)	2.245*** (0.720)	0.986 (0.720)	4.072**
Slovakia	-1.138* (0.615)	1.511** (0.615)	1.116* (0.615)	4.252**

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Slovenia	-0.441	2.236***	-0.427	6.054***
	(0.544)	(0.544)	(0.544)	
Hungary	-0.429	2.154***		11.970***
	(0.449)	(0.449)		

Standard errors in parentheses.

***p<0.01; **p<0.05; *p<0.1.

The estimations obtained highlight that the institutional variables have a statistically significant influence on the GDP growth rate and this influence is negative for the majority of the countries (Latvia, Lithuania, Poland), aspect which at first sight is in contradiction with the mutual expectations related to the positive impact of institutional structure on the economy. Despite this, in several empirical analyses (Aidt et al., 2008; Gani, 2011; Huang, 2016) there has been identified a negative correlation among these variables in the case of less developed states with a precarious institutional structure.

The positive influence of factor 2 on the economic growth of Latvia is in line with the rationale of economic theory, with FDI having an important role in boosting the growth in the recipient countries, while inflation can have short-term stimulating effects.

Factor 2 also positively influences the growth rate in Romania, Slovenia, Slovakia and Hungary. If the presence of FDI (Romania and Slovenia), of Education index (Hungary) and of institutional factors (in the case of Slovakia) within this factor justifies the positive relationship obtained, we cannot ascertain the same thing about the presence of National Debt (Romania, Slovakia) and Size of Government (Romania, Slovakia and Slovenia).

 These results can be explained by means of the significant economic decline registered in these countries in 2009. We can assess that in the case of these countries the development gaps were recovered quite fast and the economic growth rhythms returned to positive values in most countries after 2010.

The high values of the significance of the influence of factor 3, explained mainly by *Government deficit*, on the growth in Latvia and Lithuania can suggest an important role played by the state in these economies, in terms of the contribution of expenses and productive government investments to the GDP growth, taxes being less distorting, at the same time.

The sign of the influence of the analysed factors on economic growth is not in most cases the one described by the economic theory. Regardless, the signs and values obtained provide indices about the most efficient policies needed for the recovery after a shock. On a short term, the increase in government expenditure can be stimulating for the economy and can delay the negative effects of deficits and debts. The focus on exports and dependence on several external markets can be a threat for the vulnerable economies as regards the competitiveness of national industries and the dependence on a single market for exports and/or imports, even if this is favoured on the long-run also from the perspective of buyers' welfare. The social economic and institutional structure specific to each country generates distinct responses in terms of resilience.

The estimations obtained for each country for the model where *Employment rate* is the dependent variable are presented in table 3.

Table 3. Regression coefficients for the model with the dependent variable the *employment rate*

	F1	**F2**	**F3**	**F stat**
Bulgaria	3.156***	0.074	0.726	20.019***
	(0.418)	(0.418)	(0.418)	
Czech Republic	1.173***	-0.175	0.372*	6.493***
	(0.282)	(0.282)	(0.282)	
Croatia	-0.710*	0.957**		5.972**
	(0.345)	(0.345)		
Estonia	2.679***	0.796		16.769***
	(0.483)	(0.483)		
Latvia	2.081***	1.288**	1.146**	10.935***
	(0.472)	(0.472)	(0.472)	
Lithuania	1.828***	0.630**	2.099***	44.117***
	(0.248)	(0.248)	(0.248)	
Poland	2.212***	-0.243	1.226*	5.749***
	(0.612)	(0.612)	(0.612)	
Romania	-1.862***	-0.974***	1.074***	17.595***
	(0.325)	(0.325)	(0.325)	
Slovakia	1.838***	0.304	-0.184	8.477***
	(0.371)	(0.371)	(0.371)	
Slovenia	0.201	0.727***	1.181***	12.485***
	(0.229)	(0.229)	(0.229)	
Hungary	-2.821***	0.757*		26.342***
	(0.449)	(0.449)		

Standard errors in parentheses.

***p<0.01; **p<0.05; *p<0.1.

The results obtained highlight that the factors extracted following PCA have a higher influence on *Employment rate* than *GDP growth rate*.

The socio-economic variables dominant for most countries within factor 1, are in a negative relationship with the employment rate in Czech Republic and Romania. This can be explained by means of a more rigid structure of the workforce demand and its slower adaptation to the challenges imposed by the participation to the international trade flows.

For the other factors, the significant relationships with the employment rate are positive. One should notice the positive influence of institutional factors on employment (with the exception of Hungary). C*ontrol of corruption, Rule of Law*, political stability and the respect of property rights increase the quality of institutions and create an environment favourable to entrepreneurial initiatives and increase in employment level. From the perspective of economic resilience, the strengthening of institutional dimension represents an important measure. Education, political stability and strong institutions may represent the adequate ingredients at national level to counteract or absorb the external shocks (Vancea et al., 2017).

Resilience, measured by reference to the previous levels of the variables analysed, is not a measure of economic growth. As we have already mentioned, even if Estonia seems to be less resilient, the level of employment in this

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country is superior to that registered in Croatia, country enlisted by the results of our study in the category of resilient countries.

The most resilient countries seem to be Czech Republic, Hungary, Romania and Slovenia since they succeeded in recovering from the shock of the 2008 economic crisis, both by reference to GDP and employment rate. Poland is the country with the best resistance to the shock caused by the 2008 crisis and it can be framed, as Biguglio et al. (2009) stated, within the category of states with a shock-absorption resilience or having the ability to avoid it altogether. A special case is represented by the Baltic states which seem the less resilient ones, both in terms of GDP growth rate and employment rate with slight variations. If Estonia and Latvia do not succeed to recover either in terms of the GDP or employment rate, Lithuania succeeds to make up for the employment rate but not for the GDP. We can explain this by the fact that the Baltic states had known a decline in resilience starting with 2003, as a result of the increase in debt level, of the degradation of banking soundness and the increase in openness to the exterior (Boorman et al., 2013). At the same time, Bulgaria, Latvia and Slovakia are the states that experienced the biggest decline in inward FDI as a share of GDP from 2005-2007 to 2008-2010, while the migration phenomena registered the strongest intensification for Latvia and Lithuania against the backdrop of economic crisis (European Commission, 2013). The FDI reduction (which is in a significant positive correlation with economic growth), migration and dependence on the outer world can explain in the case of Latvia the lack of recovery after the 2008 crisis. In Bulgaria, despite the significant reduction of jobs throughout the 2008-2009 crisis, the balance between workforce and salaries on the labour market has been at opposite ends (European Commission, 2012). The lack of recovery in terms of employment rate is the result of high unemployment within the low-skilled workers, which can become a structural issue.

4. Conclusions

In this paper, we analyse the economic resilience for 11 Central and Eastern European countries, a highly debated topic in the literature after the economic crisis set off in 2008, regarding the ability of these countries to recover from this shock.

The profound economic, social and institutional changes implemented in these countries, generated by the reforms towards a market economy and the engagements for the EU adherence, ask for the analysis of economic resilience by means of a multidimensional approach.

The economic, social and institutional dimensions are integrated in the paper by registering 21 statistical variables while economic resilience is measured by means of the most used indicators in the literature, *GDP growth rate* and *Employment rate*.

The empirical results show that most countries proved to be resilient either in both economic output and employment (Croatia, Czech Republic, Hungary, Romania, Slovenia), or in one of these (Bulgaria, Lithuania, Slovakia). Only two countries appear to have not recovered in the GDP growth rate and Employment rate (Estonia and Latvia).

The cross-country analysis and the analysis of the specific characteristics of CEE countries highlighted that the social, economic and institutional structure specific to each country generates distinct responses in terms of resilience. If on a short term, the increase in government expenditure can be an incentive for the economy and can postpone the negative effects of deficits and debts, the focus on exports and dependence on a few external markets can be a threat for the vulnerable economies in terms of the competitiveness of national industries. From the perspective of economic resilience, the strengthening of the institutional dimension represents an important outlook while education is a significant factor to counteract or absorb external shocks.

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Appendix 1

Table 1. Statistical variables for economic, social and institutional dimensions

	Variable	Definition
Economic dimension	Government budget deficit ratio – X_1 (% GDP)	Balance of state income and expenditure. A budget deficit occurs when the expenses of an entity (a government) exceed the revenues.
	National debt – X_2 (% of GDP)	Represents the total financial obligations of a country's government.
	Size of Government – X_3 (% GDP)	It focuses on the way government expenditure and the tax rates affect economic freedom. Taken together (Government consumption, Transfers and subsidies, Government Enterprises, Superior Marginal Tax Rate, State property on Liabilities) measure the degree in which a country relies on personal choices and markets, rather than on government budgets and political decisions).
	Freedom to trade – X_4 (rang de la 0 la 100)	The higher this value, the lower the prices of the goods that enter the market.
	Foreign direct investment-net inflows – X_5 (% of GDP)	FDI represent one of the main development sources of an economy. On one hand, these complement public investments and those made by residents from private sources, on the other hand, they stimulate both the development of enterprises in which there are investments and the enterprises in the resident economy with which these have economic relationships.
	Agriculture, forestry, and fishing, value added – X_6 (% of GDP)	Includes forestry, hunting and fishing, as well as cultivation of crops and livestock production. The value added is the net output of a sector after adding up all outputs and subtracting intermediary inputs.
	Services, value added – X_7 (% of GDP)	Services performed for population comprise those activities related to selling and buying on the market, mainly for the population, regardless of the payment time, price type (selling price, tariff etc.) and the cash out

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		methods (excluding transportation services, post and telecommunications).
	Industry – X_8 (% of GDP)	Corresponds to divisions ISIC 10-45 and includes the production of divisions ISIC 15-37. It comprises the value added in mining, constructions, electricity, water and gas. The value added is the net output of a sector after adding up all outputs and subtracting intermediary inputs.
	Inflation consumer prices – X_9 (annual %)	ICP measures the whole evolution of the prices of purchased goods and of the tariffs of services used by the population during a certain period of time, named current period, in comparison with a previous period or a reference period.
Social dimension	Education Index – X_{10} (a value between 0 and 1)	It is calculated using the average of school years and the number of school years forecasted. A high value indicates a developed country from an educational perspective (at least 0.8).
	Income Index – X_{11} (a value between 0 and 1)	It is computed according to the formula: (lnGNI-ln100)/(ln75000-ln100). GNI measures a country's income (includes the incomes of residents and of the businesses of that country as well as revenues from foreign incomes).
	Population by educational attainment level, sex and age – X_{12} (Less than primary, primary and lower secondary education levels 0-2 %)	Proportion of a country comprised between 15 and 64 years old according to the educational level (kindergarten, primary and secondary).
	Life expectancy at birth, total – X_{13} (years)	The average number of years a new-born is expected to live if the current mortality rates are still applied.
	Labour market regulations – X_{14} (range from 0 to 10)	The regulation of labour market plays an important role in the workers' protection. This index is composed of other indices such as: (i) Regulations regarding the employment and the minimum wage (ii) Regulations regarding employment and work termination (iii) Centralised collective negotiation (iv) Regulation regarding working hours (v) The obligatory cost of work termination for workers (vi) Recruitment. A higher value means greater efficiency on the labour market (productivity growth).

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Institutional dimension	Government Effectiveness – X_{15} (varies from approximately -2,5 (weak) to 2,5 (strong performance in governance).	Reflects the perceptions about the quality of public services, quality of public service and its independence level against politic pressure, quality of formulation and implementation of policies and the credibility of the government's commitment towards such policies.
	Regulatory Quality – X_{16} (varies from approximately -2,5 (weak) to 2,5 (strong performance in governance).	Reflects the perceptions about the government's ability to formulate and implement solid policies and regulations which allow and promote the private sector.
	Rule of Law – X_{17} (varies from approximately -2,5 (weak) to 2,5 (strong performance in governance).	Reflects the perceptions about the measure in which agents have trust and respect the society's rules and especially, the quality of executing contracts, property rights, police and law courts, as well as the probability of crime and violence.
	Control of Corruption – X_{18} (varies from approximately -2,5 (weak) to 2,5 (strong performance in governance).	Reflects the perceptions about the extent in which public power is practiced for private gain, both small and big corruption acts, as well as "capturing" the state by elites and private interests.
	Political Stability and Absence of Violence/Terrorism – X_{19} (varies from approximately -2,5 (weak) to 2,5 (strong performance in governance).	Measures the perception about the probability of political instability and/or politically-motivated violence, including terrorism.
	Legal System & Property Rights – X_{20} (range from 0 to 10)	The legal system and the property rights are focused on the importance of the legal system as a determinant factor of economic freedom. The higher a score, the better defended the rights by law.
	Voice and Accountability – X_{21} (range from 0 to 100)	Reflects the perceptions about the extent in which the citizens of a country can participate to the selection of their government, as well as freedom of speech, freedom of association and free media.