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ECONOMIC VULNERABILITY AND RESILIENCE TO SHOCKS – AN ATTEMPT TO MEASURE

Abstract. Especially in periods of crises, economists try to explain why some economies suffer negative consequences more strongly than others. In order to explain these differential effects, two economic categories known as economic vulnerability and economic resilience can be used. Hence, the aim of the paper is to undertake a critical reflection on the interrelated categories of economic vulnerability and resilience to shocks. The paper analyses these categories from a theoretical perspective and identifies the factors that shape each of them. It then attempts to measure the economic vulnerability and resilience of selected European countries using two synthetic variables. Based on these, a classification of countries in terms of economic vulnerability and resilience was made. The results achieved provide a good starting point for a more detailed study of the paths of crises and their consequences in individual countries.

Keywords: crises, vulnerability, resilience, economic growth.

1. Introduction

The intensification of crisis phenomena in developed economies after 2007, especially in Europe, has increased the interest of researchers in the issue of economic shocks. Research on the origins and course of crises has intensified. While the topology of shocks appears to be quite elaborate, crises – while retaining their individual character – show considerable similari-

ties. An intriguing problem is the relatively diverse responses of economies to an initial shock: some manage to cushion it relatively easily, while others struggle for longer and the adverse effects in the form of lost output and employment are more profound. Economists often operate in this context with the category of "resilience", which, however, is sometimes understood and defined differently and, in our view, does not give a complete picture of the problem, so – for better operationalisation and exploratory capacity – it is worth including a second aspect: "vulnerability". The desire to explain more fully the differing responses of European economies to crises, as well as to put concepts in order, were the main reasons for undertaking this discussion. The study pursues two cognitive objectives. The first objective, of a methodological nature, involves developing measures of economic vulnerability and resilience. Corresponding to it are the empirical goals of estimating the economic vulnerability and resilience of selected European countries in the period 2004–2021 and preliminary verification of the usefulness of the calculated measures to explain the varying rates of economic growth. The study begins with a theoretical section that reviews the literature on the subject and other research. This is followed by a discussion of the research method and the metrics presented, which are then used to measure the categories of economic resilience and vulnerability of interest. The results obtained are then interpreted and the paper ends with conclusions.

2. Literature and research review

In economics, resilience is seen as the ability of households, communities or entire economies to absorb and recover from shocks while adapting and transforming structures (Mitchell 2013, p. i). Resilience is also a key attribute necessary for sustainability in ecological economics (Rose 2017, p. 29). The traces of this view can be seen for example in a definition of a resilient society developed by the European Commission as one that can respond to shocks and persistent structural changes in such a way that it does not lose its ability to deliver societal well-being in a sustainable way (Manca et al. 2017).

For the purpose of the paper, we will assume that resilience refers to the economy's ability to cope with external shocks. This category is closely related to vulnerability, which we define as the economy's exposure to external disturbances and shocks of a different nature. This exposure does not necessarily automatically mean shocks of a negative nature, as the global en-

vironment can, after all, have a stimulating effect on the growth of an economy at certain times. Secondly, exposure allows actors and entire economies to become accustomed to risk, to acquire the ability to overcome difficulties and to become resilient. The analogy with the immune system seems particularly apt – an organism exposed to viruses acquires immunity and learns to overcome disease, so over-isolating a child ends up with hypersensitivity in adulthood. In economic life, attempts to reduce vulnerability and risk probably incur costs in the form of lower average economic growth (Brunnermeier, 2021), in line with the Lucas wedge concept. This stylised fact can be explained if only on the basis of Hayek's (1968) concept of competition as a discovery procedure. In order for this procedure of generating new knowledge to be triggered, a risk-prone entrepreneur-innovator is required, whose actions lead to creative destruction in the sense of Schumpeter (1942) and accelerate structural change in the economy. The adverse effects of inhibiting these processes through regulation are pointed out, for example, by Djankov et al. (2002). It is true that disruptive innovation undermines the existence of declining industries, but in the long run it drives growth, hence blocking it weakens the dynamics of capitalism. Economic vulnerability can therefore be associated with risk, but not necessarily in a negative way, as the growth path of a challenging but resilient economy will be less smoothed but steeper. On a macro level, vulnerability is associated with the openness of the economy, as trade and capital flows stimulate growth in good times, but also increase the amplitude of GDP fluctuations, as they multiply the decline in output during crises. To illustrate the concepts analysed, it is worth drawing another comparison from the natural world – in many cultures there are proverbs about a hard and mighty tree broken by a storm and a flexible blade of straw that bends under the pressure of the storm, but does not break. The tree symbolises the characteristic of robustness, while the blade denotes precisely resilience. Taleb (2012, p. 3) goes a step further and says that "...antifragility is beyond resilience and robustness. The resilience resists shocks and stays the same; the antifragile gets better." The categories of economic vulnerability and resilience are viewed differently in the literature. Gorynia et al. (2020) treat vulnerability as a three-dimensional characteristic consisting of exposure, sensitivity, and resilience. In contrast, Röhn et al. (2015), Caldera-Sánchez et. al (2016) created an extensive measure, including more than 70 indicators, of economic vulnerability. The impact channels were separated into domestic side and international side and cover various imbalances, including financial sector, non-financial sector, asset market, public sector, external sector, as well as the category of inter-

national spillovers, contagion and global risks. European Commission (2021) carried out the assessment of vulnerabilities of the Member States defined as "features that can exacerbate the negative impact of crises and transitions, or obstacles that may hinder the achievement of long-term strategic goals" and capacities (enablers or abilities to cope with crises and structural changes and to manage the transitions). The idea was to provide a holistic assessment of the "ability to progress amid challenges", across four dimensions: social and economic, green, digital, and geopolitical. The synthetic indices in a given dimension aggregate the relative situation of the Member States and the EU.

A similarly elaborate study was carried out by Hafele et al. (2023), in which 27 resilience indicators were collected in six dimensions to then delineate three resilience capacities: absorption, recovery, adaptation. The result is a kind of multidimensional portrait of European countries showing their relative ranking positions. It is worth noting at this point that these resilience capacities lend a dynamic character to the analysis and allow for a better description of individual country shock response pathways.

Menyhert et al. (2018) distinguished four resilience metrics in their study on resilience of EU member states to the global crisis (impact of the crisis, recovery from the crisis, medium-run performance and bounce forward), associated with four resilient capacities (absorption; adaptation; absorption and adaptation; adaptation and transformation respectively). First three metrics emphasise the relative performance of countries vis-a-vis one another, the fourth measures medium-run resilience in absolute terms.

Briguglio et al. (2008) see vulnerability and resilience as two dimensions of an economy's response to an exogenous shock originating from the openness of the economy. The authors argue that vulnerability refers to inherent characteristics which render countries prone to exogenous shocks, therefore vulnerability scores for a particular country should not differ much over time. On the other side resilience can be altered by adopting measures of economic policy to build resilience. The results of measurement of vulnerability and resilience for a given country can be placed in the matrix of four basics scenarios, of which the best one refers to countries that are not inherently vulnerable and which, at the same time, adopt resilience-building policies.

This brief review of the literature indicates that different definitions and survey objectives lead to the construction of different measures of economic vulnerability and resilience. Access to cross-sectional data and time series,

which are often incomplete, remains a major problem when measuring with extended indicators. Limitations related to the quantification of theoretical concepts, comparability of data should also be borne in mind, and the results obtained should be interpreted with caution.

3. Method

The aforementioned researchers have developed the methodological issues and have conducted the measurements of the indicators of interest. In the framework of the present study, we combine the approach proposed by Briguglio et al. (2008), taking over his understanding of economic vulnerability and resilience, complementing the second measure with the three dimensions of resilience (absorption, recovery, adaptation) used by Hafele et al. (2023). In addition, we considered that the study should not be limited to the determination of levels of economic vulnerability and resilience, but relate the results obtained to the GDP fluctuations of the economies under study. In this way, at least a preliminary verification can be made as to whether these theoretically attractive categories correspond to differential economic growth rates.

In all the studies referred to, the authors created synthetic variables, which, given the complexity and multidimensionality of the categories mentioned, seems appropriate. In the present study, we also used two synthetic variables that depicted vulnerability and resilience economic, respectively.

The statistics used to calculate both measures were taken from the World Bank, Eurostat and UNCTAD databases. All European Union countries that were members of the Community in 2021 are included.

On the basis of substantive considerations, a set of potential diagnostic variables was selected, which included: share of trade in relation to GDP, product concentration of exports, inflow of foreign direct investment in relation to GDP and dependence on energy imports. In the next step, these variables were subjected to statistical verification. Each was found to have the right information content and no need was found to eliminate any of the variables. At the variable identification stage, each variable was identified as a stimulant. As can be seen, all variables determine the openness of economies and the cooperation between them. Consequently, the greater the openness, the greater the exposure of the economy to external disturbances and shocks. The variables were then normalised and a synthetic variable showing economic vulnerability was constructed.

A similar testing scheme was applied to the second synthetic variable. The identification of the variables for the construction of the economic resilience measure was done as shown in Table 1. On this basis, three synthetic variables depicting the different dimensions of economic resilience were calculated, and then one illustrating economic resilience was constructed from these three measures.

Table 1
The nature of the diagnostic variables used to measure economic resilience

	Subindex	Diagnostic variable	Nature of the variable
Economic resilience	Absorption	Consumption (as % GDP)	Stimulant
		Exchange rate system	Stimulant
		Investments (as % GDP)	Stimulant
		Inflation	Nominant
	Recovery	Government spending (as % GDP)	Destimulant
		Public debt (as % GDP)	Destimulant
		Private sector debt (as % GDP)	Destimulant
		Share of the service sector in added value (as % GDP)	Stimulant
	Adaptation	Unemployment rate	Destimulant
		Savings	Stimulant
		Ratio of the number of people at non-working age to the number of people at working age	Destimulant
		Research and development expenditure (as % GDP)	Stimulant
		Number of patent applications per million inhabitants	Stimulant

Source: own elaboration.

It is important to note that the positions of individual economies are expressed in relative terms and therefore depend on both their own actions and the activities of other countries.

Comparing the constructed measures to those in the cited studies, it can be concluded that they are not as complex. Empirical verification will determine whether they are cognitively useful.

4. Results

According to the adopted procedure, measures of economic vulnerability and resilience were estimated respectively. Based on these, Malta (0.95), Luxembourg (0.59) and Ireland (0.47) were among the most vulnerable

countries in 2004. A significant difference between Malta and the next economies is visible. It should be noted that all three countries also occupied the top three places in 2021. At the end of the period under review, Malta achieved a significantly lower score (0.70) than in 2004, and the gap between the first and second countries narrowed (second Luxembourg scored 0.63 and third Ireland 0.60). In contrast, the least vulnerable countries were Denmark, Poland and Romania at the beginning of the period under review, while in 2021 Sweden, France and Romania can be defined as such. The least vulnerable Denmark achieved a score close to zero in 2004. The negative value of the synthetic variable for Denmark is due to the fact that it is the only energy exporter and not an importer like the other economies. At the same time, the relatively low values of the other diagnostic variables resulted in the final value of the synthetic variable being close to zero, but nevertheless negative. Poland and Romania recorded a score of 0.16 and 0.21, respectively. In addition, significant variation can be observed between all the surveyed economies in 2004. At the end of the period under study, Sweden was found to be the least vulnerable country with a score of 0.20. France (0.21) and Romania (0.22) were slightly more economically vulnerable. It is worth pointing out that, at the end of the period under review, countries were characterised by much less variation.

Analysing the averages, it can be seen that countries were increasingly open to cooperation until 2007. After the onset of the global economic crisis, economic vulnerability decreased as a result of reduced cooperation between countries until 2018. In 2019, economies opened up to cooperation again, but the arrival of the Covid-19 pandemic halted this trend. The calculated measure of economic vulnerability for selected years is shown in Table 2.

In 2004, in terms of economic resilience, Luxembourg (0.76), Ireland (0.67) and the Czech Republic (0.65) achieved the highest values. It is worth noting that for resilience there are not as significant differences as for economic vulnerability. At the end of the period under review, Luxembourg, Germany and Ireland were among the most resilient countries. While Luxembourg and Ireland showed a slight improvement in terms of economic resilience, Germany improved significantly. Among the least resilient countries in 2004 were Bulgaria (0.46), Hungary (0.48) and Latvia (0.50). By contrast, Bulgaria (0.51) remained in this group in 2021, while Hungary (0.61) and Latvia (0.59) improved. They were replaced by Croatia (0.52) and Romania (0.51).

Analysing the evolution of average economic resilience, it can be seen that it grew until 2007. The global economic crisis caused it to fall significantly, which lasted until 2009. From then on, there was a short-lived

Table 2

Economic vulnerability in selected years of the 2004–2021 period (countries have been ordered according to values for 2021)

Country	2004	2009	2014	2018	2021	Country	2004	2009	2014	2018	2021
Malta	0.95	0.75	0.72	0.72	0.70	Germany	0.27	0.27	0.29	0.30	0.29
Luxembourg	0.59	0.66	0.67	0.56	0.63	Croatia	0.28	0.24	0.24	0.27	0.28
Ireland	0.47	0.56	0.60	0.55	0.60	Latvia	0.34	0.27	0.27	0.27	0.28
Slovakia	0.39	0.39	0.41	0.45	0.43	Austria	0.31	0.28	0.29	0.28	0.27
Belgium	0.41	0.40	0.40	0.40	0.41	Italy	0.29	0.27	0.27	0.28	0.27
Greece	0.28	0.30	0.40	0.41	0.40	Finland	0.31	0.28	0.28	0.25	0.25
Slovenia	0.30	0.31	0.33	0.38	0.39	Bulgaria	0.29	0.27	0.27	0.27	0.25
Lithuania	0.32	0.31	0.40	0.39	0.39	Poland	0.16	0.20	0.20	0.25	0.25
Hungary	0.36	0.35	0.39	0.27	0.37	Estonia	0.29	0.27	0.25	0.20	0.25
Cyprus	0.45	0.94	1.02	0.56	0.32	Denmark	–0.01	0.08	0.17	0.20	0.23
Netherlands	0.29	0.27	0.30	0.27	0.30	Romania	0.21	0.16	0.18	0.21	0.22
Czech Republic	0.23	0.23	0.29	0.30	0.30	France	0.22	0.22	0.22	0.23	0.21
Portugal	0.35	0.30	0.30	0.32	0.29	Sweden	0.24	0.23	0.20	0.21	0.20
Spain	0.32	0.30	0.29	0.31	0.29	Avarage	0.33	0.34	0.36	0.34	0.34

Source: own elaboration.

Table 3

Economic resilience in selected years of the 2004–2021 period (countries have been ordered according to values for 2021)

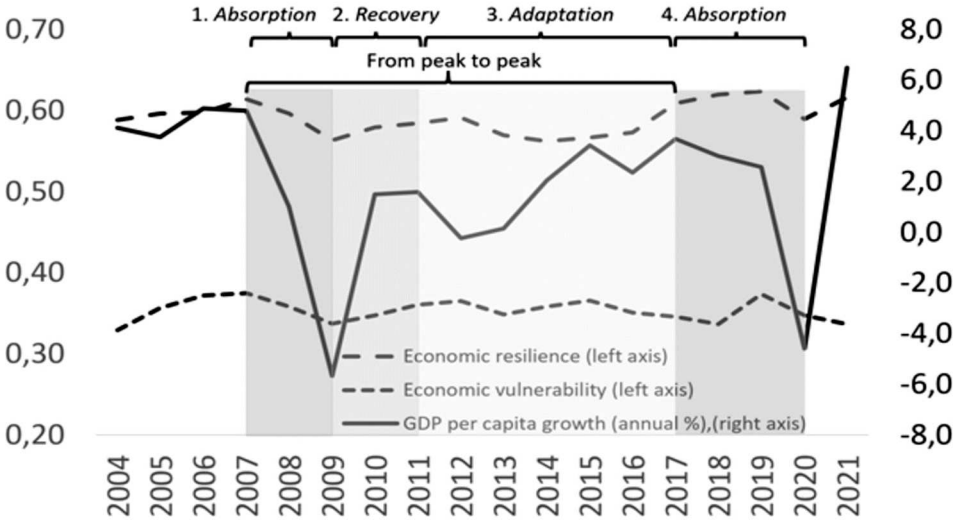
Country	2004	2009	2014	2018	2021	Country	2004	2009	2014	2018	2021
Luxembourg	0.76	0.73	0.74	0.73	0.76	Cyprus	0.54	0.57	0.51	0.59	0.61
Germany	0.63	0.62	0.66	0.71	0.70	Denmark	0.52	0.52	0.53	0.57	0.60
Ireland	0.67	0.53	0.57	0.64	0.69	France	0.61	0.57	0.57	0.60	0.59
Austria	0.64	0.62	0.66	0.69	0.68	Latvia	0.50	0.46	0.56	0.63	0.59
Netherlands	0.65	0.63	0.60	0.67	0.68	Lithuania	0.51	0.43	0.57	0.64	0.58
Sweden	0.62	0.61	0.62	0.67	0.68	Italy	0.61	0.55	0.53	0.56	0.58
Belgium	0.61	0.56	0.58	0.65	0.68	Slovakia	0.57	0.57	0.55	0.63	0.57
Czech Republic	0.65	0.60	0.51	0.72	0.67	Portugal	0.60	0.52	0.51	0.56	0.57
Finland	0.62	0.61	0.62	0.62	0.66	Spain	0.60	0.53	0.51	0.56	0.56
Malta	0.51	0.60	0.58	0.65	0.64	Greece	0.59	0.52	0.47	0.50	0.52
Slovenia	0.55	0.60	0.57	0.63	0.63	Croatia	0.59	0.50	0.41	0.47	0.51
Poland	0.58	0.57	0.55	0.63	0.62	Bulgaria	0.46	0.55	0.45	0.54	0.51
Estonia	0.61	0.50	0.60	0.66	0.62	Rumania	0.60	0.58	0.60	0.54	0.51
Hungary	0.48	0.53	0.55	0.66	0.61	Avarage	0.59	0.56	0.56	0.62	0.62

Source: own elaboration.

improvement, but from 2012 it started to decline again. This was linked to the debt crisis among European countries. As before, the decline in economic resilience was short-term. After 2014, countries were increasing their economic resilience until 2019, after which the trend reversed due to the Covid-19 pandemic. The calculated measure of economic resilience for selected years is shown in Table 3.

Changes in economic vulnerability and resilience are worth comparing with changes in output over time. All the variables mentioned were increasing between 2004 and 2007 (Figure 1). When the global economic crisis hit, both measures of economic vulnerability and resilience and the dynamics of GDP per capita started to decline. All variables reached a minimum in 2009 and fluctuated thereafter without a clear trend. Another similarity is the sharp decline in all measures from 2019 onwards due to the global pandemic. Production and economic resilience started to increase in 2021, while economic vulnerability continued to decline. This is likely a consequence of the lifting of restrictions at different times what had a significant impact on restricting trade and capital flows between countries. Thus, a clear similarity in the development of all analysed measures over time can be observed.

Figure 1. Output growth and economic vulnerability and resilience 2004–2021



Source: own elaboration.

During the period under study, sub-periods related to the course of the economic cycle can be distinguished. The period 2007–2009 can be described as an absorption phase. Between 2009 and 2011, there was a tem-

porary rebound in output, which was associated with the recovery phase, when economies were returning to growth. From 2011 to 2017, an adaptation phase can be discerned.

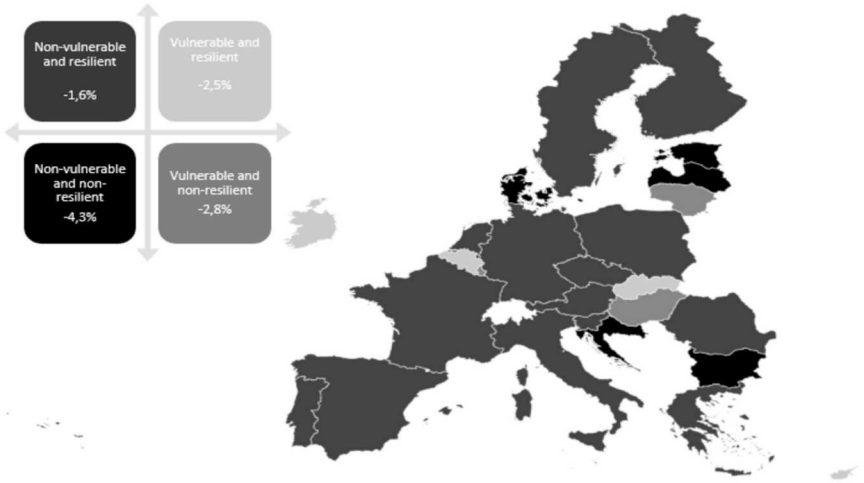
Economies were then grouped on the basis of the calculated measures. When analysing economic resilience, all its dimensions and identified periods were considered in turn. Four groups were identified:

- vulnerable and resilient;
- vulnerable and non-resilient;
- non-vulnerable and resilient;
- non-vulnerable and non-resilient.

In the first identified period (2007–2009), it was tested whether the identified dimension of economic resilience – absorption – better predicts the impact of a negative external shock. As a result of this shock, all groups achieved negative average economic growth rates. In the group of vulnerable and resilient countries, the average economic growth rate was –2.5%, while in the group of vulnerable and non-resilient countries it was slightly lower at –2.8%. As expected, the better domestic situation in the economy allowed for smaller relative declines in output. Countries considered resilient and non-vulnerable achieved the highest growth rates. This is because these countries were less exposed to the shock, while their relatively good domestic situation limited the decline in output dynamics. The worst performers were the non-vulnerable and non-resilient countries. Although these countries were not as exposed to the shock, their internal problems caused significant declines in output. In this case, economic vulnerability had a negative impact, while higher economic resilience made it possible to limit the negative shock. The results of the grouping are shown in Figure 2.

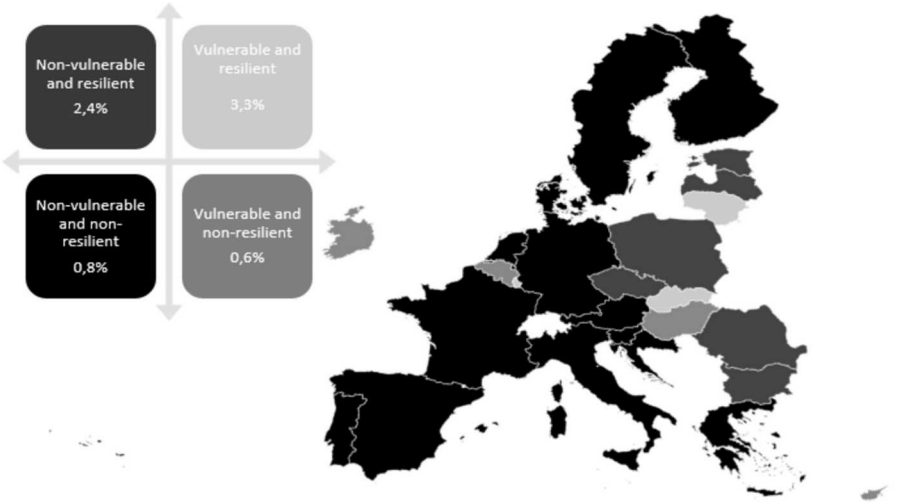
In the next sub-period (2009–2011), countries were again divided into four groups, taking into account the second dimension of economic resilience – recovery (Fig. 3). Here, the highest average growth rate was achieved by the vulnerable and resilient countries (3.3%). In contrast, countries classified as non-vulnerable and resilient grew at a slower rate of nearly 2.5%. Economies classified as vulnerable and non-resilient achieved a significantly lower average growth rate, as it stood at 0.6%. The average rate of output growth was similar among the non-vulnerable and non-resilient countries (0.8%). It can be concluded that during this period, economic growth rates were primarily dictated by the domestic situation of the economies. Economic vulnerability also slightly increased the growth rate, but only among resilient countries.

Figure 2. Economic vulnerability and resilience vs. economic growth in the *absorption* period (2007–2009)



Source: own elaboration.

Figure 3. Economic vulnerability and resilience vs. economic growth in the *recovery* period (2009–2011)

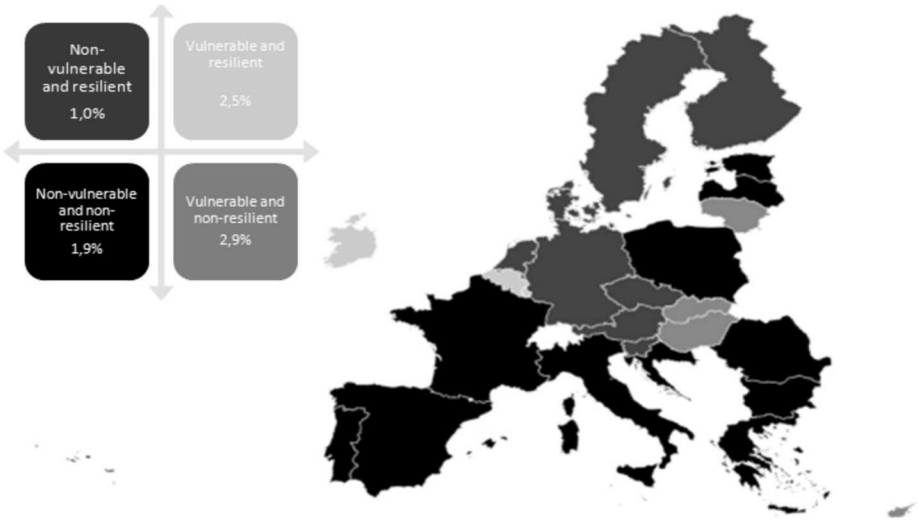


Source: own elaboration.

The 2011–2017 period was grouped using the third dimension of economic resilience – adaptation (Fig. 4). Vulnerable and non-resilient countries grew fastest during this period. Slightly lower average growth rates were recorded by countries considered vulnerable and resilient. The higher growth rates of vulnerable and non-resilient countries can be attributed

to the improving global economy and high openness, which triggers a process of gradual reduction of inefficiencies in their economies. In contrast, countries that were not vulnerable achieved significantly lower output dynamics. There is some doubt about the higher average production growth rate among the non-vulnerable and non-resilient countries than the non-vulnerable and resilient countries. This observation is not consistent with the predictions. It can be deduced that during the adaptation phase, cooperation between countries contributes to better economic performance and leads to higher efficiency.

Figure 4. Economic resilience and vulnerability vs. economic growth in the *adaptation* period (2011–2017)

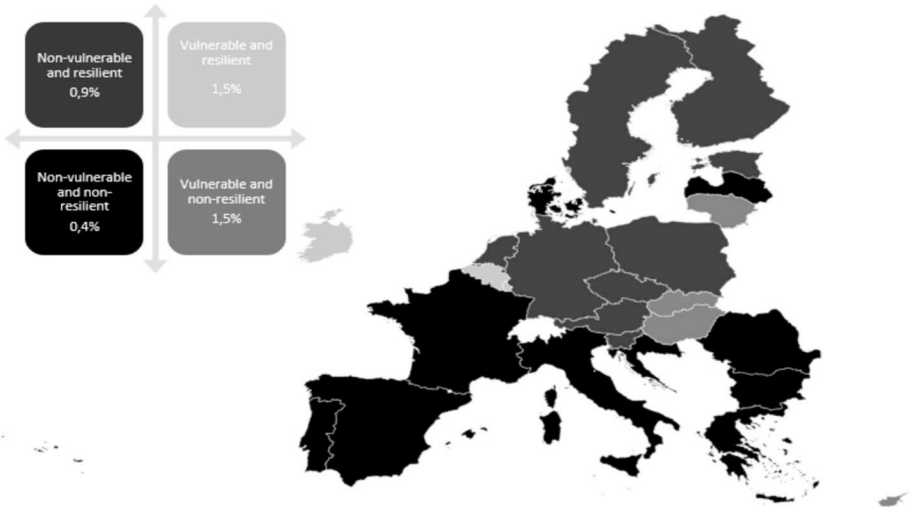


Source: own elaboration.

Between the peak points (2007–2017), the vulnerable and resilient countries grew on average at a similar rate to the vulnerable and non-resilient countries (Fig. 5). It can be added that these economies achieved a higher average economic growth rate than countries considered non-vulnerable. Thus, it can be concluded that economic vulnerability has a positive impact on economic growth rates during the period under review. At the same time, non-vulnerable and resilient countries achieved higher economic growth rates than non-vulnerable and non-resilient countries.

The procedure was used to analyse the behaviour of economies during the COVID-19 pandemic (Fig. 6). During the pandemic, vulnerable and resilient economies were least affected by the slowdown. In contrast, the lowest economic growth rates were achieved by non-vulnerable and resilient

Figure 5. Economic vulnerability and resilience vs. economic growth 2007–2017



Source: own elaboration.

Figure 6. Economic vulnerability and resilience vs. economic growth in the *absorption* period (2017–2020)



Source: own elaboration.

countries. The pandemic was a markedly different crisis from that of the first decade of the 21st century, as the pandemic crisis did not spread through the financial or trade channel. In this case, restrictions on trade or capital flows were the effect, not the cause, of the spread of the crisis.

5. Conclusions

Summarising the considerations, one can conclude that the concept of economic vulnerability and resilience is an interesting proposition for describing the behaviour of economies. When confronted with economic performance, it tended to give results consistent with theoretical prediction. Thus, it can be argued that vulnerable and resilient economies are characterised by high economic growth rates, but at the same time by a smoothed growth path. In contrast, countries considered vulnerable and non-resilient are characterised by a large amplitude of fluctuations, as they were significantly affected by the international economic crisis (2007–2009) and at the same time needed more time to recover from it. Their performance between 2007 and 2017 was not dissimilar to that of the vulnerable and resilient economies, but the course of the growth path was considerably more volatile. On average, non-vulnerable and resilient countries achieved higher growth rates than non-vulnerable and non-resilient countries. Non-vulnerable and resilient countries were least affected by the crisis and also recovered relatively quickly, and only experienced relatively low output growth rates in the period 2011–2017. Finally, non-vulnerable and non-resilient countries were hit hard by the economic crisis and at the same time were slow to recover from it. Therefore, greater economic vulnerability may result in a deeper recession, but with a positive effect on the economy in good times. It can also be concluded that economic vulnerability produces positive effects, but only among countries considered resilient. In turn, higher economic resilience reduces the likelihood of a deep recession.

The course of the pandemic crisis cannot yet be fully analysed, as only the absorption phase was included in the period studied. Only by repeating the study after all three phases have occurred can meaningful results be obtained.

It is difficult to compare the results obtained with the cited studies, as other authors did not refer to changes in production over time. It seems that the only point of reference is the empirical verification, which has proceeded satisfactorily. Therefore, it is worth continuing and developing the approach presented. The results achieved can serve as a prelude to further studies in which the behaviour of individual economies could be explored.

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