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Regional disparities in economic resilience in the European Union across the urban–rural divide

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ABSTRACT

The differences in regional economic resilience and the drivers of resilience across the urban–rural hierarchy in the European Union are explored empirically in this paper. Three different resilience indicators are computed based on employment changes. Multilevel logistic and multinomial regression models indicate that the resilience of NUTS-3 regions is strongly affected by national borders; the highest country effects are observed for rural areas. Migration has the greatest positive effect on regional resilience across the urban–rural hierarchy. Agriculture contributes positively to the economic resilience of intermediate and rural regions. Statistically significant spatial patterns of regional resilience are found throughout the EU-27.

KEYWORDS

economic crisis; urban–rural hierarchy; spatial dependence; country effects; multilevel regression models; migration

JEL C35, J21, R11, R12

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INTRODUCTION

The European economy has experienced great volatility and uncertainty during the last decade. The global financial crisis that erupted in the United States in 2008 was immediately transmitted and spread across Europe, although its effect was highly heterogeneous in intensity and timing across countries and regions (Fratesi & Perucca, 2018). The severe and uneven territorial impacts of the economic crisis have provided new stimuli to researchers to understand the factors behind the varying ability of regions to withstand, react and recover from the recessionary impact.

Regional economic resilience has been extensively studied at various territorial levels, ranging from European-level analysis using large spatial units such as NUTS-2 (Brakman, Garretsen, & van Marrewijk, 2015; Crescenzi, Luca, & Milio, 2016) and NUTS-3 (Fratesi & Perucca, 2018) to country-level analysis using finer scales of geographical resolution such as municipalities and local labour systems (Faggian, Gemmiti, Jaquet, & Santini, 2018; Holl, 2017; Palaskas, Psycharis, Rovolis, & Stoforos, 2015).

The resilience of urban areas and cities to economic crisis has received special attention in the literature. Capello, Caragliu, and Fratesi (2015) found that large European urban centres, especially those hosting diversified high-value functions, were more resilient to recession than towns and rural areas. Similarly, Fratesi and Rodríguez-Pose (2016) indicated that almost all European capital regions (excluding Paris, Athens, Lisbon and Bratislava) have been able to create more (or lose fewer) jobs during the crisis than their respective country averages.

The focus of resilience literature on urban areas can be associated with the dominant narrative of urban economics on concentrating territorial interventions on large and dynamic metropolitan areas and not on lagging regions (Rodríguez-Pose, 2018). According to this school of economic thought, promoting agglomeration and urban density is the most effective pathway to economic prosperity (Glaeser, 2011). However, the view of large agglomerations as the main engines of growth is being challenged. Factors such as quality of life, access to nature and improvements in accessibility have improved the appeal of smaller towns and rural areas (Dijkstra,

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Garcilazo, & McCann, 2013). For example, Dijkstra, Garcilazo, and McCann (2015), using the Organisation for Economic Co-operation and Development's (OECD) territorial classification scheme, found that European urban regions performed below the output and labour productivity growth rates of the intermediate and rural regions close to cities.

The study of the resilience of rural and intermediate regions has been much more limited, and largely constrained to few country-specific investigations. Rural municipalities and NUTS-2 regions in Greece have been found more resilient than their urban counterparts (Giannakis & Bruggeman, 2017b; Palaskas et al., 2015). However, Holl (2017) found that urban core municipalities in Spain performed better than rural municipalities during the recession years, while rural municipalities experienced higher employment growth during the boom years. Ženka, Pavlík, and Slach (2017) found small differences in the ability of the different types of Czech regions (metropolitan cores and hinterlands, urban regions and rural regions) to withstand the recessionary impact.

Investing in large and dynamic agglomerations in times of growth and crisis can increase territorial inequalities, which can further trigger populism, thus resulting in less economic stability and more inefficient policies (Rodríguez-Pose, 2018; Spicer, 2018). There is no consensus on the question if urban areas are more or less resilient than rural areas, while little is known about the resilience of the regions that fall between these two extremes. Not much research has been also conducted on the effect of structural characteristics and spatial assets on the resilience capabilities of regions across the urban–rural spectrum. Understanding the differential impact of the drivers of resilience across the urban–rural hierarchy can contribute to the design of targeted policies, territorial and sectoral that could increase the ability of regions to respond to adverse shocks and reduce the disparities in economic resilience among regions.

In this paper, we aim to fill this gap and empirically explore and discuss the relationship between regional resilience and the degree of urbanization. Our analysis focuses on the first two features of resilience, namely, the resistance and recovery phase of European regions in terms of employment growth paths. Specifically, we aim to contribute to the regional resilience literature and European regional policy debate along two main directions. We first analyse the temporal and spatial trends and patterns of resilience across European urban, intermediate and rural NUTS-3 regions during and after the 2008 economic crisis, that is, from 2008 to 2015. Second, we analyse how the post-crisis performance of regional labour markets across the urban–rural divide (urban, intermediate and rural regions) and along the territorial hierarchy (NUTS-3, NUTS-2, country level) is related to several key quantitative factors before the onset of the economic crisis. We computed three different metrics of regional employment resilience: relative to the European Union (EU) average; relative to the national average; and the resistance and recovery phases of resilience.

METHODOLOGY

Urban–rural typology

The classification of a region as urban or rural is not a trivial issue because there is no universal definition (Holl, 2017). We used the Eurostat (2018a) urban–rural typology that classifies NUTS-3 regions into predominantly rural (henceforward referred to as 'rural'), intermediate and predominantly urban (henceforward referred to as 'urban') to account for the geographical differences among them. The EU's classification of regions is based on the shares of a region's rural and urban population, where a rural population is defined as people living in areas outside urban clusters (contiguous grid cells of 1 km^2 with a density of at least 300 inhabitants/km^2 and a minimum population of 5000). A region is classified as urban if the rural population accounts for < 20% of the total population, intermediate if the rural population is between 20% and 50% of the total population, and rural if the rural population is > 50% of the total population. The presence of an urban centre can turn rural regions into intermediate regions and intermediate regions into urban regions (Eurostat, 2018a).

This classification allowed us to exploit the Eurostat database to analyse the various dimensions and determinants of resilience across all EU regions. It also facilitated our objective to investigate linkages between NUTS-3 and NUTS-2 regions, which are the administrative units targeted by European regional policy. A limitation of the selected urban–rural typology is that it does not account for differences in the size of the cities, which affect the ability of regions to react to the crisis (Capello et al., 2015).

Resilience indicator

Several methodologies and indicators have been employed in the literature to measure regional economic resilience empirically (Doran & Fingleton, 2016). We explored the economic resilience of European regions in terms of employment growth rates, similar to the work of Lagravinese (2015) and Faggian et al. (2018) in Italy. The rationale for focusing on employment growth is related to the persistent effects of economic crisis on employment compared with the effects on output; employment typically returns to pre-crisis levels with a longer lag than output, thus better reflecting crisis' social impact (Reinhart & Rogoff, 2009). Our analysis focused on the first two features of regional resilience, namely, the resistance and recovery phases of European regions.

EU-based regional economic resilience

First, we analysed regional employment resilience across the urban–rural hierarchy in relation to the EU average. We computed a relative measure of the resilience of NUTS-3 regions against the overall EU average to elicit policy recommendations that are aligned with the cohesion policy funding mechanism (i.e., funding is given to those regions whose development is lagging behind the EU average; Eurostat, 2018g). Following Lagravinese (2015) and

Giannakis and Bruggeman (2017a), resilient regional labour markets relative to the EU-27 (Luxemburg was not included in the analysis) were identified as follows:

$$\beta_{res}^{EU} = [(E_t^R - E_{t-1}^R)/E_{t-1}^R - (E_t^{EU} - E_{t-1}^{EU})/E_{t-1}^{EU}]/ |(E_t^{EU} - E_{t-1}^{EU})/E_{t-1}^{EU}| \quad (1)$$

where E^R is the employment at regional level (persons); E^{EU} is the employment at the EU-27 level (persons); $t-1$ is the starting year of the crisis period (2008); and t is the end year of the economic recovery period (2015).

A positive resilience index (β_{res}^{EU}) implies that the region had smaller relative employment losses (or higher relative employment gains) and/or recovered faster than the average EU-27 employment changes, that is, it was more resilient than the EU-27 average. A negative β_{res}^{EU} implies a less resilient region than the EU-27 average.

Country-based regional economic resilience

In a similar manner, we analysed regional resilience across the urban–rural hierarchy at the national level as follows (Cainelli et al., 2018; Giannakis & Bruggeman, 2017a):

$$\beta_{res}^{N} = [(E_t^R - E_{t-1}^R)/E_{t-1}^R - (E_t^N - E_{t-1}^N)/E_{t-1}^N]/ |(E_t^N - E_{t-1}^N)/E_{t-1}^N| \quad (2)$$

where E^N is the employment at country level (persons). Similar to the EU-referenced resilience, a positive resilience index (β_{res}^{N}) implies that the region had smaller relative employment losses (or higher relative employment gains) and/or recovered faster than national employment changes.

Resistance and recovery phases of resilience

Following Lagravinese (2015) and Faggian et al. (2018), we split the period between 2008 and 2015 in two subperiods representing the resistance phase (2008–13) and the recovery phase (2014–15). We estimated resistance (β_{ress}^{EU}) and recovery (β_{rec}^{EU}) indicators, relative to respective EU average performance using equation (1). The resistance and recovery indicators were then used to classify European NUTS-3 regions into four groups:

- Group I: Low resistance and slow recovery ($\beta_{ress}^{EU} < 0$ and $\beta_{rec}^{EU} < 0$).
- Group II: Low resistance and fast recovery ($\beta_{ress}^{EU} < 0$ and $\beta_{rec}^{EU} > 0$).
- Group III: High resistance and slow recovery ($\beta_{ress}^{EU} > 0$ and $\beta_{rec}^{EU} < 0$).
- Group IV: High resistance and fast recovery ($\beta_{ress}^{EU} > 0$ and $\beta_{rec}^{EU} > 0$).

Determinants of regional economic resilience

The study draws on the regional resilience literature to explore the potential determinants of the highly differential ability of European regions to withstand and recover from the economic crisis impact (Faggian et al., 2018). A region's resistance to and recovery from an economic shock is influenced by the inherent features underpinning its previous growth path (Martin & Sunley, 2015). To reduce the effects of local, temporal fluctuations, for example, agricultural regions could be affected by droughts, we computed the averages of all determinants for a six-year period (2002–07), which is the period with the highest increase in the EU-27 employment during the past decade (6.9%). Analysing the combinations of those factors in ordinary times, that is, before the onset of the economic downturn, can be useful for explaining the performance of territories during and after recessionary shocks (Di Caro & Fratesi, 2018). The determinants are described below. The definitions and descriptive statistics of all determinants, except the dummy variables for the region type, are presented in Table 1.

Sectoral structure

The pre-crisis sectoral composition of the regional employment, represented here by the share of regional gross value added (GVA) in agriculture, manufacturing, construction and services, is expected to influence regional economic resilience. Regional economies specialized in the manufacturing and construction sectors suffered to a greater extent from the economic downturn impact than others (Angulo, Mur, & Trívez, 2018; Lagravinese, 2015), while the role of agriculture (Faggian et al., 2018; Giannakis & Bruggeman, 2017b) and the services sector (Martin, 2012; Navarro-Espigares, Martín-Segura, & Hernández-Torres, 2012) in building resilience capacities is inconclusive.

Population and migration

Regional economic resilience may also be associated with the population structure, which directly affects labour supply (Bigos et al., 2013). Several studies have shown that older populations might be less adapted to technological and economic changes in workplaces, less prone to innovation and less productive than younger populations (Dixon, 2003; Lovasz & Rigo, 2013). We used in our econometric model the old-age dependency ratio, that is, population > 65 years to the population aged 15–64 years, to capture the effect of age structure in regional resilience. Population size, a proxy variable for agglomeration economies, can also affect the capability of a region to withstand and recover from economic shocks (Faggian et al., 2018). By counterbalancing negative natural population trends, pre-crisis migration could also affect a region's resilience (European Observation Network for Territorial Development and Cohesion (ESPON), 2008). Net migration as a percentage of the total population is used here to capture these effects.

Regional economic development

The differences in the economic resilience of regions may be partly attributed to their pre-crisis development level (Elhorst, 2003; Petrakos & Psycharis, 2016). The gross domestic product (GDP) per capita is used to capture the territorial economic development. Similarly, the pre-crisis labour market performance may affect the resilience of regions to recession (Marelli, Patuelli, & Signorelli, 2012;

Table 1. Description of the 12 explanatory variables used in the multilevel regression models and summary statistics of the 2002–07 pre-crisis period for the 1340 EU-27 NUTS-3 regions (n = 353 urban, 494 intermediate and 493 rural regions).

			Urban regions			Intermediate regions			Rural regions			EU-27
Variables	**Definition**	**Sources**	**Minimum**	**Maximum**	**Average**	**Minimum**	**Maximum**	**Average**	**Minimum**	**Maximum**	**Average**	**average**
AGRIC	Share of agriculture in GVA (%)	Eurostat (2018b)	0	13	1	0	21	3	0	30	6	2
MANUF	Share of manufacturing in GVA (%)	Eurostat (2018b)	1	64	17	1	69	20	1	65	19	17
CONSTR	Share of construction in GVA (%)	Eurostat (2018b)	1	29	6	1	16	6	1	23	7	6
SERV	Share of services in GVA (%)	Eurostat (2018b)	34	98	76	30	96	70	30	88	67	75
AGE	Old-age dependency ratio: population > 65 years/ population aged 15–64 years (%)	Eurostat (2018c)	11	42	25	6	44	27	12	55	29	25
POPUL	Population size (thousands of persons)	Eurostat (2019)	31	6366	606	34	1587	355	11	900	233	376
MIGR	Share of net migration to total population (%)	Eurostat (2018f)	−0.8	3.2	0.3	−1.8	6.7	0.3	−1.6	3.3	0.2	0.4
GDP	GDP at current market prices per capita (€ thousands/ inhabitant)	Eurostat (2018d)	4	307	30	2	84	22	2	48	17	23
EMPLO	Labour market performance (%)	Eurostat (2018e)	−9	34	6	−32	41	5	−27	40	3	7
ACCESS	Multimodal potential accessibility	ESPON (2009)	40	209	138	25	174	102	22	190	79	100
NEIGHB	Number of resilient neighbour regions	Authors' own analysis	0	58	25	0	55	16	0	58	10	16
EUROZONE	Euro area regions			202			366			349		917

Note: GDP, gross domestic product; GVA, gross value added.

Palaskas et al., 2015). The employment percentage change between 2002 and 2007 is used to explore these effects.

Accessibility and resilience of neighbouring regions

Less attention in the study of regional economic resilience has been given to the spatial interaction of the regions and the linkage of resilience with accessibility (Östh, Reggiani, & Galiazzo, 2015). We used the multimodal potential accessibility indicator computed by ESPON (2009) for the period 2001–06 to capture this interaction. The ESPON multimodal accessibility indicator, which integrates the accessibility by road, rail and air, is based on the population in NUTS-3 regions and the travel time to reach them (ESPON, 2009). The economic resilience of a region is also expected to be associated with the resilience of nearby regions (Ezcurra & Rios, 2019; Pontarollo & Serpieri, 2018). We used the number of resilient neighbour regions, within a 100-km radius between the centroids of the regions, to estimate the effect of spatial spillovers between neighbouring regions.

Eurozone membership

Eurozone membership, a proxy variable for macroeconomic stability, can also affect regional economic resilience (Cainelli et al., 2018; Crescenzi et al., 2016). Similar to Crescenzi et al. (2016), we included in our econometric model a dummy for the regions belonging to the 15 countries (Luxemburg is not included in the analysis) that were part of the euro area during the crisis (including Slovakia that entered the Eurozone in January 2009) to assess the effect of fixed exchange rates (Eurozone) versus flexible exchange rates (non-Eurozone) on regional resilience.

Analytical methods

We used non-parametric statistical tests to assess differences in the resilience of urban, intermediate and rural European regions; spatial statistics to measure the degree of spatial dependence of the distribution of the regional employment resilience; and multilevel logistic regression models to assess the magnitude of the country effects and disentangle the determinants of regional employment resilience.

Normality and non-parametric tests

The Kolmogorov–Smirnov and Shapiro–Wilk normality tests were performed to determine whether or not the distribution of the dependent variable, that is, regional economic resilience (β_{res}), was normal for each of the three region types. The non-parametric Kruskal–Wallis test was used to evaluate differences in economic resilience across urban, intermediate and rural European regions. All statistical analyses were conducted in IBM SPSS Statistics v20.

Spatial dependence tests

We measured the spatial dependence in the distribution of regional employment resilience with the global Moran's I statistic (Ezcurra & Rios, 2019; Pontarollo & Serpieri, 2018), using ArcGIS 10.1 (ESRI, USA). We selected a Euclidian distance threshold of 100 km between the centroids of the regions and used a row-standardized spatial weight matrix for the analysis. We tested the sensitivity of the spatial correlations of the EU-based resilience by similarly computing the global Moran's I test for distances of 200 and 500 km. We also calculated the local Moran's I test for a more precise identification of the presence of spatial clusters, for example, areas with a concentration of regions with high or low levels of resilience (Pontarollo & Serpieri, 2018). We used the spatial weight matrix to extract the number of resilient regions within the 100-km threshold distance for each region for both the EU- and country-based resiliences (*NEIGHB* in Table 1).

Multilevel regression analysis

Regional employment dynamics are significantly affected by the national context (Ezcurra & Rapún, 2006); thus, a multilevel approach is necessary to disentangle the determinants of regional labour markets resilience (Giannakis & Bruggeman, 2017a). The empirical framework of the study makes use of the nested structure of the data set, that is, 1340 NUTS-3 regions (level 1) are nested within 272 NUTS-2 regions (level 2), which are nested within 27 countries.

A three-level random intercept logistic regression model is used to relate EU-based regional resilience to a set of explanatory variables ($x_1, \ldots, x_n$) defined at the NUTS-3 level. The dependent variable, regional resilience, is expressed as a dichotomous variable:

$$y_{ijk} = 1 \text{ for } \beta_{res}^{EU} \geq 0$$

$$y_{ijk} = 0 \text{ for } \beta_{res}^{EU} < 0$$

The logistic model is formulated as follows:

$$y_{ijk} = a_0 + a_1 x_{ijk} + u_{jk} + v_k + e_{ijk} \quad (3)$$

where $i = 1, \ldots, I_{jk}$ (I_{jk} denotes the number of NUTS-3 regions in NUTS-2 region j within country k); $j = 1, \ldots, J_k$ (J_k denotes the number of NUTS-2 regions in country k); $k = 1, \ldots, K$ (K denotes the number of countries); u_{jk} is the NUTS-2 regional random intercept; v_k is the country random intercept; and e_{ijk} is the NUTS-3 regional error term. The level 1 (NUTS-3) error term is assumed to be distributed as a standard logistic distribution with mean zero and variance (σ_e^2) of $\pi^2/3$ (Goldstein, Browne, & Rasbash, 2002). The random intercepts at level 2 (NUTS-2) and level 3 (country) are assumed to be independent and normally distributed with mean zero and variances of σ_u^2 and σ_v^2, respectively.

The variance partition coefficients (VPCs) report the proportion of the residual variance in regional employment resilience at each level of the model hierarchy, thus quantifying the relative importance of countries, NUTS-2 and NUTS-3 regions as sources of variations of NUTS-3 regional employment resilience (Leckie, 2013). The country- and NUTS-2 region-level VPCs are calculated

as follows:

$$VPC_x = \frac{\sigma_x^2}{\sigma_v^2 + \sigma_u^2 + \sigma_e^2} \quad (4)$$

where the index x represents either v for country variance or u for the NUTS-2 region variance.

Similarly, a two-level (NUTS-3, NUTS-2) random intercept logistic regression model is used to explore country-based regional resilience.

A multinomial version of the three-level random intercept logistic regression model (equation 3) was applied to capture the interactions between the resistance and recovery phases. The response variable y takes values in the set of the four groups of regions. The first group, that is, the worst performing group (low resistance/slow recovery) is the reference category for which all the parameters and the random errors are set to zero.

Multicollinearity was tested and quantified using the variance inflation factor (VIF). A VIF > 5 implies a poor estimation of regression coefficients because of multicollinearity (Montgomery, Peck, & Vining, 2012). The explanatory variables were assumed to be statistically significant at the 10% level. All calculations were performed in STATA 13 econometric software package.

RESULTS

This section presents the temporal socioeconomic patterns across the EU urban–rural hierarchy; systematic evidence of the highly heterogeneous resilience of the urban, intermediate and rural European regions to economic crisis; the spatial patterns in the distribution of regional employment resilience; and empirical evidence of the differential effect of determinants on regional resilience across the urban–rural (urban, intermediate, rural) and territorial (NUTS-3, NUTS-2, country level) hierarchy.

Socioeconomic trends in EU-27 urban, intermediate and rural regions in the pre- and post-crisis periods

The pre- and post-crisis periods can be clearly distinguished from socioeconomic trends and changes in employment, GDP and population dynamics (Figure 1). Urban regions performed relatively better compared with intermediate and rural regions in terms of employment, GDP and population change for both pre- and post-crisis periods. Urban employment in the growth period (2002–07) increased by 7.2% compared with 5.3% in intermediate and 3.1% in rural regions.

The EU-27 employment decreased for six successive years (2008–13), for a total reduction of 3.7%, as a result of the global economic crisis. Urban regions had less employment losses during the economic downturn (−1.9%) compared with intermediate (−3.2%) and rural regions (−4.7%), while they exhibited rather resilient behaviour in terms of population dynamics as they

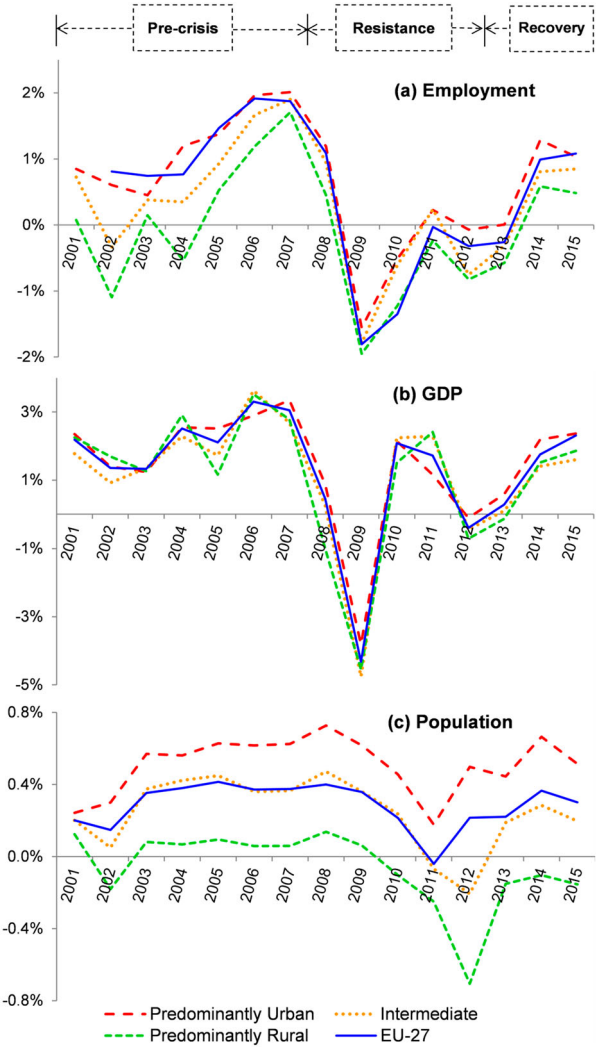

Figure 1. Annual growth rates in (a) employment, (b) gross domestic product (GDP) and (c) population across European regions, 2000–15.

managed to increase the population by 2.2%. The urban regions in Greece (−20%) and Spain (−16%) had the greatest employment losses during the recession. For rural regions losses reached 17% (Latvia, −17.4%; Spain, −17.1%). The economic crisis had a considerable impact on the EU-27's economic output in 2008 and 2009, as GDP fell by 4.3% in real terms (Figure 1). The urban regions had the lowest GDP losses (−3.8%) compared with the intermediate (−4.8%) and rural regions (−4.5%). Although the EU-27 GDP increased in 2010 and 2011 by 1.7%, the economy contracted again in 2012 (output falling by 0.4%).

From 2013 onwards, the European economy has been again on a growth path (Figure 1); the urban regions had a 4.6% increase in economic output, the intermediate regions 3.0% and the rural regions 3.4%. The recovery in European employment began with a one-year delay, that is, from 2014 onwards; the employment in the urban regions increased by 2.3% compared with 1.7% in intermediate and 1.1% in rural regions.

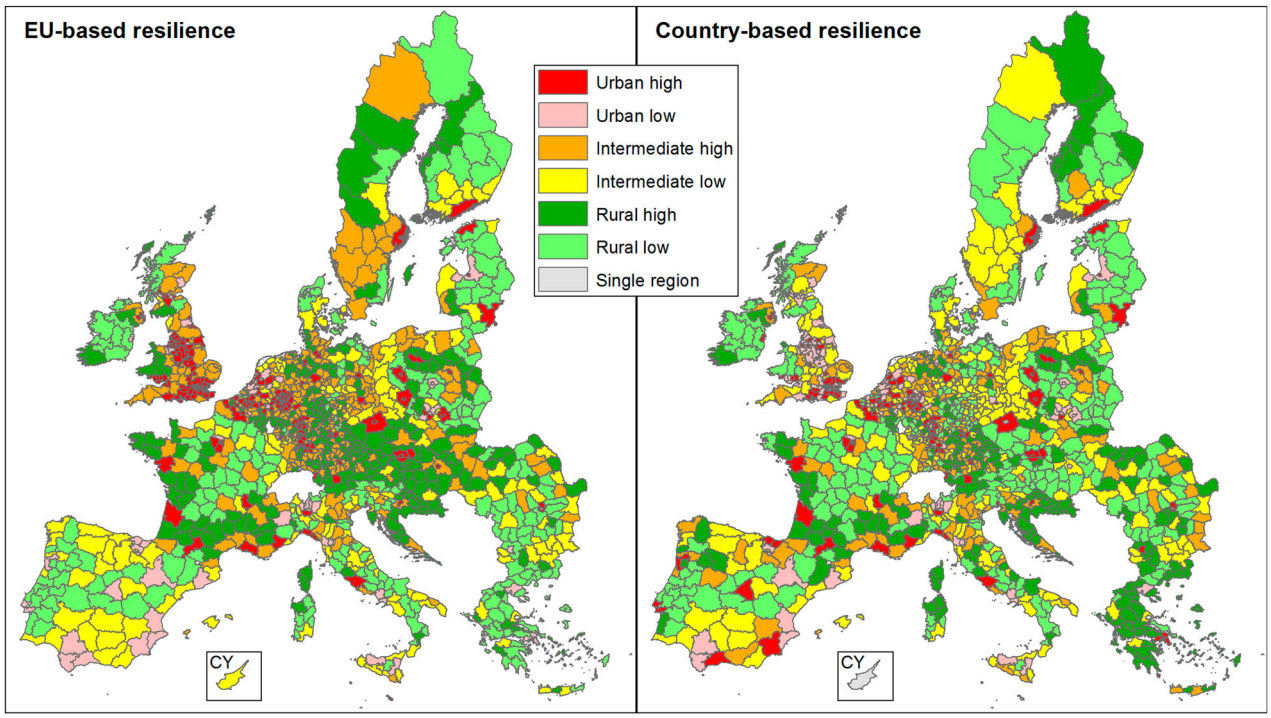

Figure 2. European Union- and country-based regional economic resilience (2018–15) across EU-27 NUTS-3 urban, intermediate and rural regions.
Note: Overseas territories are not shown.

Disparity in regional economic resilience across European urban, intermediate and rural NUTS-3 regions

The geographical distribution of the EU- and country-based economic resilience across the urban–rural typology is portrayed in Figure 2. The geography of the EU-based regional economic resilience is clearly influenced by national economies.

Table 2 presents the resilient and non-resilient region shares across the urban–rural hierarchy as well as the

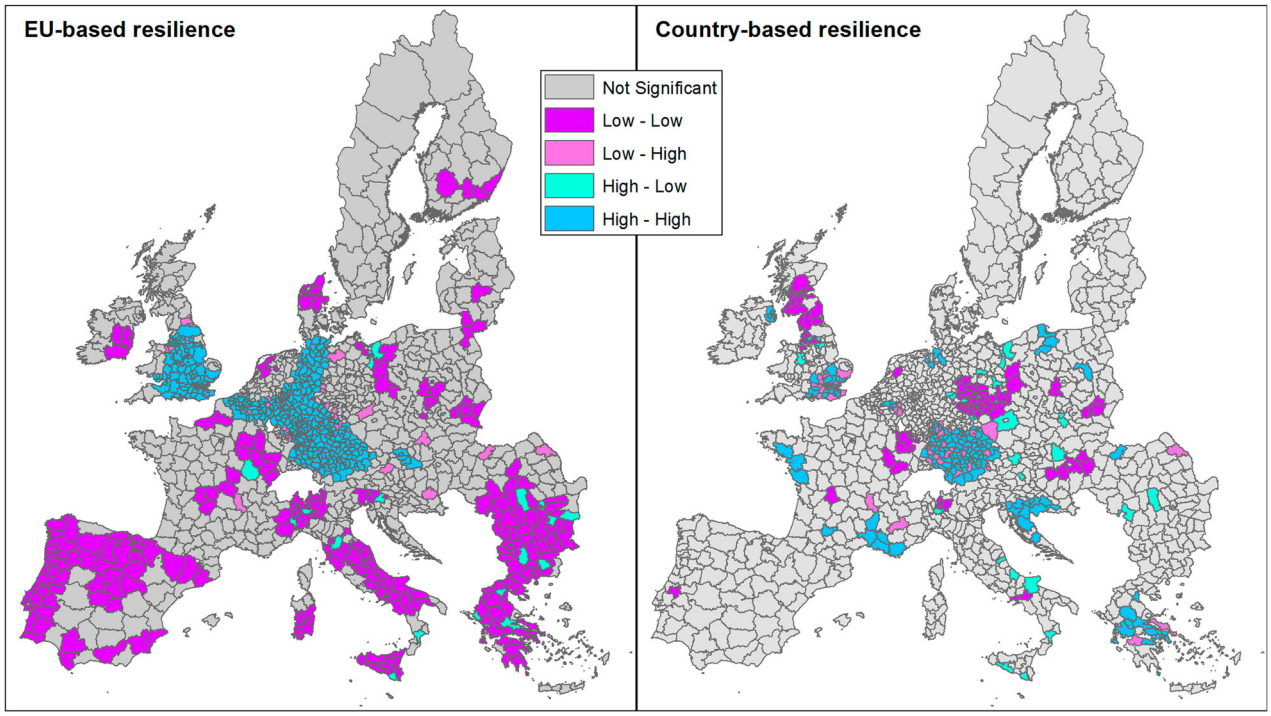

Figure 3. Local Moran significance map of European Union- and country-based resilience.
Note: The distance threshold is 100 km; overseas territories are not shown.

Table 2. Share of EU-27 regions ($n = 1340$) and EU-27 population (503,665,274 persons) living in resilient/non-resilient regions across the urban–rural hierarchy, 2008–15.

		Urban regions		Intermediate regions		Rural regions	
		Resilient	Non-resilient	Resilient	Non-resilient	Resilient	Non-resilient
Regions		353		494		493	
Population		213,715,461		175,139,078		114,810,734	
EU-based resilience	Share of EU-27 regions	0.20	0.06	0.24	0.13	0.20	0.17
	Share of EU-27 population	0.28	0.14	0.20	0.15	0.11	0.12
Country-based resilience	Share of EU-27 regions	0.14	0.12	0.16	0.21	0.16	0.21
	Share of EU-27 population	0.26	0.16	0.15	0.20	0.09	0.14

share of the population living in these regions. The country-level population data are presented in Tables A1 and A2 in Appendix A in the supplemental data online. According to the EU-based economic resilience index, 64% of EU-27 regions are characterized as resilient. These regions are home to 59% of the population. The country-based resilience analysis results in a smaller number of resilient regions (46%), for all three region-types, while the share of the population living in resilient regions drops to 50%.

The results of the Kolmogorov–Smirnov and Shapiro–Wilk normality tests ($p = 0.000$) indicated that both EU- and country-based regional economic resilience did not follow a normal distribution in any of the three region types. The results of the non-parametric Kruskal–Wallis test showed that there was a statistically significant difference in economic resilience across the different types of regions for both EU-based ($p = 0.000$) and country-based ($p = 0.001$) regional resilience (see Table A3 in Appendix A in the supplemental data online). Specifically, Dunn's pairwise tests indicated statistically significant differences between urban and rural regions for both resilience indicators. Intermediate regions are found to be similar as urban regions for EU-based resilience, but similar as rural regions for the country-based resilience.

Spatial dependence in regional economic resilience distribution

The global Moran's I test for both EU-based resilience (I-statistic = 0.475, $p = 0.000$) and country-based resilience for a 100-km distance threshold (I-statistic = 0.192, $p = 0.000$) confirmed the presence of spatial autocorrelation in the distribution of regional employment resilience. The average number of neighbouring regions per region was 20. However, there are 50 regions, including overseas territories, islands and the larger Scandinavian regions, without any neighbours; this affects Moran's test. By increasing the threshold distance, the spatial autocorrelation decreases, but it remained statistically significant ($p = 0.000$), for example, for the EU-based resilience for a distance band of 200 km, the I-statistic is 0.396 (average 68 neighbours, 10 regions without neighbours); and for 500 km, the I-statistic is 0.275 (average 293 neighbours, four regions without neighbours). Considering that the areas of the NUTS-3 regions range from < 20 to > 100,000 km^2, and no spatial criterion will fit all, we selected the 100-km Euclidian distance threshold as a relevant criterion for analysing spatial spillovers, such as access to markets and services.

The local Moran's I-statistics showed the presence of statistically significant ($p < 0.05$) spatial clusters of resilient and non-resilient regions for the 100-km threshold distance, for the EU- and country-based resilience (Figure 3). For the EU-based resilience low-resilient regions surrounded by low resilient regions (253 regions) are observed mainly in Spain, Greece, Italy, Bulgaria and Romania (Figure 3). High-resilient regions surrounded by high resilient regions (433 regions) are mainly present in Germany, Belgium and the UK. For the country-based resilience, the number of statistically significant clusters is understandably much smaller (Figure 3).

Factors behind the variability of economic resilience of European NUTS-3 regions across the urban–rural hierarchy

EU-based economic resilience

Our empirical analysis, consisting of four multilevel logistic regression models (for the 1340 NUTS-3 regions and for the urban, intermediate and rural subsets) highlights the differences in the drivers of regional resilience across the urban–rural hierarchy (Table 3). The share of services GVA (*SERV*) variable was excluded from all models due to multicollinearity. Table A4 in Appendix A in the supplemental data online presents the correlation matrix for all independent variables of the econometric analysis.

The magnitude of the country effects was largest for the rural regions; the VPCs at country level and NUTS-2 regional level for the rural regions were 0.79 and 0.06, respectively, that is, 79% of the variance in the probability of a rural NUTS-3 region to be resilient is attributable to between-country effects and 6% is attributable to between-NUTS-2 regional effects. Consequently, only 15% of a rural NUTS-3 region's economic resilience is determined at the NUTS-3 level.

Table 3. Odds ratios and significance of pre-crisis (2002–07) determinants of European Union-based regional employment resilience using a three-level logistic regression model for the 1340 EU-27 NUTS-3 regions across the urban–rural hierarchy (n = 353 urban, 494 intermediate, 493 rural regions).

	All regions	Urban regions	Intermediate regions	Rural regions
AGRIC	1.14***	1.16	1.17*	1.17**
MANUF	0.97**	0.92***	0.97	1.01
CONSTR	0.94	0.78*	0.94	0.94
AGE	0.92***	1.01	0.94	0.85***
POPUL	1.00	1.00	1.00	1.00
GDP	1.08***	1.06*	1.04	1.11**
EMPLO	0.99	0.94	1.00	0.95
MIGR	3.69***	3.08*	2.69***	9.17***
ACCESS	1.01**	1.00	1.03***	1.01
NEIGH	1.02	1.07***	1.03	1.04
EUROZONE	0.10*	0.05**	0.12*	0.06
URBAN	0.89			
INTERM	1.07			
Constant	1.67	29.42	0.40	7.54
Random effects				
Variance at country level	8.149	4.024	5.574	16.929
Variance at NUTS-2 regional level	0.892	0.405	0.697	1.267
Log-likelihood	−496.1	−114.4	−191.2	−199.7
p-value	0.000	0.000	0.000	0.000
Number of resilient regions	849	269	316	264

Notes: See Table 1 for a description of the determinants.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

Migration (*MIGR*) had a positive statistically significant relationship with regional resilience in all four models. The largest influence of migration was observed in rural areas: a 1% increase in the share of net migration to population increases the likelihood of rural regions to attain economic resilience by 9.2 times.

Sectoral structural characteristics seem to create a diverse effect on economic resilience across the urban–rural hierarchy. Agriculture has a positive effect in determining economic resilience in all four models and is statistically significant across the 1340 EU-27 regions and for rural and intermediate regions. On the contrary, a negative association of manufacturing (*MANUF*) with the ability of regions to withstand and recover from the recessionary impact appears across the 1340 EU-27 regions and for urban regions. Similarly, the negative effect of construction (*CONSTR*) on economic resilience was statistically significant only for urban areas.

Our empirical results indicated that the level of economic development (*GDP*) has a positive effect on the resilience of the 1340 EU-27 regions, and of urban and rural regions. The analysis also shows a negative influence of the ageing population (*AGE*) on the ability of rural regions to withstand the impact of recessionary shock, a relationship which is also statistically significant for all European NUTS-3 regions. The highest old-age dependency ratios were found in rural southern European regions, for example, EL643 – Evrytania, 55%; PT16H – Beira Baixa, 48%, and ES419 – Zamora, 46% (see Figure A1 in Appendix A in the supplemental data online).

Finally, the positive effect of accessibility (*ACCESS*) in shaping the economic resilience of European regions was found statistically significant across the 1340 regions and for the intermediate regions, while the positive effect of resilient neighbours (*NEIGHB*) was statistically significant only for the urban regions. In contrast, regions belonging to the Eurozone (*EUROZONE*) were found to be more vulnerable than non-euro area regions; this negative association was statistically significant, except for the rural regions.

Country-based economic resilience

The results of the country-based resilience analysis are reported in Table A5 in Appendix A in the supplemental data online. The magnitude of the effects of most of the determinants of the country-based resilience remain similar to the EU-based analysis for all four models. However, the statistical significance of some of the variables changed. More specifically, for the country-based analysis, the accessibility (*ACCESS*) is not a statistically significant determinant in any of the four models, while the positive effect of resilient neighbours (*NEIGHB*) in economic resilience becomes statistically significant across the EU-27 regions and for intermediate and rural regions. The most important

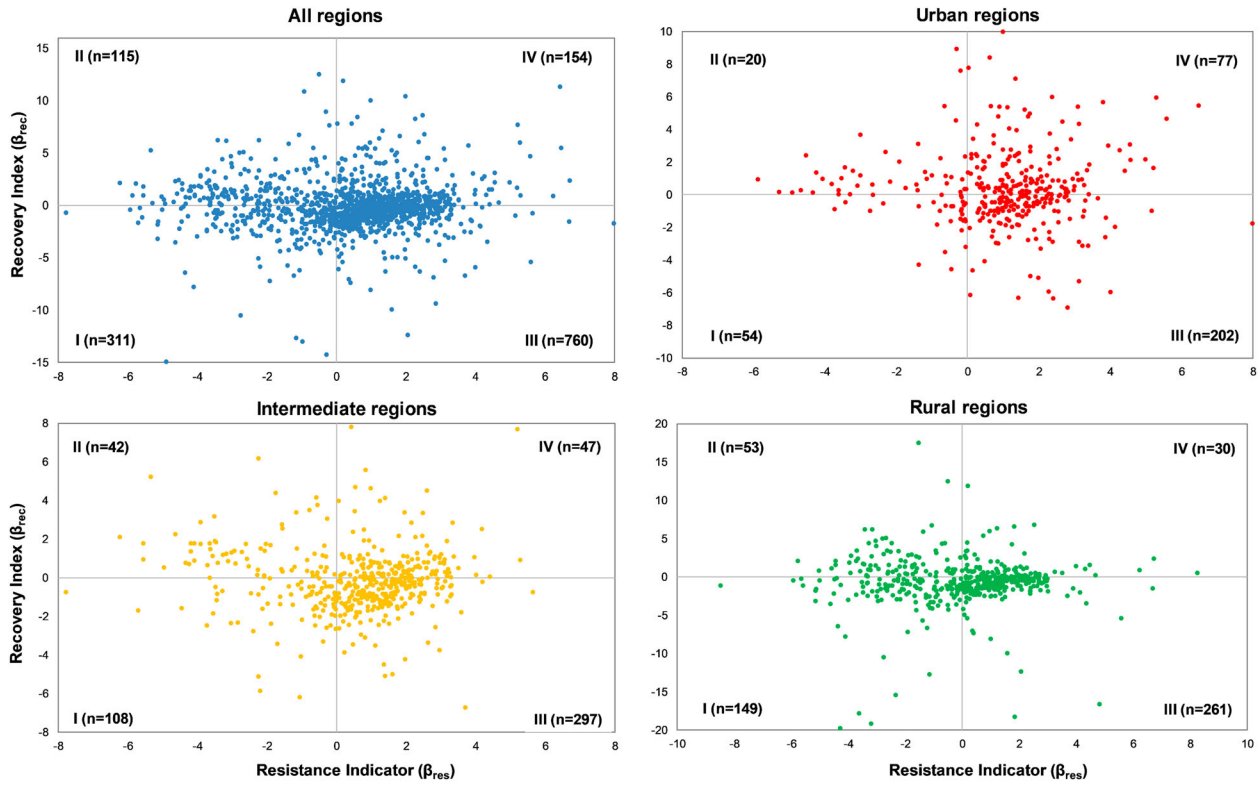

Figure 4. Scatterplot of regional resistance versus recovery.

changes are observed in urban areas; the country-based analysis confirms the negative impact of the ageing population (*AGE*) and construction (*CONSTR*) on the ability of urban regions to withstand and react to recessionary impact. For intermediate regions, the negative effects of manufacturing (*MANUF*), construction (*CONSTR*) and ageing population (*AGE*) on regional resilience became statistically significant. For rural regions, the only difference compared with the EU-based analysis was that the positive effect of economic development (*GDP*) on regional resilience was not anymore statistically significant. Considering that the share of resilient regions for the country-based analysis decreased for all region types (Table 2), these results indicate the robustness of the two models.

Resistance and recovery phases of resilience

The analysis of the resistance and recovery phases of resilience revealed that European NUTS-3 regions were unevenly distributed in the four quadrants with no correlation between the two phases across the urban–rural hierarchy (Figure 4). A total of 154 of 1340 European NUTS-3 regions (11%) exhibited high resistance with fast recovery (Group IV). This share is significantly higher for the urban regions (22%) and lower for the rural regions (6%), while it was intermediate for the intermediate regions (10%). The highest share of European NUTS-3 regions across all types of regions belongs to Group III, that is, regions with high resistance capabilities but slow recovery processes, relative to the EU average.

The results of the multinomial logistic regression model are reported in Table A6 in Appendix A in the supplemental data online. Similar to the results of the multilevel logistic regression model across all EU-27 regions, agriculture (*AGRIC*), ageing population (*AGE*), economic development (*GDP*), migration (*MIGR*) and Eurozone membership (*EUROZONE*) were statistically significant determinants for attaining high regional resistance and fast recovery. The positive effect of the presence of resilient neighbouring regions (*NEIGHB*) and the negative effect of the pre-crisis labour market performance (*EMPLO*) became now statistically significant determinants of regional economic resilience. Migration was again the factor with the highest positive contribution for attaining high resistance and fast recovery for all three region types. The largest influence of migration was observed in rural areas.

Synthesis of the determinants of the economic resilience of European NUTS-3 regions across the urban–rural hierarchy

The results of our empirical analyses revealed that migration is the factor that creates the greatest positive effect in the ability of regions to resist and recover from the economic downturn across the urban–rural spectrum, whereas the ageing population had a negative effect on regional resilience. Similarly, the resilience of EU-27 regions was positively associated with their level of economic development. The sectoral composition of regional employment created a diverse effect on regional economic resilience. On one hand our results confirmed the positive effect of agriculture in the ability of rural and intermediate regions to shape resilience capacities, on the other hand a negative association of the GVA share of manufacturing

and construction was revealed for the resilience of urban regions. Finally, regions belonging to the Eurozone were more vulnerable to recessionary impact than non-euro area regions.

DISCUSSION

The impact of the economic crisis was severe and strongly heterogeneous across European urban, intermediate and rural regions. Statistically significant differences in both EU- and country-based regional resilience were observed between urban and rural regions.

The drivers of resilience differed significantly between urban, intermediate and rural regions. The positive effect of agriculture in the ability of both intermediate and rural regions to withstand and recover from the economic downturn impact was confirmed in both EU- and country-based analyses. Faggian et al. (2018) and Holl (2017) also found a positive association of agriculture with the resilience of the local labour systems in Italy and Spain. Giannakis and Bruggeman (2017b) highlighted the resilience of agriculture during the recent economic crisis in Greece in terms of maintaining and increasing the number of employees in regional economies. Increasing the support for agricultural modernization and strengthening the training of European farmers could further increase the productivity and economic performance of European agriculture (Giannakis & Bruggeman, 2015, 2018).

Model results indicated that the GVA share of manufacturing is negatively associated with the resilience of urban regions. Lagravinese (2015) stressed the vulnerability of the sector during recessionary periods between 1970 and 2011 in Italy. Holl (2017) found that Spanish municipalities that specialized in the manufacturing industry in the pre-crisis period exhibited low resilience levels. Similarly, the GVA share of construction had a significant negative effect on the resilience of urban regions. Rivera (2012) noted that the recent recession in EU primarily hit regions with a high dependence on manufacturing and construction.

The ageing population (fraction of the population > 65 years to the population aged 15–64 years) was negatively associated with the resilience of NUTS-3 regions. For the EU-based resilience, this negative association is statistically significant for the rural regions, while for the country-based and the resistance-recovery phases of resilience it is significant across all region types and intermediate and rural regions, respectively. Lindh and Malmberg (1999) found that the 65-plus age group had a negative influence on the growth patterns of labour productivity (GDP per worker) of OECD countries between 1950 and 1990. Ezcurra and Rios (2019) explored the relationship between quality of government and regional resistance in the EU-27 and found a positive effect of the population cohort of 55–64 years in the ability of regions to withstand recessionary impact and a negative effect of the population cohort of 15–24 years.

All three analyses of different regional resilience indicators highlight that migration has the greatest positive effect on the ability of urban, intermediate and rural regions to shape economic resilience. The highest effect of migration is consistently observed for rural areas. Ghosh and Mastromarco (2018) found that the total factor productivity of US states is positively linked with skilled immigrant inflows. The interaction of incoming immigrants with the host state's existing human capital base improved state efficiency. The rising youth unemployment rates (< 25 years), for example, in 2013 Greece (58%), Spain (55%), Portugal (38%) and Cyprus (39%), have been strongly associated with the increasing mobility of youth from Southern European countries to Central–Northern Europe in search of better professional opportunities and quality of life (Bartolini, Gropas, & Triandafyllidou, 2017; Van Mol, 2016). The incipient economic recovery has not been able to reverse the new migration dynamics and trends generated by the economic crisis (González-Ferrer & Moreno-Fuentes, 2017). Thus, considering that the European regions are becoming older, since most of them, especially those belonging to Southern countries (Spain, Italy, Greece and Portugal), have negative growth rates (Figure 4), understanding the relationships between age structure, migration and economic resilience is of crucial importance.

Our analysis showed the positive association of the level of economic development with the resilience of the urban and rural European regions. Similar findings were econometrically confirmed for the NUTS-3 regions in Greece (Petrakos & Psycharis, 2016). Capello et al. (2015) showed that the presence of large cities in European regions is associated with a higher increase (or a lower loss) of GDP during the crisis, which results in greater economic resilience. Interestingly, the EU-based resilience analysis indicated a positive effect of accessibility in improving regional economic resilience for the intermediate European regions. Brakman et al. (2015) found that European commuting areas, that is, those between cities and rural areas, were more resilient to crisis than urban and rural areas. The interaction of those areas with the main cities improves the access to and exchange of knowledge, thus increasing the efficiency of local labour markets (Reggiani, Bucci, Russo, Haas, & Nijkamp, 2011). Finally, we found a negative effect of Eurozone membership on the capability of EU regions to resist and recover from the crisis. The relationship was statistically significant for urban and intermediate regions but not for rural areas, possibly because rural regions tend to be less well connected in terms of trade and business. This finding is consistent with existing literature. Holtermann and Hundt (2018) found that Eurozone membership reduces the ability of regions to recover mainly due to the unfitting monetary policy, that is, the lack of currency devaluation tools. Cainelli et al. (2018) showed that regional resilience behaviours and drivers can differ between regions belonging to euro area and non-euro regions.

In line with other studies (Crescenzi et al., 2016; Giannakis & Bruggeman, 2017a), our model results highlight the magnitude of the country effects in the ability of regions to withstand and recover from the economic crisis impacts.

These findings stress the importance of applying multilevel techniques for data sets characterized by a nested structure. Statistical methods that ignore the nesting structure of the data may result in biased standard errors, which in turn affect the tests of significance for the fixed effects (Chen, Kwok, Luo, & Willson, 2010). The country effects are much higher for rural areas than for urban and intermediate regions highlighting the dependence of rural employment dynamics on national-specific attributes and patterns, such as policies, institutional and societal factors, rather than on NUTS-2- and NUTS-3-specific factors. Although the role of national governments in designing regional development interventions is decreasing through the policy shift to the 'new paradigm of regional policy', which is place-based, multilevel, innovative and targeting to different types of regions (OECD, 2010), still the role of state in providing the fiscal and administrative framework for regional development policies is crucial and ensures the coordination among the multiple actors and systems at sectoral, territorial and governance levels.

CONCLUSIONS

This paper has made an empirical exploration of the temporal and spatial patterns of economic resilience between European urban, intermediate and rural regions and the significance of territorial and structural factors during the recent economic downturn and their short-term recovery. Our findings revealed that there are statistically significant differences in economic resilience across the urban–rural hierarchy for both EU- and country-based resilience. Model results indicated that migration is the factor with the greatest positive effect in regional resilience, whereas the ageing population had a strong negative effect on regional resilience. Both effects were highest for rural areas. Regional cohesion strategies fostering migratory movements across European regions can help regional economies across the urban–rural hierarchy to build greater resilience capabilities. Policy interventions to improve employment opportunities in non-resilient regions are needed to enhance their ability to maintain and attract young people. Our findings highlight the importance of agriculture for the resilience of rural and intermediate regions. Common Agricultural Policy tools can further enhance the viability of European agriculture, which can form a safety net for rural and intermediate regions against recessionary shocks and invigorate economic growth.

Although our findings suggest that there is scope for regional (NUTS-2) and subregional (NUTS-3) interventions, regional economic resilience is mostly influenced by attributes and strategies at the national level. Regions exhibit similar behaviour as other regions in the same country and this effect is most relevant for the rural regions. Moreover, the spatial dependence analysis of regional employment resilience revealed that spatial clusters with similar resilience levels across Europe exist, that is, clusters of low resilient regions are observed in countries such as Spain, Italy, Greece, Bulgaria and Romania, while clusters of high resilient regions are mainly present in Germany, Belgium and the UK. Considering that the development priorities and needs of European regions across the urban–rural hierarchy vary significantly, our findings suggest that rural development policy interventions should consider the national systemic structures, while more spatially targeted regional policies could be adopted for intermediate and urban regions.

Further research on the effect of the spatial spillovers on the ability of regions to withstand and recover from economic shocks through the application of a spatial multilevel regression model could improve our understanding of drivers and processes that shape the distributional patterns of economic resilience.

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