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FULL ARTICLE

Economic resilience and regionally differentiated cycles: Evidence from a turning point approach in Italy

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Abstract

The literature on regional resilience often neglects the timing of recessions and simply uses national cycles. Region-specific cycles and turning points might bias the results, however, and affect the choice of regions to target with policies. This paper investigates the geography and determinants of regional resilience with a regional turning point approach, using data for Italy, a country with a well-known and sizeable regional divide. The results show that the timing of regional cycles varies substantially and that the detected resilience determinants are different across the two approaches, implying that the policy levers may be wrongly estimated with national turning points.

KEYWORDS

Regional economic resilience, regional business cycle, turning points, regional policy, 3SLS

JEL CLASSIFICATION

R11, E32

1 | INTRODUCTION

Resilience is one of the most desirable phenomena in engineering, environmental studies, and social sciences, including economics and regional science. From an engineering standpoint, resilience refers to the resistance of an economic unit to unanticipated negative movements and the ability to achieve the pre-shock situation. The ecological perspective defines resilience rather as the long-term ability to stand robustly against the shocks and to absorb them adequately while not moving to a new equilibrium. Alternatively, an evolutionary or adaptive approach conceives of resilience as the capacity of the systems to reorient, reconfigure, and transform their structure to reach a superior and sustainable long-run equilibrium path (Boschma, 2015; Di Caro, 2017; Di Caro & Fratesi, 2018; Faggian et al., 2018; Fingleton et al., 2012; Folke et al., 2004; Giannakis & Bruggeman, 2015, 2017; Han & Goetz, 2015; Martin, 2012; Martin & Gardiner, 2019; Martin & Sunley, 2015; Modica & Reggiani, 2015; Pike et al., 2010; Simmie & Martin, 2010).

These definitions introduce three components of resilience: first, *resistance* of economies to shocks; second, speed of *recovery* from recessions; and, third, *adaptability* of economies by reorienting their economic and industrial structure to maintain a new long-run growth path (Bristow & Healy, 2018; Di Caro, 2017; Faggian et al., 2018; Fingleton et al., 2012; Folke, 2006; Folke et al., 2004; Foster, 2007; Fratesi & Perucca, 2018; Giannakis & Bruggeman, 2015, 2017; Han & Goetz, 2015; Hill et al., 2008, 2011; Martin, 2012; Pike et al., 2010).

The analyses of regional resilience may be biased, however, because almost all the literature so far analyses the different behaviours of regions by assuming that the regions are affected by the same shocks and follow the same national economic cycles, which implies that resilience is measured using the statistical national peaks (Faggian et al., 2018; Giannakis & Bruggeman, 2015, 2017; Martin, 2012; Sedita et al., 2017). The purpose of this study is to address an important shortcoming of the literature. Regions may have different cycles, and the fact that they belong to the same country and share the same currency and macroeconomic policy is not a sufficient condition for full cycle synchronization, as the literature on the syncing of national cycles following the start of the Euro shows (Camacho et al., 2006).

In the academic literature, the timing of the crisis for regions is, however, mostly defined on the basis of the national business cycle. The possibility of significant region-specific cycles and differential turning points is largely ignored, because these are difficult to detect with annual data, which is what is normally available at the regional level. However, failing to relax the assumption of synced regional cycles might seriously bias the results, as many regions might exhibit quite different timings from the national cycle. Indeed, a stream of scholars has explored large asymmetries across business cycles. Focusing mostly on the Eurozone, they have detected relatively heterogeneous business cycles (Montoya & De Haan, 2008).

This paper is intended to show the importance of pursuing resilience analyses on the basis of turning points specific to regions, but not to the national turning points, which may often be biased. The paper seeks to show explicitly the extent of the bias that occurs under national turning points and to show that this bias has important policy implications: (i) using national turning points might lead to the selection of some regions as being most affected by a crisis while others might be in a more severe recession; and (ii) using national instead of regional turning points can lead to wrongly estimating the determinants of regional resilience, resulting in the choice of less effective regional policy levers.

To the best of our knowledge, the implications of this shortcoming have never been addressed in the literature, and only a few papers have provided evidence of it. Indeed, only a small number of papers have focused on regional turning points, most of which focus on concordance, diffusion, and synchronization of the regional cycles with each other and with the national business cycle. Owyang et al. (2005), Hall and McDermott (2004), Duran (2014), and Magrini et al. (2013) represent some examples of this stream of scholars who analyse states in the US (except Hall & McDermott, 2004, who focus on regions in New Zealand). Only Sensier et al. (2016) have conducted an analysis for Europe, finding that regional cycles in Europe are inhomogeneous, although their analysis is constrained by annual data and does not look to region-specific determinants, nor specific policy implications. Some of this stream also study the underlying economic or spatial determinants of the bilateral synchronization of fluctuations (Magrini et al., 2013).

With regard to the structure of the paper, Section 2 presents an account of the existing studies. In Section 3, the aggregate and region-specific turning points are estimated using an adaption of Bry and Boschan's (1971) algorithm. The differences in regional and national turning points are presented in detail. In Section 4, the extent of the asymmetries and asynchronization across regional business cycles are shown with the help of bilateral cycle correlations, diffusion, and concordance indexes. In Section 5, regional resilience scores are computed using both national and regional turning points. The results are presented comparatively with illustrative graphs. To complement these comparisons, some statistical evidence of differences is provided. Section 6 investigates the economic and demographic determinants of regional resilience patterns using three-stage least squares (3SLS) regressions, and they are shown to differ under different turning points. Finally, Section 7 concludes the study by illustrating the relevance of the work for the choice of the regions to be assisted and the levers that must be selected for policies.

2 | LITERATURE REVIEW AND BACKGROUND

The issue of resilience has been thoroughly and heatedly debated in the economic literature. It is considered politically crucial, as systems lacking resilience suffer seriously high unemployment, welfare losses, poverty, in-utilization of the productive labour base and other related socioeconomic inadequacies (Fingleton et al., 2012).

Resilience is also important within countries, as different parts of the same country can show different rates of resilience. This was particularly evident after the financial crisis of 2007–2008, after which the term became widespread in the analysis of regional economies. Empirically, the literature has often focused on estimating the resilience levels of regions and exploring the geographical patterns. Some examples of these studies are Fingleton et al. (2012), who analysed the UK regions; Giannakis and Bruggeman (2017), who focused on 268 EU NUTS 2 regions over the period 2008–2013; Cellini and Torrisi (2014), who analysed Italian regions; Faggian et al. (2018), who focused on Italian local labor system over the period 2007–2011; Han and Goetz (2015), who studied the resilience across 3,138 US counties over the 2003–2014 period; Di Caro (2017), who analysed 20 NUTS 2 Italian regions over the period 1992–2012; Fratesi and Perucca (2018), who analysed the different patterns of resilience of NUTS 3 regions in Europe depending on territorial capital endowment; and Eraydin (2016)), who focused on the NUTS 2 Turkish regions during the 1987–2001 period. A general finding of this stream of research is the evidence of heterogeneity across regional resilience depending on their industrial structure, sectoral specialization, diversification, productive capacity, innovativeness, level of human and social capital, economic openness, and urban or rural setting, among other factors (Capello et al., 2015; Crescenzi & Rodríguez-Pose, 2011; Di Caro, 2017; Di Caro & Fratesi, 2018; Eraydin, 2013, 2016; Groot et al., 2011; Lagravinese, 2015; Ubago Martínez et al., 2019; van Bergeijk et al., 2017; van den Berg & Jaarsma, 2017). Moreover, there is new evidence that regional resilience is often different in different crises (Di Caro & Fratesi, 2022).

It is important to analyse the regional economic resilience patterns (see Sutton & Arku, 2022a, 2022b; Sutton et al., 2022). From a policy standpoint, it is essential to identify which regions are more resistant or characterized with high adaptive capacity and recovery. This information will be critical to determine the place-specific policies and related necessities (Fratesi & Perucca, 2019).

The problem of regional resilience has become topical again after the start of the global COVID-19 pandemic. This has been shown to have different effects on regions within the same country, with processes of spatial diffusion between one region and the other (Bloise & Tancioni, 2021; Bourdin et al., 2021; Paez et al., 2021). COVID-19 has caused not only a shock to human-health, but also it generated a socio-economic crisis which, even if international by definition, has had different effects on different countries and the different regions inside each country, in terms of magnitude, social groups affected and, especially relevant for this paper, timing (Crossley et al., 2021; Gong et al., 2020).

In the context of resilience, however, far fewer studies have used regional turning points. One such study was conducted by Sensier et al. (2016), who analysed the European regions. They estimated the turning points so as to determine the resilience patterns; however, they did not show explicitly how seriously the results may change under national and regional turning points, as the current paper proposes to do. Moreover, they used annual data, which masks many fluctuations. The current paper uses quarterly data, which is known to provide more accurate turning points.

Another study that uses the local turning points was carried out by Ringwood et al. (2019). They estimated the turning points (peaks) of US counties to calculate the degree of resilience to and recovery from the 2007–2009 global financial crisis (GFC). Again, while their approach is comprehensive, they do not compare the outcomes under national and local turning points, and they are uninterested in the consequences these outcomes might have for regional policy-making.

Regional business cycles are important and may exhibit far different evolutions from the national one. A number of researchers have found significant differences across the turning points of US regional economies (Duran, 2014; Magrini et al., 2013; Owyang et al., 2005). The differences across regional cycles as well as between the regional and national one (a-synchronicities) are often attributed to large dissimilarities in industrial structure (Krugman, 1991), inadequate financial and trade linkages (Frankel & Rose, 1998; Imbs, 2004; Kalemli-Ozcan et al., 2001), and the differences in labour market characteristics (Duran & Ferreira-Lopes, 2017). Thus, to avoid biased or misleading results in resilience analysis, one should refer to the regional pattern of business cycles rather than the national business cycle.

The case study chosen for this paper is Italy. It is a country of wide and long-standing regional disparities (Capello, 2016). Important policy efforts have been made to reduce the divide, with limited results (Dunford, 2002). Italy has also been investigated in a number of regional resilience analyses (Cainelli et al., 2019; Cellini & Torrisi, 2014; Di Caro, 2015, 2017; Terzo, 2021). Moreover, the country was seriously affected both by the public finance crisis that followed the GFC of 2007–2008 (Moro & Beker, 2016) and by the first wave of the pandemic in 2020 (Ascani et al., 2021).

The following sections will show that using regional turning points instead of national ones produces two important differences. The first is that the ordering of the regions most affected by an economic crisis is changed, meaning that policy initiatives to counteract crises will need to target different regions. The second is that the determinant of regional resilience may also be different, and so the policy targets may need to be changed.

3 | TURNING POINT ESTIMATION OF REGIONAL BUSINESS CYCLES

To illustrate the conceptual need for a turning point approach, it is helpful to illustrate it with an example. In Figure 1, the cycles are represented for Italy and three of its regions. The three regions are large and of similar size but show different patterns.

To perform the analysis, quarterly employment data were used. The data were collected over the period 1999:1–2020:2.[1] Two variables are generally used in the literature to measure resilience, namely GDP and employment. In this case, employment is focused on for two reasons. Conceptually, losses of employment are more linked with the actual suffering of regional inhabitants during a crisis (Fratesi & Rodríguez-Pose, 2016). Moreover, regional employment data are available quarterly, while GDP data are only available annually, which makes it hard to use GDP time-series techniques to detect cycles.

As Figure 1 shows, the national pattern of employment growth was positive until 2008-Q3, after which the financial crisis took its toll on the national economy and employment declined sharply. Between 2012 and 2014, another important loss of employment took place after the economic crisis involved the sovereign debt of the country, which required heavy restructuring of the national financial system. From the first quarter of 2014, however, a new period of employment creation took place, which led to a peak just before the start of the pandemic.

The national pattern was not followed by all regions, however. As Figure 1 shows, Veneto, a manufacturing region in the north of the country, experienced a similar pattern to the nation as a whole. The second region,

[1]The source of these data is ISTAT, the national statistical institute, Italy.

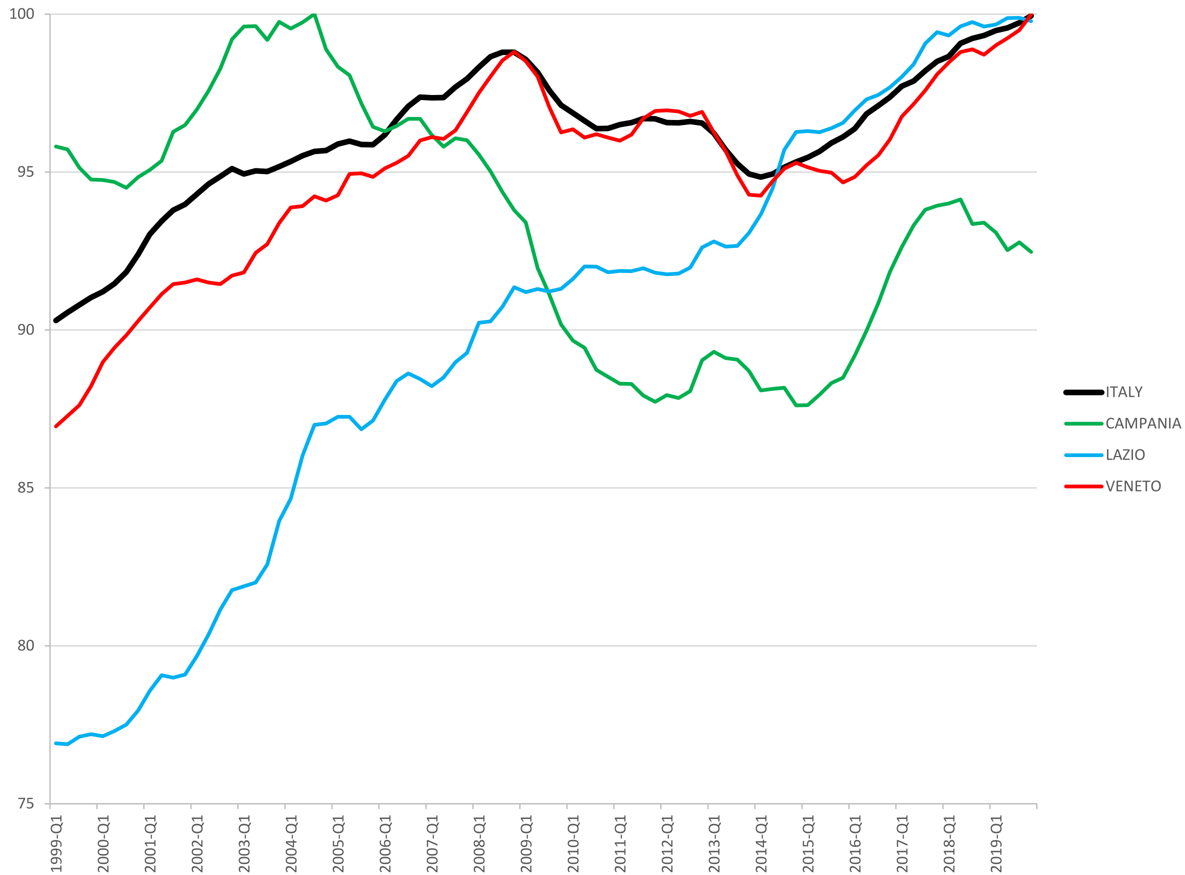

FIGURE 1 comparison of the employment growth pattern of different regions inside the same country. Each time series is standardized to have 100 when the maximum value of employment was reached. *Note*: Represented data are 4–Quarters moving averages. All cycles are standardized by levelling them to 100 to the quarter in which the maximum employment was reached. *Source*: Our elaborations on ISTAT data.

Campania, is a populous region in the South. The cycle of this region is different, as the peak in total employment was reached in 2004, and this region was already in a sharp decline pattern when the national crisis of 2008 started. After 2014, a growth pattern began, but it halted well before the pandemic in 2018. The third regional case is Lazio, a populous region in the centre of the country, which hosts the national capital, Rome. In this case, there has not been any real employment crisis, only periods of faster and slower growth; the wider economic crisis did not bring any decrease but just a temporary slowing down, consistent with the expectations for a region with large shares of public employment (Rodriguez-Pose & Fratesi, 2007).

The issue cannot be treated anecdotally. An initial fundamental analysis is needed to estimate the regional and aggregate level turning points.

A number of studies have tried to identify the phases of business cycles and turning points in national economies or common currency zones (Artis et al., 2004; Harding & Pagan, 2003; Magrini et al., 2013). However, far fewer studies have estimated the turning points for regional economies (the notable exceptions being Hall & McDermott, 2004; Owyang et al., 2005; Sensier et al., 2016). This lack of research was a motivation for the present study, even before coming to the analysis of resilience of the following sections.

There are two main, widely accepted methods for turning point detection. The first is a monthly algorithm proposed by Bry and Boschan (1971). It is designed to replicate the NBER's official monthly turning points for the US economy. Harding and Pagan (2003) converted this procedure to quarterly data (Harding & Pagan, 2002). The second method is Hamilton's Markovian regime-switching MSVAR model (Hamilton, 1989; Krolzig, 2001). It is assumed that growth varies across two different phases of the business cycle. The calculated probabilities of regimes release the turning points.

Although the more recent method is more in accordance with the data-generating process, the earlier one has been shown to provide accurate results (Bry & Boschan, 1971; Hamilton, 1989; Harding & Pagan, 2003; Krolzig, 2001; Owyang et al., 2005). The former method is thus employed in this study due its simplicity and intuitiveness. In principle, the Bry–Boschan routine searches for a local set of minima and maxima in the business cycle series while imposing certain limitations on the phase and cycle length (Duran, 2011). There are many intermediate steps, but the main procedure is as follows. The algorithm searches for sets of local minima and maxima in every five quarters (window length; Bry & Boschan, 1971; Duran, 2011, 2014). It imposes the restrictions that the minimum phase duration is at least two quarters and the minimum length of the cycle is at least five quarters (Bry & Boschan, 1971; Duran, 2011, 2014; Duran & Ferreira-Lopes, 2017; Harding & Pagan, 2002, 2003). At the final stage, the points identified in the first and last two observations are discarded and the procedure is completed.

The turning points of the Italian national economy and 20 NUTS 2 regions are estimated using quarterly employment data (seasonally adjusted and in natural logarithms).

The results for the national economy are presented in Table 1. As a benchmark, the estimated dates are compared to those declared by the OECD's report.[2] The OECD uses GDP as a reference series and the Bry and Boschan (1971) method.

The results indicate that the two chronologies are mostly consistent with each other. The BBQ algorithm matches all turning points estimated by the OECD while detecting five more additional turning points. There are moderate disparities between the dates. These differences seem plausible, since the OECD uses GDP as a reference variable, which might have different cyclical properties than employment.

The economic crises during 2008–2010 and 2011–2013 are detected. GFC was triggered by the failure of mortgage markets in the US (McKibbin & Stoeckel, 2010). The overvaluation of mortgage-backed assets created an artificial bubble. The downturn in expectations led to a collapse of the financial system, and so a serious drop was observed in GDP and employment in many countries. Sovereign debt crises were observed, particularly in Southern European economies, and Italy is among the countries heavily hit by both crises.

[2]This report can be seen at:
https://www.oecd.org/sdd/leading-indicators/CLI-components-and-turning-points.pdf

TABLE 1 Estimated turning points for Italian aggregate economy.

Turning points	BBQ	OECD
Peak	1999Q3	
Trough	2000Q1	1999Q1
Peak	2004Q4	2001Q1
Trough	2005Q3	2003Q3
Peak	2008Q2	2008Q1
Trough	2010Q3	2009Q2
Peak	2011Q1	2011Q2
Trough	2013Q3	2013Q2
Peak	2016Q2	
Trough	2016Q4	
Peak	2018Q2	2017Q4
Trough	2018Q4	
Peak	2019Q2	

Note: BBQ: Bry-Boschan-Quarterly.
Source: Own calculation/estimation, Bry and Boschan (1971) and https://www.oecd.org/sdd/leading-indicators/CLI-components-and-turning-points.pdf for turning points calculated by OECD.

A similar exercise in turning point estimation is performed for 20 NUTS 2 regions using the same parameters as in the national case. The results are presented in Table 2.

A heterogeneous timing of recessions across the regions is observed, including diverse timing of peaks and troughs and also many different idiosyncratic recessions and expansions. Hence, these results provide a visualization of the low synchronization between the regions.

4 | ASYMMETRIES IN ITALIAN REGIONAL BUSINESS CYCLES

The extent of differences in timing across regional business cycles is an important factor in this study (Duran, 2011). The presence of asynchronous cycles may imply the necessity of region-specific calculations of economic resilience indicators.

Studies on business cycle co-movement often find an increasing but still low cycle synchronization across the Eurozone (Artis & Zhang, 1999; Montoya & De Haan, 2008). The lack of co-movement is usually attributed to industrial dissimilarity (Krugman, 1991), weak financial integration (Kalemli-Ozcan et al., 2001), inadequate trade ties (Frankel & Rose, 1998; Imbs, 2004), and differential institutional and labour market characteristics (Duran & Ferreira-Lopes, 2017).

The business cycles in Italy show similarly substantial structural differences in economic oscillations across regions. Some examples of these studies are Mastromarco and Woitek (2007), focusing on the period 1951–2004, and Duran and Fratesi (2020), focusing on the period 1978–2016.

This section aims to demonstrate the degree of asynchronization among regional business cycles using three types of statistical indicators. The first is the bilateral Pearson's correlation calculated using the first differences of employment (in natural logarithms). The results are documented in Table 3. The last two rows highlight the average and standard deviation of the bilateral correlations across regions.

Although many high and low bilateral associations are observed, the level of correlation is low on average (0.14). This means that two regional cycles in Italy can scarcely move in a synchronous manner.

TABLE 2 Phases of regional business cycles.

	IT	ABR	BAS	CAL	CAM	EMR	FVG	LAZ	LIG	LOM	MAR	MOL	PIE	PUG	RD	SIC	TAA	TOS	UMB	VDA	VEN
1999-Q1																					
1999-Q2																					
1999-Q3																					
1999-Q4																					
2000-Q1																					
2000-Q2																					
2000-Q3																					
2000-Q4																					
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Note: Gray shaded periods are recessions, white periods are expansions.
Abbreviations: ABR, Abruzzo; BAS, Basilicata; CAL, Calabria; CAM, Campania; EMR, Emilia Romagna; FVG, Friuli-Venezia-Giulia; IT, Italy; LAZ, Lazio; LIG, Liguria; LOM, Lombardia; MAR, Marche; MOL, Molise; PIE, Piemonte; PUG, Puglia; RD, Sardegna; SIC, Sicilia; TAA, Trentino-Alto Adige; TOS, Toscana; UMB, Umbria; VDA, Valle D'Aosta; VEN, Veneto.
Source: Own calculation/estimation.

TABLE 3 Bilateral cycle correlation.

Regions	IT	ABR	BAS	CAL	CAM	EMR	FVG	LAZ	LIG	LOM	MAR	MOL	PIE	PUG	RD	SIC	TAA	TOS	UMB	VDA
ABR	0.12																			
BAS	0.37	0.1																		
CAL	0.29	−0.1	−0.04																	
CAM	0.47	0.16	0.2	0.02																
EMR	0.51	−0.22	0.4	0.02	0.1															
FVG	0.46	0.16	0.36	0.08	0.04	0.18														
LAZ	0.54	0.01	0.13	0.15	0.3	0.12	0.22													
LIG	0.18	−0.08	0.07	0.09	−0.03	−0.03	0.3	0.1												
LOM	0.59	−0.13	0.01	0.11	0.19	0.5	0.07	0.01	0.1											
MAR	0.42	0.07	0.1	−0.1	0.15	0.11	0.18	0.14	−0.01	0.25										
MOL	0.32	0.02	0.23	0.14	0.26	0.29	−0.02	−0.07	−0.11	0.33	0.28									
PIE	0.38	0.01	0.21	0.14	−0.01	0.04	0.04	0.27	0.13	0.1	0.26	0.12								
PUG	0.6	0.17	0.28	0.17	0.25	0.22	0.3	0.28	0.03	0.18	0.27	0.05	0.27							
RD	0.52	0.08	0.23	0.18	0.02	0.15	0.44	0.32	0.16	0.14	0.12	0.07	0.22	0.37						
SIC	0.42	−0.05	−0.12	0.37	0.13	−0.01	0.02	0.23	0.2	0.29	0.14	0	0.17	0.18	0.21					
TAA	0.45	0.09	0.37	0.02	0.32	0.23	0.29	0.21	0	0.2	0.12	0.16	0.24	0.27	0.33	−0.08				
TOS	0.58	0.15	0.42	−0.1	0.13	0.41	0.4	0.18	−0.02	0.33	0.27	0.23	0.12	0.33	0.31	−0.01	0.27			
UMB	0.07	0.26	0	0.01	−0.31	−0.08	0.25	−0.07	0.06	0.02	0.19	0.06	0.01	0.04	0.05	0.08	−0.16	0.2		
VDA	0.23	−0.07	0	0.13	0.03	−0.01	0.24	−0.05	0.2	0.09	0.21	0.19	0.06	0.08	0.28	0.12	0.18	0.2	0.04	
VEN	0.63	0.06	0.15	0.15	0.31	0.39	0.35	0.23	0.02	0.37	0.24	0.28	0.08	0.18	0.22	0.12	0.32	0.4	0.01	0.3
Mean	0.14																			
SD	0.14																			

Abbreviations: ABR, Abruzzo; BAS, Basilicata; CAL, Calabria; CAM, Campania; EMR, Emilia Romagna; FVG, Friuli-Venezia-Giulia; IT, Italy; LAZ, Lazio; LIG, Liguria; LOM, Lombardia; MAR, Marche; MOL, Molise; PIE, Piemonte; PUG, Puglia; RD, Sardegna; SIC, Sicilia; TAA, Trentino-Alto Adige; TOS, Toscana; UMB, Umbria; VDA, Valle D'Aosta; VEN, Veneto.

Source: Own calculation/estimation.

The second statistical indicator is a diffusion index (Figure 2). It indicates how well the recessions are diffused among the regions of the country. It is expressed mathematically in the following way (Duran, 2011, 2014; Hall & McDermott, 2004; Owyang et al., 2005):

$$D_{i,j} = \frac{\sum_{i=1}^{20} s_{i,t}}{20},$$

where s denotes the recessions and takes the value 1 when the region i is in crisis (recession), 0 otherwise. The D statistic indicates the percentage of regions in recession and reveals the diffusion level of crisis. This measure is also used by several studies on US states, such as Owyang et al. (2005) and Duran (2014), and Hall and McDermott (2004) on New Zealand's regions. Similar to their findings, Figure 2 shows that the recessions are weakly diffused within the country, particularly during the recession 2011–2013. During the national peak of the 2008–2009 and 2011–2013 crises, almost 40% of regions did not experience an employment decrease. Even in the mid-point of both recessions, the diffusion level is about 80%. At the national through dates, about 50% of the regions are in recession, while others are experiencing an expansion phase. Hence, the timing of the recessions is observed to be heterogeneous across regions.

The third indicator of synchronization is the concordance index, defined as follows (Duran, 2014; Harding & Pagan, 2003; Owyang et al., 2005):

$$C = \sum_{t=1}^{T} [S_{i,t} S_{nat,t} + (1 - S_{i,t})(1 - S_{nat,t})]/T,$$

C shows the percentage of quarters in which region i and the national economy are in the same business cycle phase. T denotes time periods. $C = 1$ implies full synchronization; that is, region i and the national economy are always in the same phase). In contrast, $C = 0$ implies full asynchronization; that is, region i is never in the same business cycle phase as the national economy (Duran, 2014; Harding & Pagan, 2003; Owyang et al., 2005).

This ratio is calculated for regions and presented in Table 4. The results show low concordance rates. The minimum concordant region is the Friuli-Venezia Giulia (FVG), with a score of 0.53, and the maximum concordant region

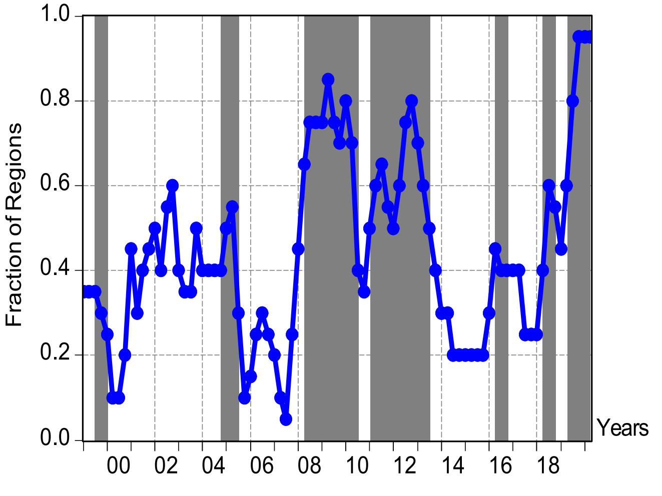

FIGURE 2 Regional diffusion of recessions. *Source*: Own calculation/estimation.

TABLE 4 Concordance index of regions.

Region	Concordance	Region	Concordance
ABR	0.686	MOL	0.593
BAS	0.686	PIE	0.767
CAL	0.628	PUG	0.709
CAM	0.628	RD	0.709
EMR	0.651	SIC	0.663
FVG	0.535	TAA	0.663
LAZ	0.721	TOS	0.628
LIG	0.698	UMB	0.651
LOM	0.686	VDA	0.581
MAR	0.651	VEN	0.779
Mean	0.666	Max	0.779
SD	0.059	Min	0.535

Abbreviations: ABR, Abruzzo; BAS, Basilicata; CAL, Calabria; CAM, Campania; EMR, Emilia Romagna; FVG, Friuli-Venezia-Giulia; IT, Italy; LAZ, Lazio; LIG, Liguria; LOM, Lombardia; MAR, Marche; MOL, Molise; PIE, Piemonte; PUG, Puglia; RD, Sardegna; SIC, Sicilia; TAA, Trentino-Alto Adige; TOS, Toscana; UMB, Umbria; VDA, Valle D'Aosta; VEN, Veneto.
Source: Own Calculation/Estimation.

is Veneto with a concordance rate of 0.78. The average rate is 0.66, which means that in 66% of the quarters, one region is in the same phase as the national economy, and in 34% of the quarters they are in different phases.

Similar analyses have been made by various scholars. sectional regression model and Granville (2017) analysed European countries' business cycles over the period 1961–2013 and found that, most recently, the concordance index is 0.67 for the 1993–2002 period, 0.75 for 2003–2008, and 0.96 for 2009–2013. Similarly, focusing on concordance among US states, Duran (2014) found it to be 0.73 for 1993–2008, and Owyang et al. (2005) found it to be 0.8 for the period 1979–2002.

Compared to these benchmark studies, the values in this study are lower, indicating once more the severity of heterogeneity across regional cycles and how seriously the results on economic resilience might be biased if national turning points are used instead of region-specific ones.

5 | MEASURING REGIONAL DIFFERENCES IN ECONOMIC RESILIENCE

In the regional resilience measurement, four different ratios are computed and summarized in Table 5.

First, sensitivity measure (which represents 1-resistance) is defined by the percentage loss in regional employment at trough compared to the previous peak level (Faggian et al., 2018; Fingleton et al., 2012; Giannakis & Bruggeman, 2015, 2017; Han & Goetz, 2015; Martin, 2012; Sensier & Artis, 2016; Sensier et al., 2016).

Second, the recovery index is defined by the period (quarter) length required to reach the previous peak level of regional employment. The index is defined in categories, since there are some regions which have not yet had a trough after the crisis in 2008.

Third, adaptability is defined as the per quarter average growth rate of regional employment through to about 2013 until the most recent peak of the region.

Finally, resistance, recovery, and adaptability scores are converted into relative values by applying (X-Min)/(Max-Min), where X is the value to be converted (Chhaochharia et al. 2020). Then the three relative indicators are

TABLE 5 Definition of resilience scores.

Type of Resilience	Definition
Resistance	Resistance = 1- Sensitivity Index Sensitivity index= $\left(E_{peak} - E_{through}\right)/E_{peak}$ (Faggian et al., 2018; Fingleton et al., 2012; Giannakis & Bruggeman, 2015, 2017; Han & Goetz, 2015; Martin, 2012; Sensier & Artis, 2016; Sensier et al., 2016) E: Employment
Recovery	n = time passed (in quarters) after the peak level of employment about 2008 until restoring the previous peak level. It is expressed in terms of categories: (0) no recovery yet, (1) recovery in [40.30) quarters, (2) recovery in [30.20) quarters, (3) recovery in [20.10) quarters, (4) recovery in [10.0) quarters, (5) already recovered (or no recession to recover) (Faggian et al., 2018; Fingleton et al., 2012; Giannakis & Bruggeman, 2015, 2017; Han & Goetz, 2015; Martin, 2012; Sensier & Artis, 2016; Sensier et al., 2016)
Adaptability	Per quarter average growth rate of employment between the through about 2013 until the most recent peak. (Faggian et al., 2018; Fingleton et al., 2012; Giannakis & Bruggeman, 2015, 2017; Han & Goetz, 2015; Martin, 2012; Sensier & Artis, 2016; Sensier et al., 2016)
Composite Resilience Index	Firstly, *resistance, recovery and adaptability* scores are converted into relative values by applying: *(X-Min)/(Max-Min)* where X is the value to be converted. Then 3 relative indicators are chained by taking averages and composite resilience indicator is constructed. (Faggian et al., 2018; Fingleton et al., 2012; Giannakis & Bruggeman, 2015, 2017; Han & Goetz, 2015; Martin, 2012; Pontarollo & Serpieri, 2020; Sensier & Artis, 2016; Sensier et al., 2016)

Note: Recession Matching Criterion: Maximum 2 leads in peak, maximum 2 lags in trough, from national peak of 2008 to national trough of 2013 is assumed.
Source: Own creation.

chained by taking averages, and a composite resilience indicator is constructed. Details of these calculations are shown in Table 5.

The two national recessions are assumed to be unique recessions. Hence, this study uses the regional peak levels corresponding to the start of the 2008–2009 crisis and the regional trough levels corresponding to the end of the 2011–2013 crisis The corresponding four resilience indicators are calculated using national and regional turning points. The results are plotted in Figures 3–5 (maps) and in Table 6 (for recovery, for which a map would be less informative).

In regard to *resistance* (Figure 3), there is a relatively strong correspondence between the results obtained under national and regional turning points, with some exceptions, most notably Puglia and Basilicata. A North–South (Mezzogiorno) dualism is clearly observed, with regions in the North and Mezzogiorno seemingly more resistant to the crises. In other words, these regions experience a smaller decrease in employment between peak and trough levels. The most resistant regions are Lazio (resistance score: 1.00), Trentino Alto Adige (0.88), and Lombardia (0.88), which experience approximately only 0–2% loss in employment. In contrast, Southern regions and islands located in the periphery (Sicilia, Sardegna) are more vulnerable and less resistant to the crises. The three least resistant regions are Calabria (0.82), Molise (0.85), and Sicilia (0.87), with a high loss in employment (18%, 15%, and 13%, respectively).

With respect to *recovery* (Table 6), quite different patterns are observed across the scores calculated under different turning point types. When national turning points are employed, no distinct geographical pattern is observed. However, once the region-specific turning points are used, Mezzogiorno-North–South dualism becomes more clear. Some Northern regions, especially Mezzogiorno, seem to be fast recovering zones, while most of the Southern regions are slow or not recovering. In detail, central and Northern regions such as Lazio, Liguria, Marche, Trentino-Alto Adige, and Valle D'Aosta recover fast in 0–10 quarters. In contrast, Southern regions such as Sicilia, Sardegna, Calabria, Puglia, Molise, and Abruzzo have not yet recovered. What is more striking is that there are five regions (four

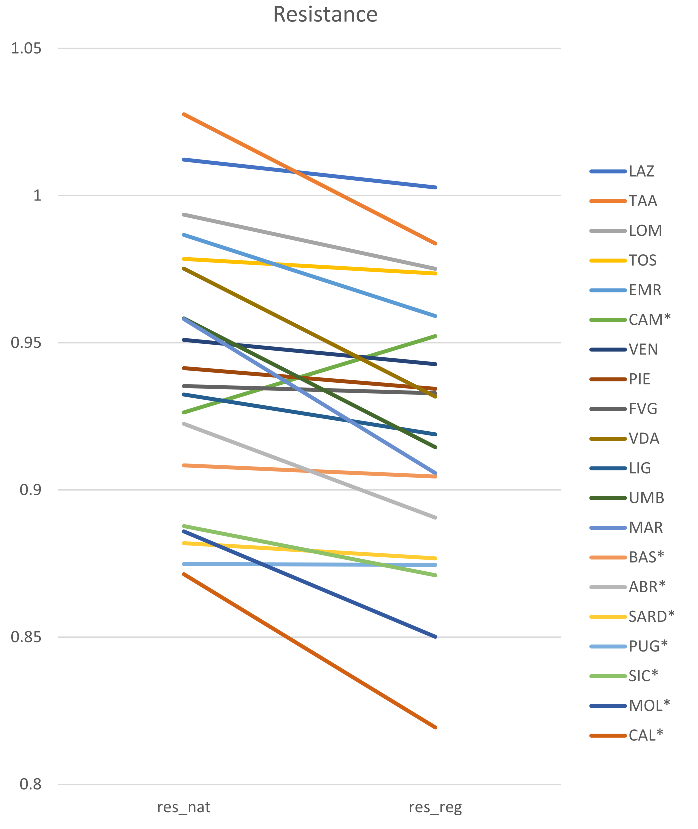

FIGURE 3 Regional patterns of resistance. *Note*: * Indicates regions belonging to the poorer part of the country, the southern Mezzogiorno. *Source*: Own calculation/estimation.

in the lagging Mezzogiorno) that seem to have had no recovery in terms of national turning points and that have experienced no recovery yet in terms of regional turning points.

In regard to the *adaptability* patterns (Figure 4), the dualism is more obvious when regional turning points are used. Southern regions seem to be more adaptable to a high growth path. The faster growth pattern is observed in Molise, Sardegna, Calabria, Campania, and Lazio, whereas the slowest growth pattern is observed in Valle D'Aosta, Lombardia, Liguria, Sicilia, and Umbria. Moreover, some regions' ranking changes significantly, most notably Puglia, but also Umbria and Basilicata.

Finally, *composite resilience scores* provide an overview (Figure 5). Sizable differences can be observed between the scores obtained under national and regional turning points. For the later ones, the regions in Mezzogiorno and the North East seem to have more resilience, whereas Southern regions are less resilient. The most resilient regions are Lazio, Trentino Alto Adige, and Marche, with resilience scores of 0.83, 0.79, and 0.64, respectively; the least resilient ones are Sicilia, Umbria, and Puglia, with resilience scores of 0.16, 0.19, and 0.26, respectively.

These results deviate from those of previous studies on Italy in two important respects. First, previous empirical studies on Italian regions have found a North–South dualism. However, the analyses in this study point to some regions of Mezzogiorno as being more resilient than the average. Second, the analyses conducted under national turning points yield remarkably different results from those implemented under regional turning points, particularly in recovery but also moderately in adaptability and the composite resilience index. To support this result, several tests are applied to examine the significance of the differences:

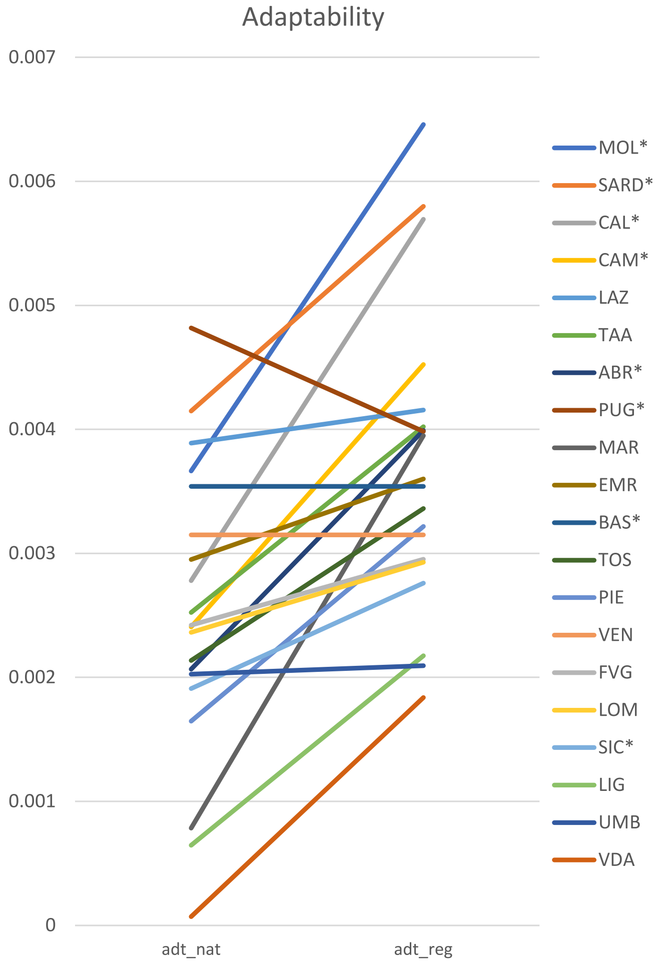

FIGURE 4 Regional patterns of adaptability. *Note*: * Indicates regions belonging to the poorer part of the country, the southern Mezzogiorno. *Source*: Own calculation/estimation.

> **H1.** The resilience score distributions computed by using national and regional turning points are identical.

> **H2.** The resilience score distributions computed by using national and regional turning points are not identical.

Kolmogorov–Smirnov (KS) tests are applied along with bi-lateral correlations, and some descriptive statistics are provided (Kolmogorov, 1933; Smirnov, 1939, 1948). The results are presented in Table 7.

The KS tests indicate significant differences in two resilience types (recovery and adaptability) between the results under the two different turning points. The correlation coefficients are also informative. In the *resistance* context, the results under the two different assumptions are almost perfectly correlated (0.9). However, this correlation is weak for *recovery* (0.32), low for the *composite resilience* index (0.45), and moderate for *adaptability* (0.6).

This section has shown the importance of considering regional turning points, since the rankings of the regions in crisis can be radically different between the two approaches.

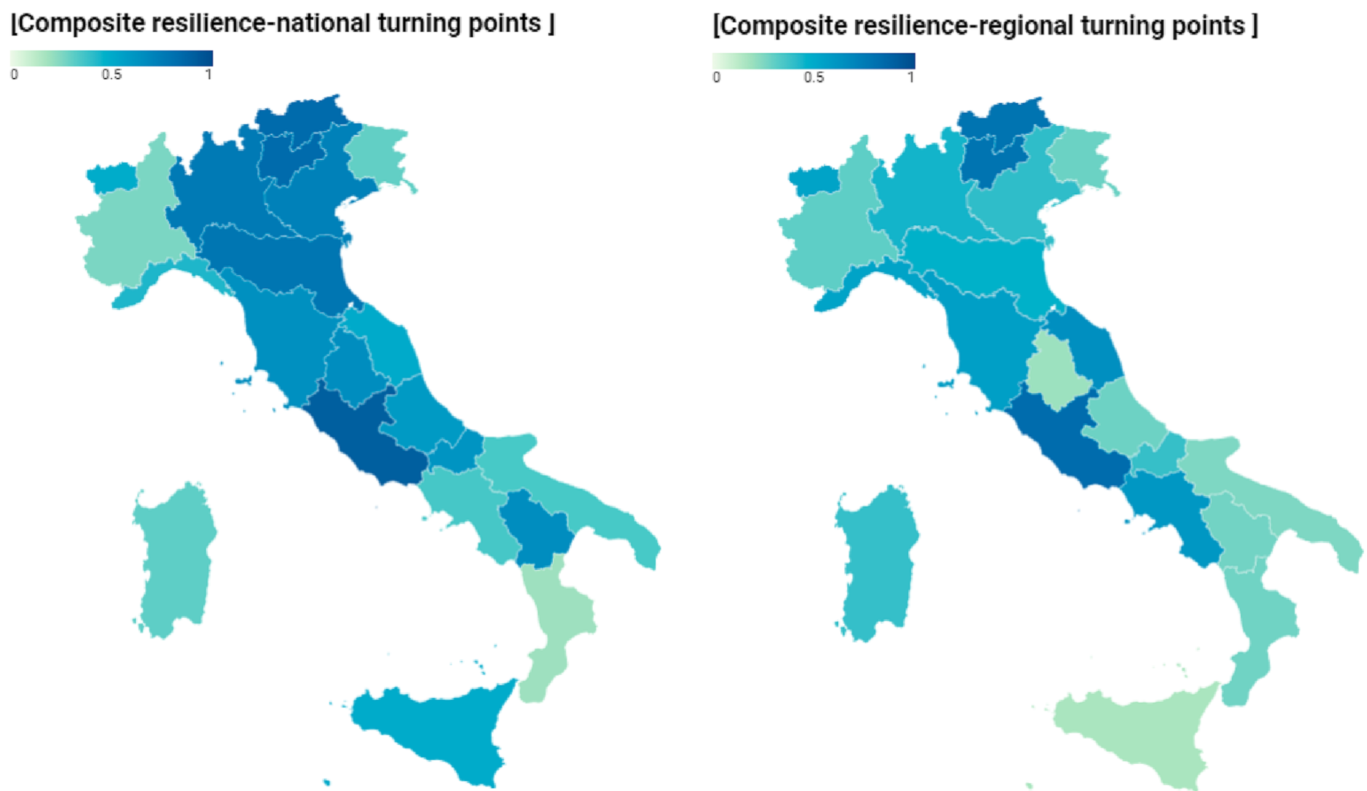

FIGURE 5 Geographical pattern of composite resilience index. *Source*: Own calculation/estimation. *Note*: the maps are prepared by using the online tool at www.datawrapper.de

TABLE 6 Regional patterns of recovery, based on number of quarters (number of regions and names).

		Regional turning points						
		no recovery yet	[40,30)	[30,20)	[20,10)	[10,0)	Nothing to recover	*Total*
National turning points	no recovery yet	**5** **CAL*** **FVG** **PIE** **PUG*** **SARD***						*5*
	[40,30)			**1** **CAM***				*1*
	[30,20)							
	[20,10)							
	[10,0)			**1** **TOS**		**3** **LIG** **MAR** **VDA**		*4*
	Nothing to recover	**5** **ABR*** **BAS*** **MOL*** **SIC*** **UMB**	**3** **EMR** **LOM** **VEN**			**2** **LAZ** **TAA**		*10*
	Total	*10*	*3*	*2*		*5*		*20*

Note: * Indicates regions belonging to the poorer part of the country, the southern Mezzogiorno.
Abbreviations: ABR, Abruzzo; BAS, Basilicata; CAL, Calabria; CAM, Campania; EMR, Emilia Romagna; FVG, Friuli-Venezia-Giulia; LAZ, Lazio; LIG, Liguria; LOM, Lombardia; MAR, Marche; MOL, Molise; PIE, Piemonte; PUG, Puglia; SAR, Sardegna; SIC, Sicilia; TAA, Trentino-Alto Adige; TOS, Toscana; UMB, Umbria; VDA, Valle D'Aosta; VEN, Veneto.
Source: Own calculation/estimation.

TABLE 7 Comparative tests.

Indicators	res_nat	res_reg	rec_nat	rec_reg	adt_nat	adt_reg	comp_nat	comp_reg
Max	1.027625	1.002818	5	4	0.004819	0.006458	0.902014	0.833834
Min	0.871423	0.819348	0	0	6.99E-05	0.001838	0.190259	0.160542
Mean	0.940484	0.92073	3.35	1.35	0.002497	0.00371	0.541072	0.431744
SD	0.046448	0.047625	2.183069	1.694418	0.001195	0.001221	0.205946	0.188427
Paired T-Test	0.000215325***		0.0004828174***		3,64672E-05***		0.014	
Kolmogorov–Smirnov (D-Stat)	0.2		0.5***		0.45**		0.3	
Pearson correlation	0.902762		0.320852		0.6029		0.45	

Source: Own calculation/estimation.

6 | DETERMINANTS OF REGIONAL RESILIENCE

This section explores the underlying determinants of cross-regional variation in regional resilience. Section 6.1 explains the methodology and data issues, and the results are discussed in Section 6.2.

6.1 | Methodology

6.1.1 | Econometric model

The adapted cross-sectional regression model is as follows:

$$R_{i,j} = R_i - R_j = \gamma + \delta E_{i,j} + \theta D_{i,j} + \emptyset 1 d_{i,j} X\, dist_{i,j} + \emptyset 2\, dist_{i,j} + \varepsilon_{i,j},$$

where $R_{i,j}$ represents the difference in resilience score between regions *i* and *j*; *E* denotes the class of economic variables (which will be explained below); *D* represents the demographic variables; $d_{i,j}$ is a dummy indicator that equals 1 if region *i* has a higher resilience score than region *j* and 0 otherwise. Finally, *dist* represents the bilateral distance between regions *i* and *j*.

In this regression, pairs of regions are used as observational units. There are 190 pairs (observations) in total. One reason for this choice is the lack of data (only 20 regions) for a classical cross-sectional analysis. Another reason is that estimating the impact of the distance between the two regions on resilience is possible with this specification.

6.1.2 | Data and variables

The dependent variable $R_{i,j}$ represents the difference in resilience score between regions *i* and *j*. All four resilience types are used, since they are expected to have different determinants (Fratesi & Perucca, 2018) for *resistance*, *recovery*, *adaptability*, and the *composite index*. These scores are used in two types, calculated under national and regional turning points. Hence, eight dependent variables are used.

Independent variables are divided into two main categories: economic and demographic variables.

Starting with *economic* variables, industrial mix of regions are claimed to be critical for resilience. The details of the independent variables are summarized in Table 8 and explained below.

TABLE 8 Definitions of independent variables.

Variables	Definition	Unit	Source
Innovativeness	regional innovativeness: patent applications per million inhabitants (in ln) obtained from Eurostat.	Ratio	Eurostat (https://ec.europa.eu/eurostat)
Diversity	Diversity Indicator: (Duranton & Puga, 2000; Herfindahl, 1950; Hirschman, 1964): $Diversity = 1 - \sum_{i=1}^{k} S_i^2$ where $\sum_{i=1}^{k} S_i^2$ represents a Herfindahl Index. s is the GVA share of 29 sectors of regions	Index	ISTAT (https://www.istat.it/en/)
Density	Population density (in ln)	Number of inhabitants per kilometersquare	Eurostat (https://ec.europa.eu/eurostat)
Education	percentage of people who had tertiary education in population (25–64 age) (in natural logs)	Percentage	Eurostat (https://ec.europa.eu/eurostat)
Active population	share of active population (25–64 age group) (in natural logs) in total population	Percentage	Eurostat (https://ec.europa.eu/eurostat)
Manufacturing sector	share of manufacturing in regional GVA (in natural logs)	Percentage	ISTAT (https://www.istat.it/en/)
Public sector	share of public sector in regional GVA (in natural logs)	Percentage	ISTAT (https://www.istat.it/en/)
Financial sector	share of finance sector in regional GVA (in natural logs)	Percentage	ISTAT (https://www.istat.it/en/)
Social Capital	The social capital indices were obtained from the study by (Cartocci, 2007; Fratesi et al., 2019)	Indices	(Cartocci, 2007; Fratesi et al., 2019)
Distance	Distance between the regions (in ln)	kilometers	ARCMAP, ARCGIS

In regard to the sectoral or industrial variables, credit-dependent sectors (e.g., manufacturing, finance) are known in the literature to be cyclically more sensitive (Carlino et al., 2003, 2013; Duran, 2017; Owyang & Wall, 2009; Rodriguez-Pose & Fratesi, 2007). Hence, the regions that include a higher share of these sectors may be worse affected by the recession. To capture such an effect, the differences between two regions in the share of *manufacturing* and *finance* in regional gross value added (GVA; in natural logs) are included. In contrast, some sectors, such as the *public sector*, are supposed as more protected from recessions, as public workers are difficult to lay off and can only mildly be affected by fluctuations (Fratesi & Rodríguez-Pose, 2016; Trigilia, 1992). Its share is included in regional GVA. These industrial variables are obtained from ISTAT for 2008. In support of these hypotheses, Feyrer et al. (2007), Fingleton et al. (2012), Rivera (2012), and Lagravinese (2015) have claimed that manufacturing has been hit more seriously by recessions.

Diversity of economic activities is another independent variable. According to many researchers, diversification of industries provides stability and resilience. In an economic environment with a variety of sectors, industry-specific shocks are easily mitigated, as the decline of some sectors is compensated by the increase of employment in others. (Kort, 1981; Malizia & Ke, 1993). In a similar vein, diversification is perceived as a source of adaptive capacity (Pike et al., 2010). Furthermore, greater resistance is observed in these regions, as the diversification spreads the risk and the diversity of sectors creates a risk-sharing mechanism (Christopherson et al., 2010; Eraydin, 2013, 2016; Giannakis & Bruggeman, 2015, 2017; Lee, 2014; Martin, 2012). The diversity indicator used in this paper is as follows (Duranton & Puga, 2000; Herfindahl, 1950; Hirschman, 1964):

$$Diversity = 1 - \sum_{i=1}^{k} S_i^2,$$

where $\sum_{i=1}^{k} S_i^2$ represents a Herfindahl index; *s* is the GVA share of sectors in regional economies. In its calculation, 29 different sectors data are used. Bilateral differences in the diversity indicator are used as an independent variable.

Disparity in the *innovativeness* between the two regions is used as another important variable. In the literature, innovativeness has been claimed to induce regional resilience (Bramwell et al., 2008; Eraydin, 2013, 2016; Giannakis & Bruggeman, 2015, 2017). state that high-tech clusters are more resilient. Crespo et al. (2014) emphasize the critical role played by knowledge networks, and similar arguments are put forward by Christopherson et al. (2010). As a measure of regional *innovativeness*, the present study uses patent applications per million inhabitants (in logs) obtained from Eurostat.

As a final economic variable, bilateral disparity in *social capital* is used (Putnam, 1995). The social capital indices were obtained from the study by Cartocci (2007), also used by Fratesi et al. (2019). This index is calculated by aggregating various related indicators.

With respect to the demographic variables, one variable is the population density, *popdens*, obtained from Eurostat. Urbanized areas are claimed to be more vulnerable to the crisis (Eraydin, 2013, 2016; Giannakis & Bruggeman, 2015, 2017). Dijkstra et al. (2015) state that more urbanized European areas were observed to be more sensitive to GFC, possibly because real estate activities are more intense, which is seen as the source of the crisis (Giannakis & Bruggeman, 2015, 2017). Population density is defined as the difference between two regions in the number of people per square kilometre (in natural logs).

Another demographic variable is the differences across regions in the active population (25–64 age group; in natural logs), obtained from Eurostat. A larger active population indicates more supply of labour and hence employment. Productive activities are enhanced by more active labour. Thus, regions with a proportionally larger labour force are likely to have higher resilience.

Human capital is the final demographic variable. An educated labour force helps generate creativity, productivity, knowledge, and absorption of shocks (Crescenzi et al., 2016; Crescenzi & Rodríguez-Pose, 2011; Di Caro, 2017; Eraydin, 2013, 2016; Faggian & McCann, 2009; Giannakis & Bruggeman, 2015, 2017). This variable is measured as the disparity between two regions in the portion of the population who have had tertiary education (25–64 age; in natural logs), obtained from Eurostat.

Finally, the last independent variable is the *distance* between the two regions. The impact of distance is measured by $\emptyset 1 d_{i,j} X\, dist_{i,j} + \emptyset 2 dist_{i,j}.$ $d_{i,j} = 1$ if region *i* has a higher resilience score than region *j*, and 0 otherwise.

It captures the impact with the following mechanism as shown in Figure 6 (Magrini et al., 2013).

If region *i* has a higher resilience score than region *j*, $d_{i,j} = 1$, it corresponds to the positive (upper) side of the diagram. The impact of distance is represented by $\emptyset 1 + \emptyset 2$. Its expected sign is negative. If $d_{i,j} = 0$, it corresponds to the negative (lower) side of the diagram. The impact of distance is represented by $\emptyset 2$ (expected to be positive).

In the regression specification, diversity and innovation variables are included as endogenous variables. This comes from the literature in which both types of variable are commonly accepted as endogenous (Alam & Adeyinka, 2021; Coulson et al., 2020; Rodriguez-Pose & Crescenzi, 2008; Yin & Sheng, 2019). They are also theoretically plausible endogenous variables, since both variables may be argued to have circular or simultaneous relationships between many economic, demographic, and industrial variables.

Moreover, bilateral differences in income *per capita* and population are used as instrumental variables. Both variables should be considered as exogenous, as they represent a structural characteristic of a country. In other words, *per capita* income and population represent the level of welfare and the size of the population. They are mostly structural, although they can change from year to year. The cross-country or cross-regional mobility of these variables is quite limited.

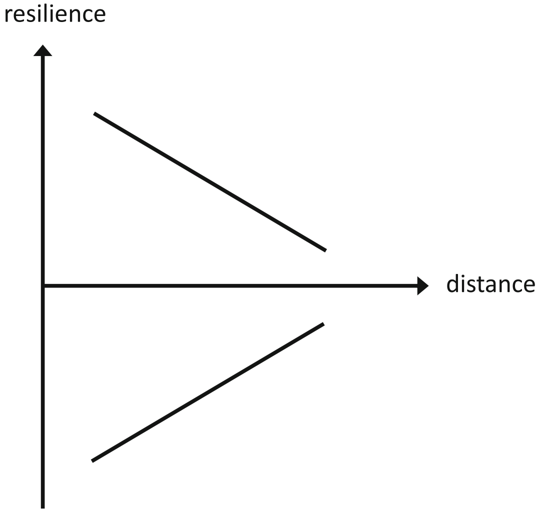

FIGURE 6 Mechanism of the impact of distance on resilience. *Source*: Adapted from Magrini et al. (2013) and modified by the authors.

The results are presented in Table 9, which represents the full model. However, some important collinear variables were detected. Manufacturing-diversity, innovation-public, and innovation-social capital are highly correlated. In Tables A1 and A2 (in the Appendix), alternative models are estimated that do not include these variables together.

6.1.3 | Estimation method

All models are estimated with the three-stage least squares technique (Baltagi, 2011; Basmann, 1957; Baum, 2006; Cameron & Trivedi, 2010; Greene, 2017; Stock & Watson, 2019; Theil, 1953). This technique is known to handle endogeneity. One other benefit is that 3SLS provides efficient estimates for discrete dependent variables, such as the *recovery* variable. It is assumed that innovation and diversity are endogenous to the system, while other variables are accepted as exogenous. Endogenous variables are instrumented by the exogenous ones.

With regard to the regression specifications, the regressions are estimated for each resilience type separately (resistance, recovery, adaptability, composite). The regressions are also run separately by referring to regional turning points and national turning points. Hence, eight different or separate regressions are estimated using 3SLS estimation.

6.2 | Results

The results in Tables 9 and 10 (with further details in Tables A1–A4 in the Appendix) highlight an important finding: the drivers of resilience calculated under national and regional turning points differ substantially. The sign and significance of these coefficients vary substantially across the two types of estimations.

Most importantly, the determinants of composite resilience deserve the most attention in this context. The determinants of the three indicators that compose it are instead reported in the Appendix to save space. It must be emphasized that the determinants estimated under regional and national turning points are different. While diversity and manufacturing are significant under the regional turning points assumption, they have an insignificant impact

TABLE 9 3SLS regressions, full model.

	Composite resilience			
	Regional		national	
Innovativeness	0.613***	0.000	0.730***	0.000
Diversity	−37.399***	0.001	−10.272	0.444
Density	−0.121	0.165	−0.299***	0.003
Education	2.303***	0.000	2.814***	0.000
Active population	8.046***	0.000	4.501**	0.039
Manufacturing sector	0.306*	0.082	0.300	0.139
Public sector	0.813***	0.008	1.229***	0.000
Financial sector	−1.774***	0.001	−1.312**	0.041
Social Capital	−0.100***	0.010	−0.172***	0.000
Distance	0.030	0.528	−0.031	0.575
dint_res_reg	0.066***	0.000	0.054***	0.000
_cons	−0.907	0.141	−0.198	0.781
R-Square	0.6262		0.4396	
Durbin	31.7539***		37.9806***	
Wu–Hausman	17.6582***		21.986***	
Eigen Value: 15% 4,58	13.425		14.03	

Notes: *** when p-value<0.01, ** when 0.01 < p-value<0.05, when * 0.05 < p-value<0.1. Please refer to Durbin (1954); Wu (1973, 1974); Davidson and MacKinnon (1993) for Wu–Hausman and Durbin tests. Endogenous: inov, diversity, exogenous (instruments): all other explanatory variables, bilateral differences in *income per capita* and *population* obtained from Eurostat.
Source: Own calculation/estimation, N = 190.

TABLE 10 Z-test of equality between the estimated coefficients under regional and national turning points.

Z-Scores	Composite resilience
Innovativeness	−0.554
Diversity	−1.520*
Density	1.333
Education	−0.766
Active population	1.242^
Manufacturing sector	0.022
Public sector	−0.896
Financial sector	−0.548
Social Capital	1.211^

Note: *** denotes significance at 10%, ** at 5%, * at 10%, ^ at 15%.
Source: Own calculation/estimation.

under the national turning points assumption. In contrast, population density has an insignificant impact with regional turning points, whereas it has a significant impact with national turning points. Accordingly, the sizes of the coefficients under the two assumptions are also different from each other.

In regard to the other determinants of composite resilience, regions that have a greater innovation capacity, higher education levels, a larger active labour force, and a larger share of public sector workers are likely to exhibit greater overall resilience. In contrast, regions that have larger finance sector and social capital exhibit lower resilience.[3]

To formally test the discrepancy across the estimated coefficients under the two assumptions, a one-tail *z*-test was conducted and the results reported in Table 10. *Z*-scores are calculated by referring to the differences in coefficients estimated with regional and national turning points. The critical values are also reported. Various parameters were found to vary across the two assumptions. For instance, the diversity variable has significantly different coefficients (and this is confirmed in almost all resilience subcomponents except resistance; see the Appendix). An active labour force is almost significantly different, with a higher coefficient with regional turning points; social capital is also almost significant, with a higher coefficient with regional turning points. These findings seem to suggest that the traditional national turning point approach tends to underestimate the importance of soft and social variables as determinants of resilience, although this would need to be verified for other countries.

Results are robust to different specifications, as shown in the Appendix and, more specifically, in Tables A3 and A4.

7 | CONCLUSION

This paper investigated the nature and geography of regional economic resilience by adopting region-specific turning points. Specifically, it employed long-term quarterly time-series data of employment in regions of Italy. This country is especially interesting as a case study, because it is characterized by important disparities between the Southern and Northern regions, which have been persistent and have hence caught the attention of scholars in various disciplines from economics to geography. Moreover, also for that reason, Italy has also been one of the most closely investigated countries in terms of resilience following the financial crisis in 2008.

The analysis employed a wide range of time series and econometric tools, which allowed three employment cycles of Italian regions to be studied and compared to the national trajectory. The study produced three major findings.

First, the nature of regional business cycles varies, even within a country that has been unified since 1861 and is not a federal one, although increasing amounts of autonomy have been granted to regions in recent decades. Regional fluctuations do not move in a synchronous manner; they have different peaks and troughs, and their quantitative behaviour varies significantly. If regions of the same country show such different behaviours, it is unlikely that—even in the presence of processes of integration, for example the ones within the European Union—complete convergence of the international business cycle will ever be achieved between countries.

Second, as the timing of regional business cycles varies substantially from each other, the common practice of referring to the national timing of cycles in the analysis of regional resilience may significantly bias the results, particularly in the recovery and adaptability elements of resilience. This aspect is especially important when large crises affect a national economy, such as the crisis at the end of the 2000s or the crisis induced by the COVID-19 pandemic, because in these cases a country, or supra-national bodies such as the EU, can decide to implement policies to alleviate the socioeconomic impacts—for example, concentrating resources in regions whose levels of resilience are lower.

The analysis in this paper shows that using national turning points provides different results than using regional ones and, consequently, that the choice of which regions need to be supported may be unable to correctly select the regions which are more in need. The rankings of the most affected regions can change significantly.

Third, the traditional factors of resilience were shown to be relevant at the regional level. For instance, regions that have different levels of innovative activities, industrial diversity, share of active labour in the population, and

[3]The expectation for social capital was instead to have larger resilience, but this might also depend on which aspects of it are proxied by the indicators and those made available by Cartocci (2007) are mostly bonding social capital (Fratesi et al., 2019).

stock of human and social capital are likely to exhibit different levels of economic resilience. Moreover, the determinants can change based on the resilience type (resistance, recovery, or adaptability).

While the importance of each determinant might be different in other countries, one may assume that the use of either regional or national turning points will make a difference in most (if not all) contexts. What is more interesting, in fact, is that the regional determinants of resilience are not exactly the same if the analysis considers regional instead of national turning points. In particular, it was found that, in the case of Italy, the importance of diversity as a resilience factor is overestimated with national turning points, while the importance of agglomeration economies is underestimated. The role of manufacturing in adaptability is also underestimated. These different results indicate the need to use reliable targets for policies if they are to be effective.

These results are important in policy terms in two respects. The first is the selection of regions to assist following a crisis, which can significantly change once the specificities of regional economic cycles and patterns are considered. The second is the target of interventions. When a country has the intention to intervene on the assets which enhance the resilience capacity of regions, the identification of these assets can be biased when the widespread assumption of common cycles is used in the analysis.

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APPENDIX: DETERMINANTS ANALYSIS BY SUBCOMPONENT

The estimated coefficients and signs of the subcomponents of resilience differ under the two assumptions. For instance, in *resistance* analysis, the coefficient of population density becomes insignificant under regional turning points, whereas it is significant under national turning points. In *recovery* analysis, the coefficients of manufacturing and diversity are not significant and that of public employment is weakly significant under national turning points, but they become strongly significant under regional turning points. For adaptability, the coefficient of manufacturing is insignificant under regional turning points but significant under national turning points. Finally, in the case of composite resilience, diversity and manufacturing have significant coefficients under regional turning points but significant ones under national ones, and vice versa for population density.

Looking at the results, we search for the robustly evident variables across different specifications. We refer to the estimates which dependent variable is calculated under regional turning points. For *resistance*, *innovativeness* and

TABLE A1 3SLS regressions, full model.

	Resistance				Recovery			
	regional		national		regional		national	
Innovativeness	0.153***	0.000	0.156***	0.000	3.551***	0.000	3.371***	0.000
Diversity	−1.031	0.581	−1.650	0.386	−201.299***	0.000	−70.183	0.283
Density	−0.029	0.057	−0.062***	0.000	−1.030***	0.002	−1.953***	0.000
Education	0.385***	0.000	0.424***	0.000	10.216***	0.000	13.184***	0.000
Active population	0.870***	0.003	0.663**	0.023	10.327	0.124	−0.376	0.971
Manufacturing sector	0.023	0.419	0.019	0.515	1.402**	0.034	0.573	0.563
Public sector	0.271***	0.000	0.222***	0.000	5.094***	0.000	3.140*	0.050
Financial sector	−0.114	0.204	−0.104	0.249	−6.609***	0.002	−7.552**	0.015
Social Capital	−0.027***	0.001	−0.032***	0.000	−0.739***	0.000	−0.941***	0.000
Distance	0.007	0.438	0.009	0.264	0.163	0.373	−0.201	0.452
dint_res_reg	0.001	0.515	0.001	0.517	0.197**	0.000	0.294***	0.000
_cons	−0.123	0.252	−0.158	0.134	−3.669	0.117	0.098	0.977
R-Square	0.2353		0.0926		0.615		0.4958	
Durbin	65.374***		131.181***		31.8771***		35.7944***	
Wu–Hausman	46.1614***		196.264***		17.7405***		20.4267***	
Eigen Value: 15% 4,58	6.39997		7.13253		12.0602		17.949	

Notes: *** when p-value <0.01, ** when 0.01 < p-value <0.05, when * 0.05 < p-value <0.1, It is referred to Durbin (1954); Wu, 1973, 1974 Davidson & MacKinnon, 1993 for Wu–Hausman and Durbin tests. Endogenous: inov, diversity, exogenous (instruments): all other explanatory variables, bilateral differences in *income per capita* and *population* obtained from Eurostat.

Source: Own calculation/estimation.

TABLE A1 (Continued)

	Adaptability				Composite			
	regional		national		regional		national	
Innovativeness	−0.001***	0.000	−0.001***	0.002	0.613***	0.000	0.730***	0.000
Diversity	0.045**	0.035	0.130***	0.000	−37.399***	0.001	−10.272	0.444
Density	0.000***	0.003	0.001***	0.002	−0.121	0.165	−0.299***	0.003
Education	0.000	0.518	0.000	0.564	2.303***	0.000	2.814***	0.000
Active population	0.016***	0.000	0.013***	0.004	8.046***	0.000	4.501**	0.039
Manufacturing sector	0.000	0.294	−0.001***	0.001	0.306*	0.082	0.300	0.139
Public sector	0.000	0.765	0.000	0.976	0.813***	0.008	1.229***	0.000
Financial sector	−0.001	0.282	0.001	0.290	−1.774***	0.001	−1.312**	0.041
Social Capital	0.000***	0.000	0.000***	0.003	−0.100***	0.010	−0.172***	0.000
Distance	0.000	0.345	0.000	0.147	0.030	0.528	−0.031	0.575
dint_res_reg	0.000***	0.000	0.000***	0.000	0.066***	0.000	0.054***	0.000
_cons	0.000	0.740	0.001	0.462	−0.907	0.141	−0.198	0.781
R-Square	0.8224		0.7753		0.6262		0.4396	
Durbin	5.74029*		11.5659***		3.7539***		37.9806***	
Wu–Hausman	2.74149*		5.70404***		17.6582***		21.986***	
Eigen Value: 15% 4,58	14.5618		13.889		13.425		14.03	

Notes: *** when p-value <0.01, ** when 0.01 < p-value <0.05, when * 0.05 < p-value <0.1, It is referred to Durbin (1954); Wu, 1973, 1974 Davidson & MacKinnon, 1993 for Wu–Hausman and Durbin tests. Endogenous: inov, diversity, exogenous (instruments): all other explanatory variables, bilateral differences in *income per capita* and *population* obtained from Eurostat.
Source: Own calculation/estimation.

TABLE A2 Z-test of equality between the estimated coefficients under regional and national turning points.

Z-Scores	Resistance	Recovery	Adaptability	Composite
Innovativeness	−0.077	0.196	−0.047	−0.554
Diversity	0.232	−1.659**	−2.705***	−1.520*
Density	1.432*	1.581*	−0.459	1.333
Education	−0.326	−1.031	0.859	−0.766
Active population	0.499	0.865	0.547	1.242^
Manufacturing sector	0.104	0.697	1.841**	0.022
Public sector	0.536	0.973	−0.172	−0.896
Financial sector	−0.080	0.251	−1.503*	−0.548
Social Capital	0.486	0.770	0.139	1.211^

Note: *** denotes significance at 10%, ** at 5%, * at 10%, ^ at 15%.
Source: Own calculation/estimation.

share of active labour have significant and positive coefficients. It is robustly evident in Tables 9, 10, A1–A4. Innovative regions possibly focus on creative, knowledge-based, highly value-added and productive activities that induce production and employment even during recessions. In this way, innovativeness helps to mitigate the drastic outcomes of recessions (Bramwell et al., 2008; Christopherson et al., 2010; Eraydin, 2013, 2016; Giannakis & Bruggeman, 2015, 2017). Share of active labour force might enhance the labour supply and increase the likelihood of employment. Hence, the regions that have a higher share are likely to be resistant.

For recovery, *innovativeness* has a positive robustly significant coefficient and industrial diversity has a negative one. It follows that innovative regions can easily absorb the shocks and recover from recessions due to the benefits mentioned above. Interestingly, it is more difficult for regions with diverse economic structures to recover quickly. Diversity in industrial structure might hamper specialization and productivity growth. It might also slow the recovery, as there are no specialized dynamic sectors to lead the economic growth (Christopherson et al., 2010; Kort, 1981; Lee, 2014; Malizia & Ke, 1993; Martin, 2012; Pike et al., 2010).

To test formally the discrepancy across the estimated coefficients under the two different assumptions, a one-tail *z*-test was conducted and the results presented in Tablea A2. *Z*-scores are calculated by referring to the differences in coefficients estimated under regional and national turning points. The critical values are also reported. Various parameters were found to vary significantly across the two assumptions. For instance, the diversity variable has significantly different coefficients (and this is confirmed in almost all resilience subcomponents except resistance). Lower coefficients are detected under regional turning points than under national ones. Population density was found to have significantly different coefficients in the resistance and recovery contexts. It seems that the coefficient is higher under regional turning points. Finally, manufacturing (in the adaptability context), active labour (in the composite resilience context), finance (in the adaptability context), and social capital (in the composite resilience context) exhibit significantly different coefficients under the two turning point conditions.

For *adaptability*, innovation has a negative coefficient, whereas diversity and active labour share have positive and robustly significant coefficients. A diverse economic structure is seen as a *source* of adaptive capacity (Pike et al., 2010). Similarly, adaptability is enhanced with a high share of active labour, since it provides labour supply and employment. Overall resilience is significantly associated with high innovativeness, less diversity, high levels of human capital, and a high share of active labour.

The role of human capital deserves further explanation. The presence of human capital enhances regional productivity and creative and knowledge-intensive industries. Thus, human capital makes it easier for regions to absorb and mitigate shocks. Having a more educated and talented work force makes resilience more effective.

APPENDIX: ROBUSTNESS ANALYSIS

TABLE A3 3SLS regressions, robustness model 1.

	Resistance				Recovery			
	regional		national		regional		national	
inov	0.052***	0.000	0.057***	0.000	2.132***	0.000	1.541***	0.000
diversity	−3.262***	0.002	−3.708***	0.000	−280.461***	0.000	−125.024**	0.015
popdens	0.011**	0.041	−0.001	0.872	0.570**	0.042	0.063	0.811
edu	0.200***	0.000	0.252***	0.000	9.111***	0.000	11.633***	0.000
activelab	1.081***	0.000	1.105***	0.000	27.755***	0.001	20.305**	0.018
fin	−0.257***	0.001	−0.291***	0.000	−16.347***	0.000	−15.521***	0.000
dist	0.000	0.917	0.005	0.258	0.186	0.359	−0.174	0.423
dint_res_reg	0.004***	0.000	0.004***	0.000	0.178***	0.000	0.294***	0.000
_cons	−0.031	0.608	−0.099*	0.079	−3.550	0.169	0.151	0.957
R-Square	0.746		0.731		0.549		0.671	
Durbin	29.095***		69.728***		15.780***		37.336***	
Wu–Hausman	16.183***		51.888***		8.107***		21.889***	
Eigen Value: 15% 4,58	24.138		26.281		14.845		23.580	

Notes: $N = 190$. *** when p-value <0.01, ** when 0.01 < p-value <0.05, when * 0.05 < p-value <0.1, It is referred to Durbin (1954); Wu, 1973, 1974 Davidson & MacKinnon, 1993 for Wu–Hausman and Durbin tests. Endogenous: inov, diversity, exogenous (instruments): all other explanatory variables, bilateral differences in *income per capita* and *population* obtained from Eurostat.

TABLE A3 (Continued)

	Adaptability				Composite			
	regional		national		regional		national	
inov	−0.001***	0.003	−0.001***	0.000	0.454***	0.000	0.350***	0.000
diversity	0.050**	0.041	0.130***	0.000	−49.612***	0.000	−25.773**	0.013
popdens	0.000*	0.092	0.000*	0.075	0.108*	0.074	0.052	0.329
edu	0.000	0.720	−0.001	0.120	2.259***	0.000	2.390***	0.000
activelab	0.009**	0.027	0.006	0.209	10.631***	0.000	8.102***	0.000
fin	0.002	0.271	0.007***	0.000	−3.506***	0.000	−3.262***	0.000
dist	0.000	0.275	0.000*	0.089	0.036	0.463	−0.032	0.475
dint_res_reg	0.000***	0.000	0.000***	0.000	0.062***	0.000	0.055***	0.000
_cons	0.001	0.652	0.001	0.298	−0.911	0.140	−0.106	0.851
R-Square	0.755		0.709		0.634		0.648	
Durbin	7.738*		13.897***		23.336***		39.795***	
Wu–Hausman	3.800*		7.063***		12.531***		23.712***	
Eigen Value: 15% 4,58	22.952		23.889		18.873		24.081	

Notes: $N = 190$. *** when p-value <0.01, ** when 0.01 < p-value <0.05, when * 0.05 < p-value <0.1, It is referred to Durbin (1954); Wu, 1973, 1974 Davidson & MacKinnon, 1993 for Wu–Hausman and Durbin tests. Endogenous: inov, diversity, exogenous (instruments): all other explanatory variables, bilateral differences in *income per capita* and *population* obtained from Eurostat.

TABLE A4 3SLS Regressions, Robustness Model 2.

	Resistance				Recovery			
	regional		national		regional		national	
popdens	0.009	0.196	−0.007	0.266	−0.167	0.544	−0.922***	0.005
edu	0.029	0.164	0.049***	0.009	0.696	0.393	4.914***	0.000
activelab	0.366***	0.004	0.295***	0.008	−9.553**	0.048	−9.824*	0.100
manuf	0.015*	0.062	−0.001	0.934	−0.742**	0.027	−0.223	0.573
public	0.017	0.313	−0.024	0.128	0.183	0.787	−2.212***	0.007
fin	0.070*	0.090	0.060	0.118	1.427	0.385	−1.753	0.385
sc	0.005**	0.014	0.003*	0.065	0.066	0.402	−0.127	0.178
dist	−0.010**	0.023	−0.004	0.253	−0.184	0.265	−0.450**	0.025
dint_res_reg	0.006***	0.000	0.006***	0.000	0.276***	0.000	0.314***	0.000
_cons	0.080	0.134	0.017	0.720	1.084	0.607	3.905	0.128
R-Squared	0.7738		0.7865		0.6595		0.6,989	

Notes: $N = 190$. *** when p-value <0.01, ** when 0.01 < p-value <0.05, when * 0.05 < p-value <0.1, It is referred to Durbin (1954); Wu, 1973, 1974 Davidson & MacKinnon, 1993 for Wu–Hausman and Durbin tests. Endogenous: inov, diversity, exogenous (instruments): all other explanatory variables, bilateral differences in *income per capita* and *population* obtained from Eurostat.

TABLE A4 (Continued)

	Adaptability				Composite			
	regional		national		regional		national	
popdens	0.000	0.318	0.000*	0.067	0.035	0.606	−0.074	0.233
edu	0.003***	0.000	0.003***	0.000	0.546***	0.007	0.956***	0.000
activelab	0.018***	0.000	0.023***	0.000	3.686***	0.002	2.351**	0.046
manuf	0.000	0.362	0.000**	0.024	−0.138*	0.086	0.193***	0.010
public	0.001**	0.017	0.001*	0.064	−0.058	0.727	0.071	0.652
fin	−0.003**	0.014	−0.002*	0.097	−0.322	0.426	−0.075	0.845
sc	0.000	0.326	0.000	0.575	0.039**	0.046	0.001	0.971
dist	0.000	0.881	0.000	0.764	−0.032	0.424	−0.084**	0.026
dint_res_reg	0.000***	0.000	0.000***	0.000	0.074***	0.000	0.063***	0.000
_cons	−0.001	0.568	−0.001	0.577	−0.046	0.930	0.587	0.224
R-Squared	0.7183		0.7526		0.7141		0.7233	

Notes: $N = 190$. *** when p-value <0.01, ** when 0.01 < p-value <0.05, when * 0.05 < p-value <0.1, It is referred to Durbin (1954); Wu, 1973, 1974 Davidson & MacKinnon, 1993 for Wu–Hausman and Durbin tests. Endogenous: inov, diversity, exogenous (instruments): all other explanatory variables, bilateral differences in *income per capita* and *population* obtained from Eurostat.

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Resumen. La bibliografía sobre la resiliencia regional suele pasar por alto el momento de las recesiones y se limita a utilizar los ciclos nacionales. Sin embargo, los ciclos y los puntos de inflexión específicos de las regiones podrían sesgar los resultados y afectar a la elección de las regiones a las que dirigir las políticas. Este artículo investiga la geografía y los determinantes de la resiliencia regional con un enfoque de punto de inflexión regional, para lo cuál emplea datos de Italia, un país con una división regional bien conocida y considerable. Los resultados muestran que el momento de los ciclos regionales varía sustancialmente y que los determinantes de la resiliencia detectados se pueden distinguir en los dos enfoques, lo que implica que las palancas políticas pueden estimarse erróneamente si se emplean puntos de inflexión nacionales.

抄録: 地域のレジリエンスに関する研究は、経済不況のタイミングを無視し、単純に国の景気サイクルを使用していることが多い。ただし、地域特有のサイクルや転換点が偏った結果を生み、対象とする地域の選択に影響を与える可能性があります。この論文では、大きな地域格差があることでよく知られているイタリアのデータを使用し、地域の転換点に対するアプローチを用いて地域の回復力の地理と決定要因を調査した。この結果は、地域のサイクルのタイミングが大幅に異なり、検出された回復力の決定要因が2つのアプローチで区別されることを示しており、国の転換点により政策レバーが誤って推定される可能性があることを示唆している。