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# Unfolding Smart Specialisation for Regional Economic Resilience: the role of Industrial Structure

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## Unfolding Smart Specialisation for Regional Economic Resilience: the role of Industrial Structure

*Luciana Lazzeretti\**, *Stefania Oliva\*\**, *Niccolò Innocenti\*\*\**

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### ABSTRACT:

The European Regional Development Funds for the programmatic cycle 2014-2020 aims to support regions that implement an innovation strategy based on Smart Specialisation. Within this framework, the European Commission emphasises the role of smart specialisation in favouring regional transformation, enhancing competitiveness and fostering resilience. However, the concepts of smart specialisation and resilience have been poorly combined. The article aims at investigating their relationship to understand if a smart specialisation strategy may promote the economic resilience of regions in response to major economic shocks. Drawing upon the concepts of adaptation/adaptability, the analysis investigates the relatedness of new industrial specialisations to the existing industrial structure before and after a shock occurrence. Evaluating the resilience of Italian provinces in relation to the economic crisis of 2008, the analysis aims to understand if provinces that resisted and recovered better followed a smart specialisation framework where new industrial specialisations are related to the existing industrial structure.

**KEYWORDS:** Industrial structure; resilience; relatedness; smart specialization.

**JEL CLASSIFICATION:** O25; L16; R11.

### Despliegue de la Smart Specialisation para la resiliencia económica regional: el papel de la estructura industrial

### RESUMEN:

El Fondos Europeos de Desarrollo Regional para el ciclo programático 2014-2020 tienen como objetivo apoyar a las regiones que aplican una estrategia de innovación basada en la Smart Specialisation. En este marco, la Comisión Europea destaca el papel de la Smart Specialisation para favorecer la transformación regional, mejorar la competitividad y fomentar la resiliencia. Sin embargo, los conceptos de Smart Specialisation y resiliencia han sido poco combinados. El artículo pretende investigar su relación para entender si una estrategia de Smart Specialisation puede promover la resiliencia económica de las regiones en respuesta a las grandes crisis económicas. Basándose en los conceptos de adaptación/adaptabilidad, el análisis investiga la relación de las nuevas especializaciones industriales con la estructura industrial existente antes y después de una crisis. Evaluando la resiliencia de las provincias italianas en relación con la crisis económica de 2008, el análisis pretende comprender si las provincias que resistieron y se recuperaron mejor siguieron un marco de Smart Specialisation en el que las nuevas especializaciones industriales están relacionadas con la estructura industrial existente.

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**PALABRAS CLAVE:** Estructura industrial; resiliencia; relatedness; smart specialization.

**CLASIFICACIÓN JEL:** O25; L16; R11.

## 1. INTRODUCTION

One of the main points of the debate regarding the transformation of the industrial structure is how regions develop – or fail to develop – new sectorial specialisations. Evolutionary economic geography scholars have tackled the question through different theories and empirical applications, modelling the evolution of regional paths (Martin, 2010; Isaksen, 2015; Simmie, 2017) and arguing that new specialisations may emerge as related to close existing specialisations (Boschma, 2017; Balland et al., 2018; Xiao et al., 2018).

From a policy perspective, the problem of the evolution of the industrial structure and the creation of new industrial paths has been the central focus of several regional innovation policies led by concepts such as the Technology Plans or the Regional Innovation System (Cooke et al., 1997; Cooke, 2001) that have evolved recently into the idea of ‘smart specialisation’ (Foray et al., 2009; McCann and Ortega-Argilés, 2015).

This debate has assumed a central role after the occurrence of the economic and financial crisis of 2008 when both academics and politicians have tried to understand how and why some regions and cities better resist and react to crisis (Oliva and Lazzeretti, 2018) and how innovation policies may influence the responsiveness of regions in developing new industrial trajectories after crisis (Fingleton et al., 2012; Bristow and Healy, 2018). These questions have led to rethinking the economic recovery as a path of industrial transformation through the lens of regional economic resilience. The latter acts as a dynamic and evolutive process that generates positive hysteretic outcomes of opportunities for the development of new sectors and new economic growth. “*Regional economic resilience in this framework could be viewed as having to do with the capacity of a regional economy to reconfigure, that is adapt, its structure (firms, industries, technologies and institutions) so as to maintain an acceptable growth path in output, employment and wealth over time.*” (Martin, 2012, p.10).

Concerning the policy perspective, failures in innovation systems have emerged due to the economic crisis. An example is the relative inability of regions’ policies to promote solutions considering regional differences. This scenario has led to going beyond an innovation policy that supports neutrally technology, science and innovation, opening up to the renaissance of the industrial policy (Foray et al., 2011; Ortega-Argilés, 2012).

In this scenario, the theory of ‘resilience’ (Simmie and Martin, 2010; Martin, 2012; Boschma, 2015; Lazzeretti and Cooke, 2015) and the concept of ‘smart specialisation’ have become guiding principles for many policies. Despite the criticisms (Cooke, 2017; Marques and Morgan 2018; Foray, 2019; Hassink and Gong, 2019), they have started to influence a large part of the research on regional economies. Both approaches recognise the significant role of the industrial structure in promoting new specialisations and developing new industrial paths. Regional economic resilience defines structural change as the output of a resilient regional economy (Martin, 2012). Based on concepts of adaptation and adaptability, response to exogenous shocks can lead towards the recombination of existing resources to create new knowledge or the development of new and unrelated trajectories (Grabher, 1993; Hu and Hassink, 2017). Following the smart specialisation framework, a new specialisation may be linked to the existing economic structure in which the region has a competitive advantage compared to other regions (Foray et al., 2011).

Despite the emerging works in evolutionary economic geography (Balland et al., 2018; Xiao et al., 2017), few studies have explored the relationship between smart specialisation and regional economic resilience. The present work contributes to this debate by merging the two approaches and questioning if a strategy based on ‘smart specialisation’ may promote regional economic resilience in the face of shocks.

This conceptual approach is applied to the case of 103 Italian provinces (NUTS-3) to understand if provinces following a strategy of diversification into related industries before the crisis resisted and recovered better to the Great Recession of 2008. In line with other research concerning economic resilience

in Italy (Cellini and Torrisi, 2014; Lagravinese, 2015; Faggian et. al., 2018; Cainelli et al., 2019), Italian provinces represent an interesting unit of analysis due to regional differences related to sectors specificities and productive structure. Moreover, the Italian economy is strongly characterized by economic inequalities expressed by the divide between the Northern and Southern regions. Such differences may contribute to the ability of Italian regions to respond and recover from a crisis (Di Caro, 2015). Additionally, the crisis context may constitute an interesting field to reflect on the successful (or not) of smart specialisation strategy in an uncertain scenario.

From an evolutionary perspective, the analysis can provide valuable insights to explain how regions transform and evolve in response to shocks. Furthermore, such analysis can help understand whether the smart specialisation strategy can be an instrument to foster resilience leading towards more comprehensive and sustainable growth.

The article is organized as follows. Section 2 discusses the similarities between the concepts of resilience and smart specialisation, building the conceptual framework of our empirical analysis. Section 3 clarifies the data sources and the methodology applied. Section 4 introduces the results of the empirical research, while Section 5 underlines the conclusions and the implications for the policy and theoretical discussion of smart specialisation.

## **2. SMART SPECIALISATION, RESILIENCE AND THE INDUSTRIAL STRUCTURE**

The origin of the idea of ‘smart specialisation’ dates to the debate of the divergence in productivity between the USA and Europe since 1995 (see van Ark et al., 2008). From a European perspective, the Cohesion Policy 2014-2020 puts the development of an innovative strategy based on a ‘smart specialisation’ as a necessary condition to access European funds. In a post-crisis context, the idea of policymakers is to promote a plan for favouring the emergence of new economic activities with a specific policy based on innovation, investments in R&D and information and communication technology (ICT) within the framework of the Research and Innovation Strategies for Smart Specialisation (RIS3). Such a strategy stresses the industrial strength of regions, enhances competitiveness and fosters resilience (European Commission, 2010; 2012; 2017).

The idea of a ‘smart specialisation’ would like to represent a response to the risks and uncertainties of the global economy. The concept comes from the observation of the competitive scenario of European regions and recognises the high fragmentation of the European research systems and their almost everywhere national organisation. This aspect may limit the possibility of creating knowledge hubs that are spatially localised. Moreover, investments in innovation generally occur on similar activities, leading towards a ‘homogenization’ of industrial trajectories among European regions. In some cases, such characteristics may make regions unattractive for firms' global location (Foray, 2015).

Moreover, as EU regions have different economic and institutional structures, a unique top-down policy is impossible to apply (Balland et al., 2018). So smart specialisation should enhance entrepreneurial coordination within a framework structured by the government (Foray et al., 2018). Discovering the domain on which prioritising investments to generate a long-term economic transformation assumes a bottom-up perspective through the interactions between the government and the private sector (Montresor and Quatraro, 2017). The smart specialisation framework identifies this as the entrepreneurial discovery process (EDP). This process is the main difference between smart specialisation and other innovation strategies (Pinto et al., 2019). Smart specialisation formally recognises the entrepreneurial discovery process's role in fostering the region's structural change based on the current industrial commons. European Commission identifies the smart specialisation strategy as a roadmap to help regions to adapt to the changes derived from globalisation, energy and digital transactions. It may be considered a way to increase regional resilience in facing global challenges (European Commission, 2017).

Resilient growth is a theoretical framework widely explored in studies of regional economies (Bailey and Turok, 2016; Cooke, 2017; Fröhlich and Hassink, 2018; Webber et al., 2018; Evenhuis, 2017). It discusses the capacity of a region to recover, reorganise and reorient its structure and functions in order to respond to external pressure (Martin, 2012).

The concept of smart specialisation has been poorly studied in regional economic resilience studies, although the two approaches present interesting similarities. A first similarity concerns that both smart specialisation and resilience stress structural change and transformation as the output of their processes. Smart specialisation embraces a more productive use of resources to achieve regional sustainable growth. The concept goes beyond the investments in R&D and high technologies, involving a broader meaning of inputs of innovation – such as creativity and design - and outputs of the innovative process and promoting productive use of resources to achieve smart regional growth. Thus, this is based on existing local capabilities that ultimately develop new high value-added activities fostering existing strengths. Smart specialisation, therefore, assumes that a new specialisation is related to the existing economic structure in which the region has a competitive advantage compared to other regions. The result is not just technological innovation, but a structural change based on different paths (Foray et al., 2011). According to Foray (2015), each path of structural change shows a degree of relatedness between the existing resources and the new domain. The transition, modernisation and diversification patterns link with the original industrial commons. A regional transition occurs when a new domain is generated from the existing range of capabilities. At the same time, modernisation involves increasing the quality and efficiency of an existing sector through developing applications of a general-purpose technology. Finally, diversification can be achieved by identifying synergies between the new and existing activities. On the contrary, *radical foundation* is actuated when the new domain has not any connections with the existing industrial structure.

Within the theory of regional resilience, the region's possible structural change is the evolutionary approach's guiding principle (Boschma, 2015). Exogenous shocks can lead to the recombination of existing resources in order to create new knowledge or the development of new and unrelated trajectories (Grabher, 1993). According to this view, resilience refers to the adaptive ability of regions to change structure and functions to deal with external pressures (Martin, 2012). However, regional economic resilience cannot be directly observed but it is inferred analysing adapting processes and how they evolve in time and space (Evenhuis, 2017). This adaptive process may be discussed in terms of 'adaptation' and 'adaptability' (Grabher and Stark, 1997). Adaptation represents a path-dependent process that involves a non-radical transformation of the regional path based on the existing structure. Adaptability deals with a long-term change within the regional economy that may occur through a shift in the industrial path. Such processes coexist and interact as old and new industries coexist and interact within the region (Hu and Hassink, 2017; Simmie, 2017). When resilience is conceived as a long-term transformation, a synergic action of adaptation and adaptability should be considered. Reciprocity between adaptation and adaptability may involve the need for a degree of relatedness between existing industries and new emerging trajectories (Boschma, 2017).

A second similarity between the framework of smart specialisation and regional resilience is the importance that both approaches reserve to the existing industrial structure in boosting regional transformation processes. Regional and local economies are an aggregation of technological capabilities, routines and institutions. The emergence of new trajectories depends on several variables that deal with the internal dynamics of the regions and their capacity to absorb external knowledge. The existing base of knowledge plays an important role. New technologies and new sectors do not develop from random events but encompass the capabilities of regional agents that shape the regions' distinctive technological and industrial characteristics (Balland et al., 2018). As Boschma and Gianelle (2014) proclaim, the objective of smart specialisation is "*to favour a specialised diversification into related technologies which generates new economic activities that are rooted in the region and that can draw on local related resources*". Foray et al. (2018) stress the idea of 'differentiation with specialisation' – and vice versa. On the one side, differentiation is based on the existing peculiarities of the region, such as institutions, socio-economic characteristics, geographic and demographic conditions. So, each region should prioritise some domains based on its capabilities. On the other side, a degree of specialisation is required to agglomerate actors and resources and develop related projects in order to produce innovation in the selected domain.

In respect of resilience, recent literature considers factors and dynamics that can contribute to making a region more resilient. Such contributions focus on determinants of resilience, considering it a process rather than a simple system property (Simmie and Martin, 2010; Sedita et al., 2017) and aim to identify the most suitable form of sectoral structure in influencing the responsiveness of regions to external pressures. As argued by Martin et al. (2016), several explanations stress the role of specialisation (Storper

et al., 2015), complexity (Hausmann et al., 2013) or related-variety (Frenken et al., 2007) of the existing industries. A regional economy specialised in activities that involve intensive knowledge and information capital can easily adapt to changing circumstances and be more resilient (Martin et al., 2016). By contrast, high diversity hardly impacts the sustainability of the growth rate (Eraydin, 2016).

Moreover, sector-specific shocks may likely hit more diversified regions than regions with specialised economies. However, the damage will be less dangerous for the whole local economy because variety spreads risks among different sectors (Boschma, 2015). Frenken et al. (2007) reconstitute the issue to the degree of 'related' and 'unrelated' variety of regions. In this regard, the concept of relatedness is particularly useful because it captures both dimensions and identifies the proximity of sectors that are usually not considered as close as they are.

Based on an analysis of the industrial structure, the article wants to understand if smart specialisation may foster regional economic resilience in the face of shocks. The analysis focuses on the core of the smart specialisation, namely, the structural change as the process of regional transformation (Foray, 2015). For this reason, we analyse how the regional diversification paths before and after the advent of the great recession affect the regional capacity to resist and react to the crisis. As highlighted above, the smart specialisation is a policy adopted within the Europe 2020 initiative and financed with the European Regional Development Funds for the programmatic cycle 2014-2020, thus, subsequent to the considered period. However, an analysis that explores if diversification's patterns, coherent with the smart specialisation framework, are associated with higher or lower resilience, may promote further insights concerning this kind of policy in an uncertain scenario. The article's main arguments are that the regions that follow a more related diversification path before the crisis are better suited to resist the shock than those that follow a more unrelated diversification in new industries and ultimately perform higher growth rates in the medium-long run.

### 3. DATA AND METHODOLOGY

The article explores the relationship between smart specialisation and regional economic resilience. Even if the European Commission (2017) recognises that smart specialisation policy may increase the resilience of regions, the two approaches have not been frequently combined. However, as explicated in the previous section, they have some interesting similarities and deserve more extensive investigation.

The study concerns the totality of Italian provinces (103) corresponding to the NUTS-3 classification of the European Union, existing before the changes occurred from the 2007.

The paper builds on data drawn from the firm-level AMADEUS database of Bureau Van Dijk, which referred to the number of employees subdivided by the NACE code up to the four-digit level of detail (560 industrial categories) for the period 2006-2015.

Using these data, we firstly measured the occurrence of new specialisation, taking the cue from Xiao et al. (2017), following the procedure presented in section 3.1. Section 3.2 shows how we measure the relatedness between the occurred new specialisations and the existing ones. For this purpose, we have followed the methodology developed by Hidalgo et al. (2007) computing, firstly, a relatedness index for every pair of industrial categories and, secondly, a synthetic index measuring how the existing specialisations are related to the new specialisations occurred in every province for each year (Innocenti and Lazeretti, 2019b). Finally, section 3.3 shows how the resistance and recovery indexes are calculated. This procedure allows understanding if a relationship exists between a province's related diversification and the capacity to resist and react to the economic crisis. It is also useful to understand how the 'diversification/specialisation' strategy of the provinces has changed after the 2008 economic crisis and if this has affected their recovery process.

### 3.1. NEW INDUSTRIAL SPECIALISATIONS

To understand which new industrial specialisations occurred during the period 2007-2014 we partly followed the method proposed by Xiao et al. (2017). Firstly, we compute a Location Quotient (LQ) for every industrial category of each province for the whole period.

$$LQ_{pi} = \left( \frac{E_{pi}/E_P}{E_I/E} \right) \quad (1)$$

To avoid considering new specialisations that are not structural for the area but tend to appear and disappear frequently, a new specialisation is defined as follows:

- The LQ is higher than 1, meaning that the specific industry has a concentration in that province that is higher than the national average.
- The LQ has been lower than 1 since 2006, this is aimed at avoiding the consideration of those industrial specialisations that appear and disappear frequently, concentrating the analysis only on those that are more stable.
- At least 0.5% of the province's workers are employed in that sector. This point is aimed to exclude those micro-sectors where a change in a few employees may determine the appearance of the specialisation.
- There has been an increase in employment in that sector compared to the previous year. This last point is aimed at excluding those specialisations that appear in connection to a decrease in the area's employment rather than an increase in the specific industry (Xiao et al., 2017).

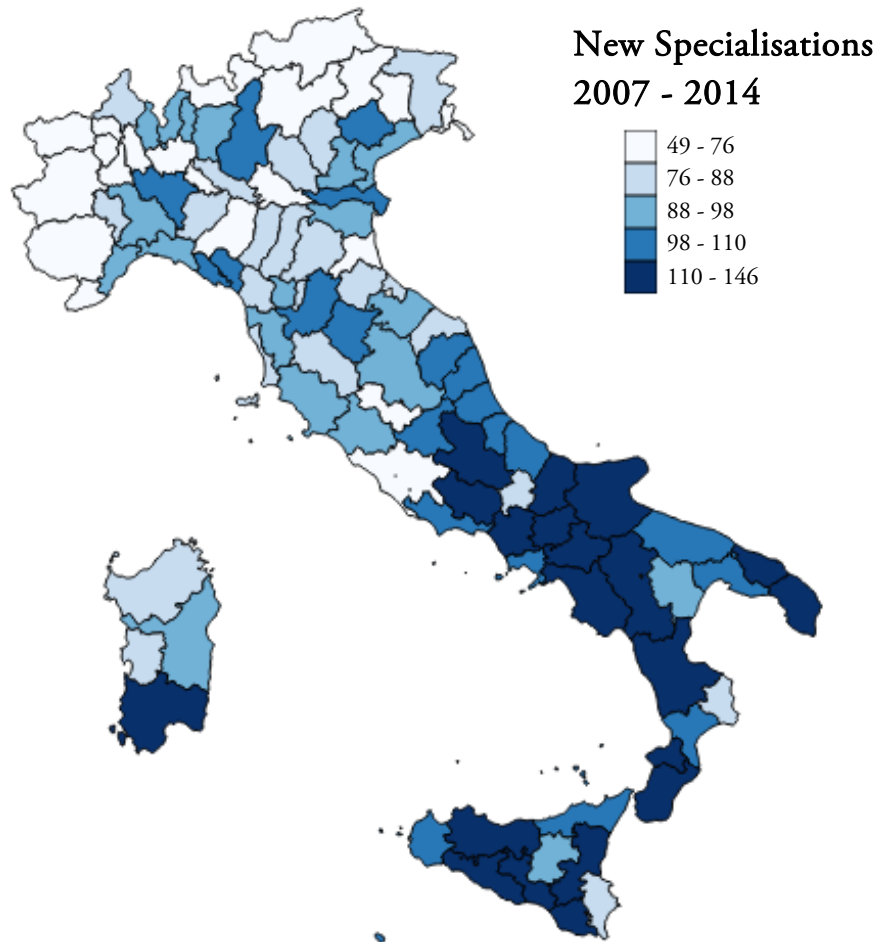
Following this analysis, 9684 new specialisations were identified during the nine years period considered. Figure 1 shows the number of new specialisations occurred in each Italian province during the period 2007-2014. This result shows clearly how the occurrence of new specialisations is largely concentrated in the south of Italy. It may seem an unexpected result at first sight. However, the changes that occurred in the south of the Italian peninsula were much larger than those appearing on the north since the beginning of 2000 (Barca, 2006). This result is then confirmed by the fact that the productivity growth and the diversification of industrial structure of the south were largely higher than the national average since the mid of the '90 (Boschma and Iammarino, 2009). Of course, this did not allow us to cover the gap between north and south, and it is probably connected to the diversification strategy followed that will be considered here.

### 3.2. RELATEDNESS OF NEW SPECIALISATIONS

The following step aims at understanding if the new specialisations that occurred in each province are related or unrelated to the specialisations existing already. For every new specialisation, we have computed an index based on the relatedness measure between each pair of industrial categories.

Firstly, it is necessary to compute the relatedness measure between each pair of industrial categories. It is done following the methodology of Hidalgo et al. (2007) for creating the *product space*. We want to create an *industry space* (Neffke et al., 2011) among the industrial categories in order to determine their proximity. However, in this case, the *industry space* is built differently because the data about the labour flow between industries, or the co-occurrence in the same plant are unavailable. The number of workers in every industrial category will be used to determine if there is a higher or lower proximity among them (Innocenti and Lazzeretti, 2019b). It also differs from the *product space* construction, where export data are used to compute the proximity among products. This is done because the work aims to understand the industrial relatedness to infer the industrial diversification and the specialisation of each Italian province.

FIGURE 1.  
New specialisations in Italian provinces 2007-2014



**Source:** Authors' elaboration using QGIS software.

This way of measuring relatedness allows to infer that two sectors draw on similar knowledge and to overcome the problem of the classification-based measures (ex-ante determination of relatedness like related variety) with an ad-hoc determination of relatedness and so we do not rely on the number of digits shared between two industries to determine their level of relatedness.

In this specific case, measuring industry relatedness, from a theoretical point of view, allow us to be near to the definition firstly made by Frenken et al. (2007) and the following works that rely on industries' employment to determine relatedness (Cortinovis et al. 2015; Hartog et al., 2012; Fritsch and Kublina, 2018; etc.). Summing up, higher relatedness implies that the two industries share similar knowledge that allows cross-fertilisation and spillovers between the two industries.

Now, we explain briefly how we have created the *industrial space*. The *product space* represents in the network the exported products, where the nodes represent every different product and the lines, the relatedness degree between them, based on the idea that two products are related if they are co-exported by many nations.



In our case, we use the same concept but we refer to the industrial categories and we will consider related those categories that are present together in many Italian provinces with an employment level higher than the national average.

We create an  $n*n$  matrix where  $n$  represents the number of industrial categories considered, that in our case are 560, classified following the NACE classification, and we will calculate the degree of relatedness as follows:

$$\varphi_{ijt} = \min \left\{ P(RCA_{x_{it}} | RCA_{x_{jt}}), P(RCA_{x_{jt}} | RCA_{x_{it}}) \right\} \quad (2)$$

The relatedness of every pair of industrial categories is calculated as the minimum of the conditional probability for every Italian province to find an industrial category  $I$  given the category  $J$  is already available in the province.

Then, using this measure of relatedness among industrial categories, the following step is to compute a measure of relatedness of each new industrial specialisation. This leads to a measure of how the new specialisation is related to the already existing specialisations of the area.

$$C_{ip,t} = \frac{\sum_{k=1}^n \varphi_{ikt-1}}{n} \quad (3)$$

Where  $i$  is the industrial category of the new specialisation,  $p$  represents the province,  $k$  represents the industries that province  $p$  was specialised at time  $t-1$ , and  $\varphi$  is the proximity among the new specialisation  $i$  and industry  $k$ .

This measure is specific to each new industrial specialisation in each province (as each province has its specialisation tree) and each year (as the specialisation tree changes every year). This measure is then aggregated at the provincial level. The results give us a measure of how the new specialisations of each province are connected to the already existing specialisations.

$$RC_{pt} = \frac{\sum_{i=1}^n C_{ipt}}{n} \quad (4)$$

Figure 2 shows the measure of relatedness of new specialisations of each Italian province, respectively in the year 2007, 2011 and 2013. They show that the relatedness of new specialisations does not follow the occurrence of new specialisations. However, in this case, it is also possible to see how higher levels are reached in the center and south of Italy than in the North.

Meaning that in the north of Italy there is a larger search for new paths based on new specialisations unrelated to the already existing specialisations. This is an interesting pattern that could be due to the high competition favouring the search of new sectors less related to those with already high competition in the considered area.

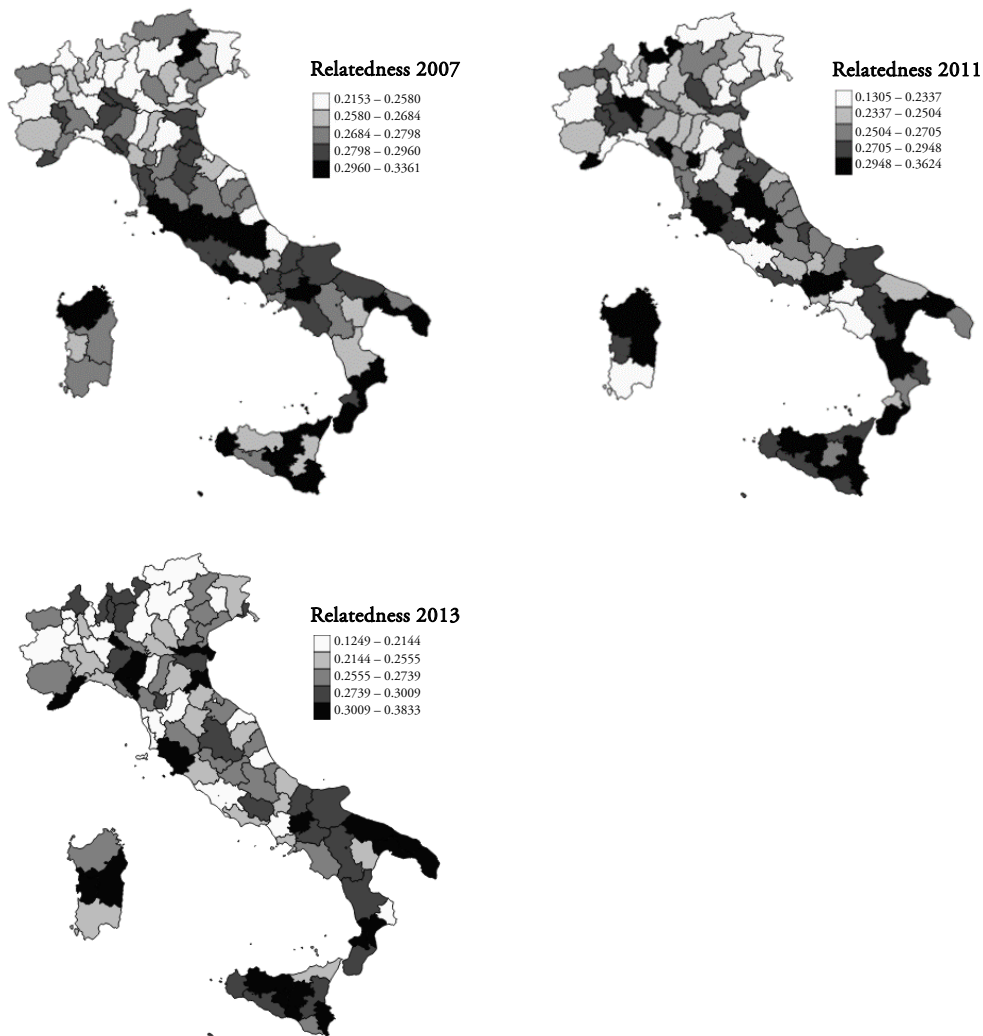
Following the framework developed in the theoretical background, we infer that:

- A high value of relatedness indicates a propensity for a ‘**related diversification**’.
- A low value of relatedness indicates that new specialisations are ‘**un-related**’ to the existing specialisations.

### 3.3. MEASURING RESILIENCE

We measure resilience through resistance and recovery indices using the index firstly developed by Martin (2012). Particularly, resistance is measured using the method adapted by Faggian et al. (2018) and recovery through the measure proposed by Lagravinese (2015).

FIGURE 2.  
Relatedness of new specialisations (years 2007, 2011, 2013)



Source: Authors' elaboration using QGIS software.

The measure of resistance is used to understand how each province resisted the occurred shock.

$$RES = \frac{E_{p,t}}{E_{p,t-1}} \bigg/ \frac{E_{n,t}}{E_{n,t-1}} \quad (5)$$

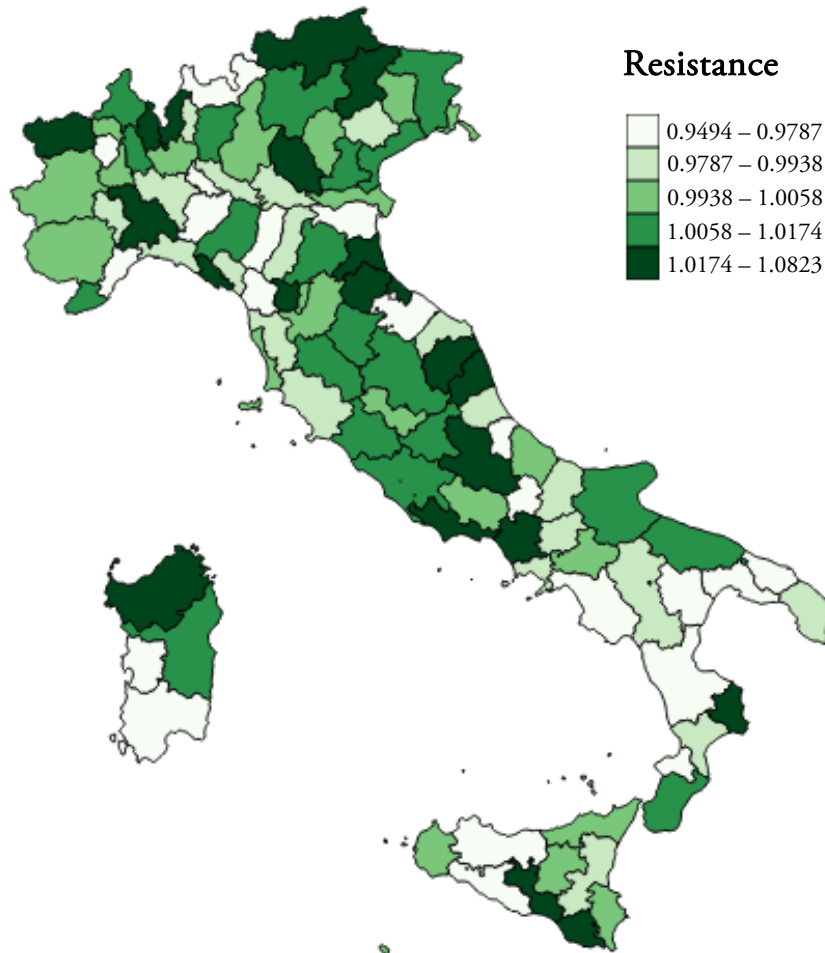
Where  $E_p$  is the total employment in the province of interest and  $E_n$  is the total employment in the nation. The period ( $t$ ) represents the recessionary period and the period ( $t_i$ ) represents the pre-recessionary period. In this case, following the literature, the recession period is considered as the variation between 2009 and 2010.

A value of the index higher than 1 indicates that the province resisted better than the others to the shock, while a level lower than 1 indicates a performance lower than the average compared to other provinces.

Figure 3 shows the resistance of Italian provinces to the great recession of 2008. It is possible to see that there is not a precise pattern of resistance through the north-south divide. However, a slightly higher

resistance appears in the center-north of Italy even if there are some highly resistant provinces in the north of Sardinia in the extreme south of Sicily and that the crisis hit so bad also in some provinces in the north.

**FIGURE 3.**  
**Resistance of Italian provinces**



**Source:** Authors' elaboration using QGIS software.

The following index of recovery shows how a province has reacted after the occurrence of the shock.

$$REC = \left( \frac{\Delta E_p}{E_p} \right) / \left( \frac{\Delta E_N}{E_N} \right) \quad (6)$$

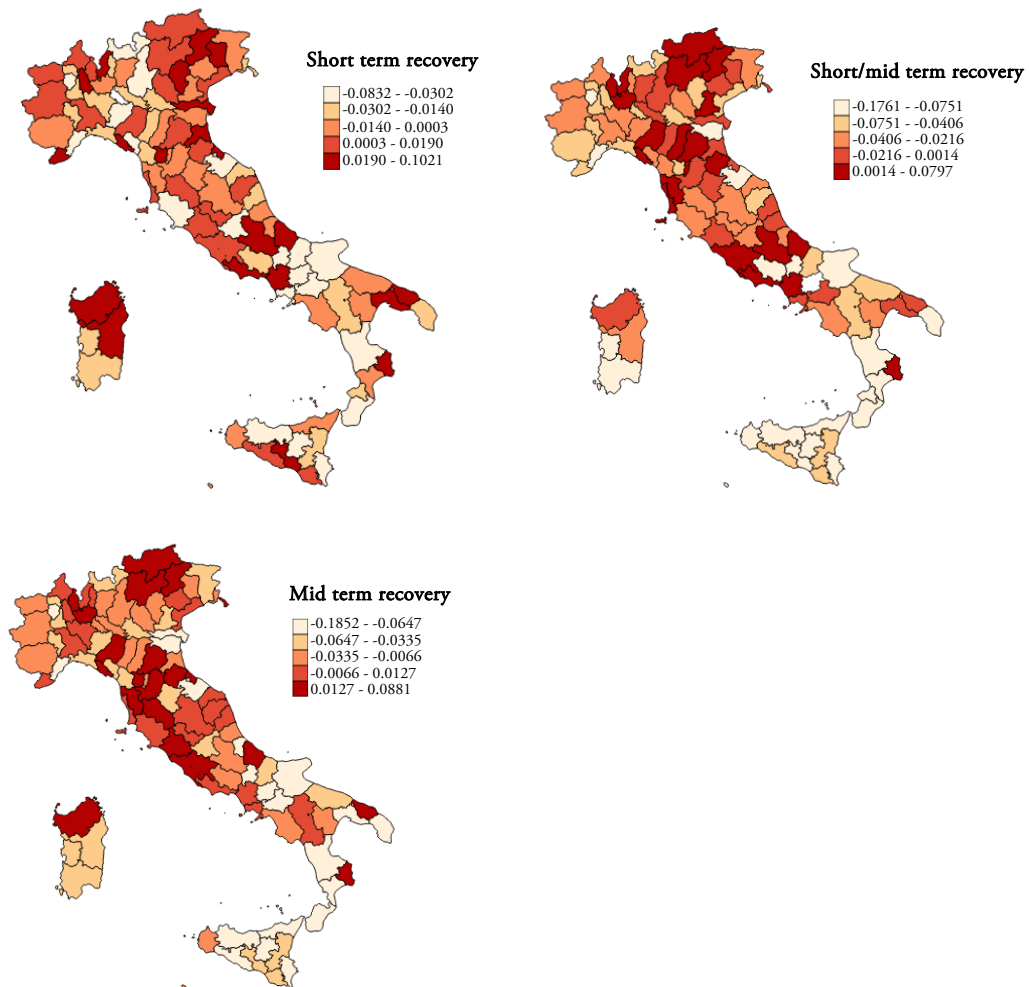
It is represented by the change in the percentage of the province's employment after the shock and is usually computed between one and five years after the crisis<sup>1</sup>. In this case, figure 4 shows the recovery of Italian provinces after one year (2011), to capture the recovery in the very short-term, after three years (2013) representing a short/mid-term recovery and five years (2015), that represents a mid-term recovery after the crisis occurrence.

It is possible to see how in this very short term the levels of recovery are quite similar to those of resistance, meaning that the provinces that resisted the crisis also continued to grow in the following

<sup>1</sup> Here the indexes of recovery have been computed after one, three and five years after the occurrence of the crisis, to understand if different diversification strategies were effective in short or medium term.

period. At the same time, after three and five years the north started to recover and grow much more than the south of Italy.

**FIGURE 4.**  
Recovery of Italian provinces after 1, 3 and 5 years



**Source:** Authors' elaboration using QGIS software.

## 4. RESULTS

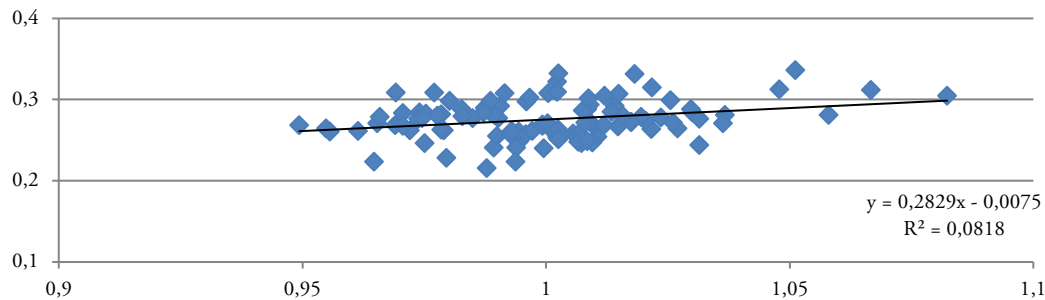
### 4.1. NEW SPECIALISATIONS AND RESILIENCE

This section investigates the relation among the relatedness of new specialisations of the Italian provinces compared to resistance and recovery. This allows us to understand if following a strategy of diversification in industries related to those already existing in the province, during the years before the crisis, is associated with a higher resistance to the shock occurred in 2008.

Figures 5 and 6 present the scatterplot between the relatedness of new specialisations occurred in the Italian provinces in the period 2006-2007 and 2007-2008 and the resistance in term of employment after the occurrence of the great recession 2008-2010.

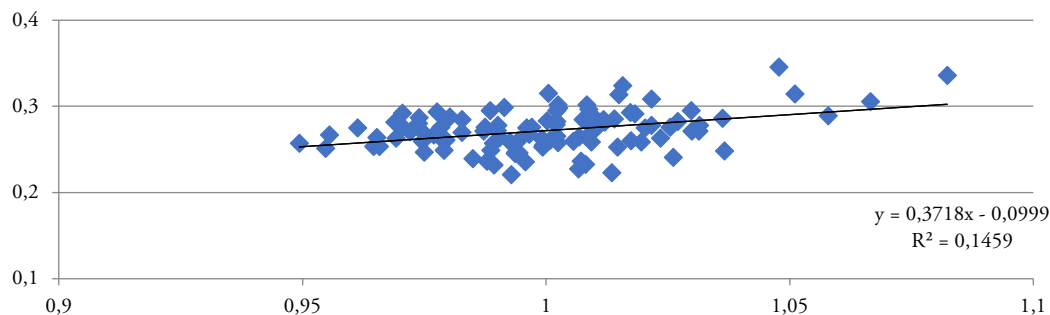
The results show how provinces that were following a strategy of diversification into related industries before the crisis resisted better to the great recession. This result is confirmed in the case of the relatedness of both years before the advent of the crisis.

**FIGURE 5.**  
**Relatedness before the crisis (2007) and resistance of Italian provinces**



**Source:** Authors' elaboration.

**FIGURE 6.**  
**Relatedness before the crisis (2008) and resistance of Italian provinces**



**Source:** Authors' elaboration.

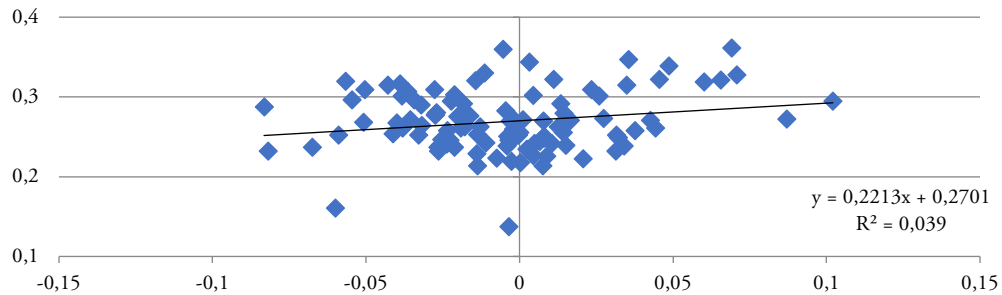
The following figures use the same methods to establish a relationship between the relatedness after the occurrence of the great recession and the recovery of the Italian provinces. In the very short-term recovery – two years - (Figure 7), the relation with the strategy of diversification followed immediately after the crisis is positive but very weak, which means that new specialisations relatedness to the already established specialisations of the area does not seem to have a clear association with the recovery of the regions in the very short-term.

However, when we look at the Figure 8 showing the short/mid-term recovery (2013), the relationship becomes negative. Finally, this result is even more evident in the mid-term recovery (2015) represented in Figure 9, meaning that concerning the capacity to grow after the occurrence of the crisis, the strategy that seems to play a positive role is to diversify into less related activities.

The results are in the opposite direction compared to the resistance to the shock. This implies that to resist the shock occurrence, a more conservative strategy that diversifies into related activities enables the region to better absorb the shock. Thus, those regions that followed riskier diversification, specialising into less related activities had a lower capacity to resist the shock. An explanation could be that new specialisations, born immediately before the crisis and unrelated to those already present in the area, are probably less consolidated in the region and thus less suited to resist a shock occurred few years after their birth. While after the crisis, it seems that a riskier diversification path is needed to enable the region's

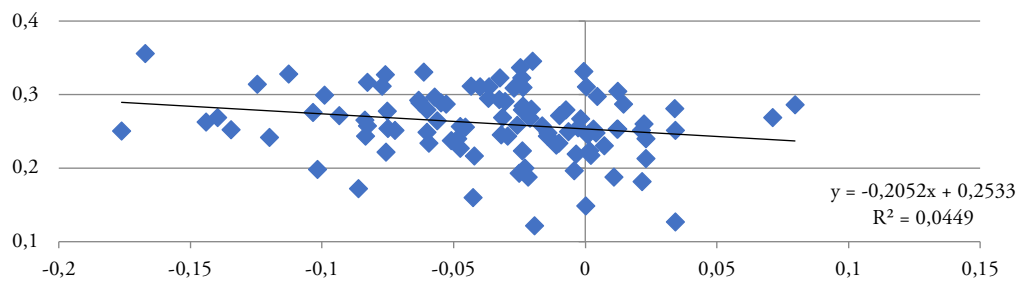
recovery and thus start to grow again. This result could be associated with new opportunities and new niches that arise after the shock.

**FIGURE 7.**  
**Relatedness 2009 and short term recovery (2011) of Italian provinces**



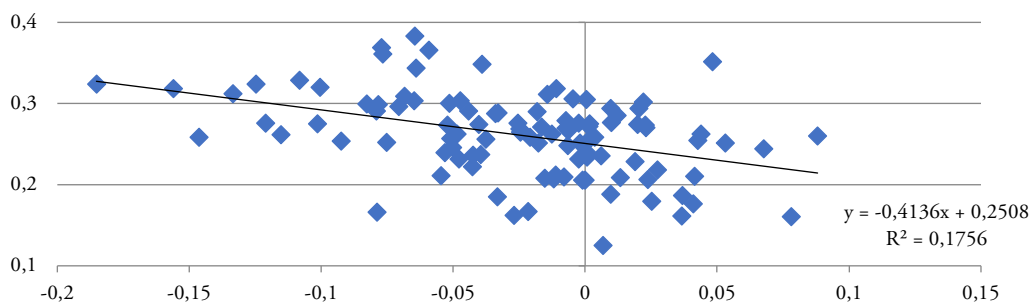
Source: Authors' elaboration.

**FIGURE 8.**  
**Relatedness (2011) and short/mid term recovery (2013) of Italian provinces**



Source: Authors' elaboration.

**FIGURE 9.**  
**Relatedness (2013) and mid term recovery (2015) of Italian provinces**



Source: Authors' elaboration.

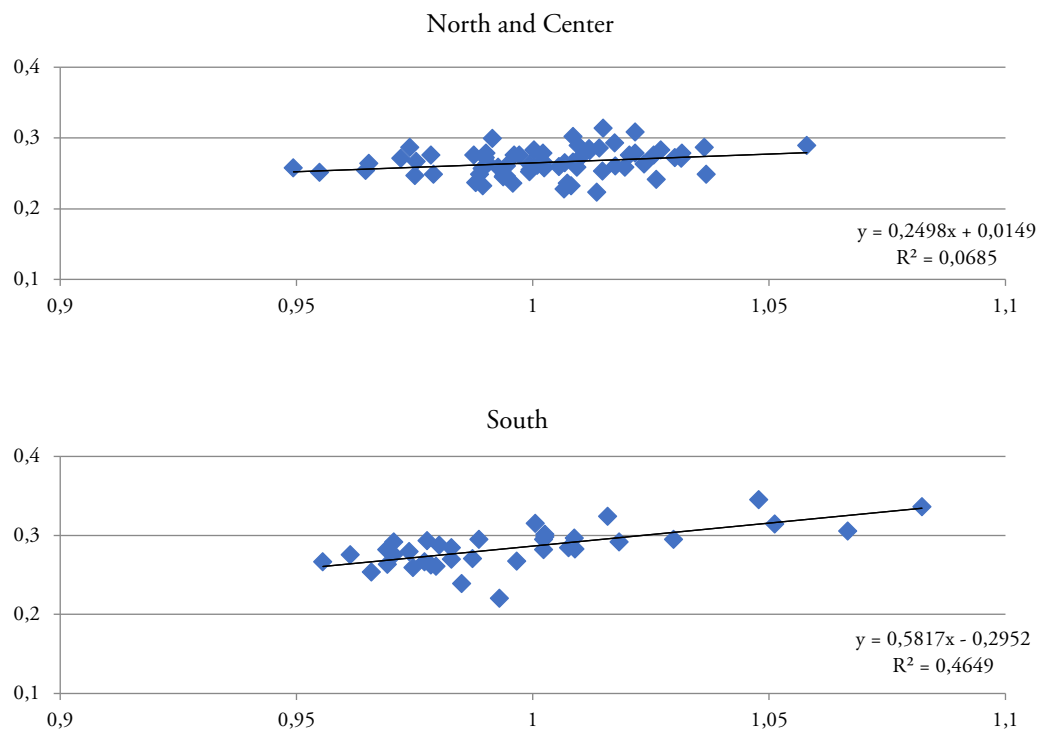
#### 4.2. DIFFERENTIALS OF DEVELOPMENT

The different effects on resistance and recovery of new specialisations relatedness to the industrial structure of the region may be due to differentials in the industrialisation between regions. For this purpose, the Italian case is particularly relevant. In fact, it is well known that the differentials in the industrial development between the north and the south of the Italian peninsula (Cellini and Torrissi,

2014; Di Caro, 2015) could have influenced the capacity to react to the shock occurrence. To better investigate this phenomenon, Figures 10 and 11 show the results of the relation between the level of relatedness and resistance divided respectively for the provinces located in the north-center and the south of the Italian peninsula.

The results show that the positive association between the relatedness of new specialisations occurred in the period before the crisis and the resistance is strongly driven by the provinces located in the south of Italy. In fact, the results for the provinces located in the north-center are still positive but largely less robust than those of the provinces located in the south.

**FIGURES 10, 11.**  
**Relatedness before the crisis (2008) and resistance of Italian provinces divided by north and south of Italy**



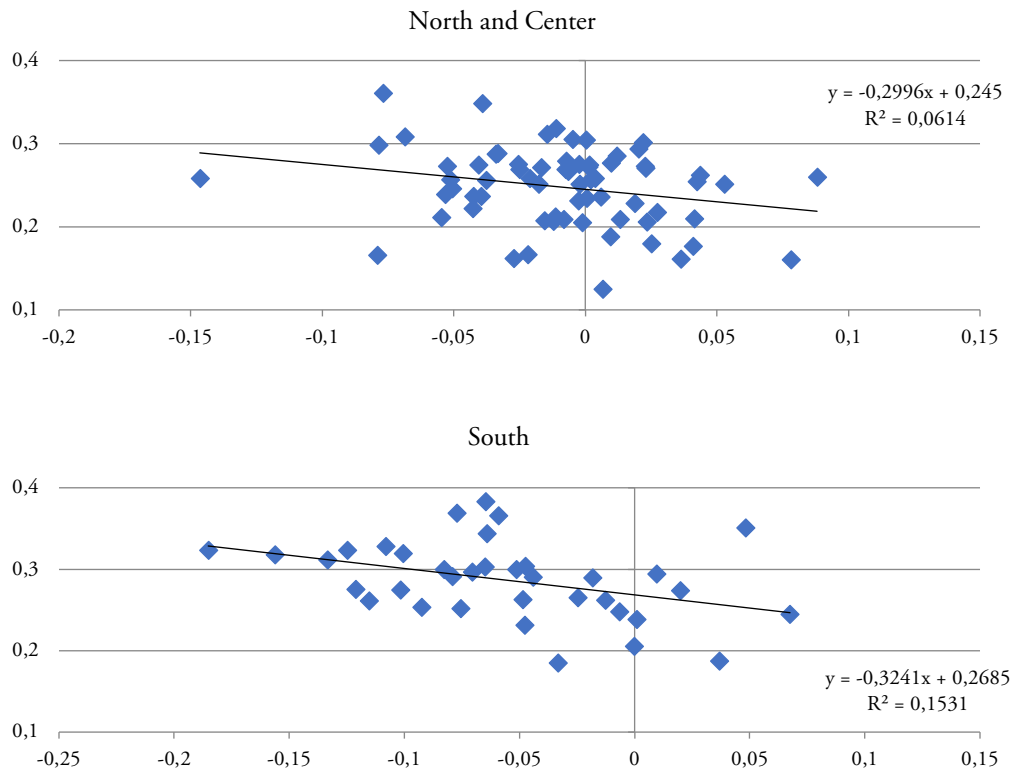
**Source:** Authors' elaboration.

The same results can be seen in Figures 12 and 13. In fact, when we decompose the results related to the connection between the relatedness of new industrial specialisations occurred after the crisis and the recovery of the last period considered in our analysis (2015), we can observe that the negative relation is stronger for those located in the south of the Italian peninsula.

What it seems to emerge from an in depth analysis of the new specialisations occurred before the crisis and that drive the south into a higher resistance of those provinces specialising into related activities, is that they diversified their specialisations into activities more connected with the heavy industry and this lead to a higher capacity to absorb the shock in respect to the provinces located in the north of the country.

However, what seems to have a negative impact is the diversification into related activities after the shock. And what emerges is that, after the shock, the diversification into related activities leads to lower growth in terms of employment and thus to a slower recovery of the provinces. In fact, with the great recession, many firms were driven to failure. Even if the market shrunk, new opportunities arose that were occupied by less competitive firms before the advent of the crisis. This result led the provinces that diversified in those less related activities, to achieve higher performance and a faster recovery.

FIGURES 12, 13.  
Relatedness after the crisis (2013) and recovery of Italian provinces divided by north and south of Italy



Source: Authors' elaboration.

## 5. DISCUSSION AND CONCLUSIONS

As shown in the previous sections, Italian provinces reacted differently to the crisis and the diversification effect was strongly affected by the area's industrial development. Results show that provinces following related diversification are resistant in the very short-term. However, considering recovery in short to mid-term, the adoption of a related diversification is unexpectedly not associated with higher performance in the following years. Such results may be explicated assuming that when regions face a crisis, a radical change is required because the relatedness effect may reduce in the long-term (Saviotti and Frenken, 2008).

In general, the principle of relatedness (Hidalgo et al., 2018) affirms that the probability of the entry of a region in a new economic activity depends on the number of related activities, hence the related diversification is a key driver of economic growth (Boschma, 2017). However, some empirical evidence suggests that cases of unrelated diversification may lead to a higher growth rate under certain conditions (Pinheiro et al., 2018). This result could also be shown in the case of an economic crisis.

The canonical model of path dependence suggests that a paradigmatic change occurs as a response to an external shock (Arthur, 1994; David, 2001). It implies that certain lock-in mechanisms supporting path-dependent industrial trajectories may be de-locked by the advent of an economic shock, leading actors to explore unusual and less-related paths. A crisis context makes diversification/specialisation strategies different from the usual context of economic growth. It may open possibilities to fill underused potentialities of regions to favour growth.



Both resilience and smart specialisation approaches look at structural change as a positive output of regions and a successful application of the policies. In line with the existing literature (Martin, 2012; Evenhuis, 2017), our results suggest that structural change is the output of the resilient process and that resilience can be influenced by the industrial structure. Contrary to the expectations, it emerges as an unrelated diversification. These implications are highly interesting for further development of smart specialisation and resilience approaches.

Concerning resilience, before the advent of a crisis, a related diversification strategy can lead to a higher resistance to shocks because it may favor the consolidation of acquired regional advantages and easy integration of new specialisations with existing ones. On the contrary, a path of diversification in unrelated sectors may expose the region to a higher sensitivity to an external shock, in the short-term because synergies and connections with other sectors are not yet stabilized. However, during the recovery period, further dynamics come into play and these are linked to new opportunities where the crisis forced the exit of firms outside the market. Furthermore, sector-specific crises may entail the need to invest in less related activities, less affected by the crisis and, therefore, still profitable. This reflection is in line with the literature on resilience that affirms that the diversity of economic structure, especially with little dependence on procyclical industries, may reduce the effect of shocks (Evenhuis, 2017). This aspect may be even more significant for those countries strongly specialized in certain industrial fields and where a big difference in the levels of development of northern and southern regions exists, such as Italy. The effect of unrelated variety on the growth of specific sectors, such as manufacturing (Bishop and Gripaios, 2010; Mameli, et al., 2012), or in all sectors (Fritsch and Kublina, 2018) is confirmed by empirical evidence. Moreover, concerning the specific case analysed, previous studies on resilience in Italy (Di Caro, 2015; Lagravinese, 2015) underline the inability of the Italian southern regions to recover from a series of economic crises over time. This feature has exacerbated their ‘un-resilience’ and has probably favoured the conditions to develop related specialisations due to a low innovative capability and the consequent inability to create new and un-related sectors. On the contrary, longer and higher resilience of northern regions may explicate their higher innovation capacity in generating new less path-dependent trajectories.

Concerning policy implications for smart specialisation, results suggest that a higher risky context, such those of a crisis, may lead towards unexplored opportunities and the structural change advocated by smart specialisation may coincide with patterns of *radical foundation* where the new domain has few connections with the existing industrial structure (Foray, 2015). A variety of smart specialisation strategies exist and they do not only concern ‘related diversification’. Among the others, they may be connected to a combination of unrelated knowledge to move into new related and unrelated industries or a strategy based on related activities to move into unrelated industries (Asheim et al., 2017). What is important is to consider also some contextual elements, such as those that can characterise an uncertain economic environment, to achieve the most desirable model of structural change. These should coincide with the search for the entrepreneurial knowledge that corresponds to this vision (Foray and Rainoldi, 2013).

Moreover, some characteristics, such as the quality of institutions and the propensity for innovation by policymakers, can inhibit the application of smart specialisation policies and lead to the failure of the entrepreneurial discovery process (Marques and Morgan, 2018). Indeed, if a successful strategy should be based on the economic structure of regions and should support the discovery process undertaken by companies and organisations operating within that economic structure (Foray et al., 2011), this would require a high level of institutional capabilities. These are, therefore, ‘place-based’ and may lack in those economically weaker regions that most need innovation policies (McCann and Ortega-Argilés, 2016). It may be the case in the southern Italian regions where the poor quality of institutions and a weaker socio-economic structure can interfere with applying innovative policies based on existing local capacities. It follows that the planning of a successful strategy of smart specialisation should take into account not only the strengths of the regions, such as their competitive advantages, but also their weaknesses, often linked to a socio-economic context not inclined to innovation due to absence of entrepreneurial capacity, low quality of the government, unemployment, few propensity for R&D investments, etc. This evidence aligns with the European Regional Development Funds’ idea for innovation-led territorial development based on smart specialisation that has activated specific strategies for lagging regions. These strategies should involve not only the identification of potential local strengths and market opportunities for competitive

advantage but also require policymaking and governance support to innovation strategy to avoid institutional failures and limit their transformative potential.

Despite this evidence, there is still little knowledge about the relationship between ‘smart specialisation’ and resilience. This article represents a preliminary contribution to combining such approaches. The analysis explores the transformation of industrial structure concerning economic shocks, both in a short and mid-term perspective, through evaluating dimensions of resistance and recovery. It aims to understand if new industrial specialisations may emerge in a context of crisis and are related to the existing ones. Moreover, applying the methodology of relatedness, the research has made an effort to develop a framework that operationalizes the concept of smart specialisation and connects resilience with a policy dimension.

Of course, the paper is not free of limitations. Firstly, the rather short period under consideration does not allow us to make considerations regarding long term structural changes. In the same direction, the few years considered before the advent of the great recession limit the strength of the association between structural change and resilience. For this purpose, studying resilience and smart specialisation is particularly interesting and opens the discussion for further research. Future analysis should go deep into understanding which characteristics of the pre-shock industrial structure may influence the recovery trajectories, taking into account other place-specific features, such as innovation capacity, endowment of territories, quality of institutions or interregional linkages. These arguments are tackled by both the resilience and the smart specialisation literature. Finally, future research should investigate the implications of the discovery process of domains that should be prioritized when contexts of change and uncertainty are considered. This aspect could indeed be useful for the orientation of the policy of smart specialisation and to cope with the challenge of the global scenario.

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