Economic crisis and regional resilience: detecting the 'geographical footprint' of economic crisis in Greece*

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Abstract. Taking stock from the research on regional resilience and by constructing a composite regional resilience indicator this paper sets out to detect the resistance/vulnerability of Greek regions and prefectures to economic crisis. Analysis is based on a newly elaborated dataset with socio-demographic, economic and welfare variables for Greek regions enabling to pre and after-crisis comparisons. Results highlight the multiplicity of ways in which crisis impacts on regions. Metropolitan areas and regions that are based on manufacturing activities seem to have been more vulnerable to crisis while places that are based on tourism such as islands are usually more resistant. Regional policy seems to be pro-cyclical to economic downturn.

1 Introduction

Amid the most severe economic and fiscal crisis that most countries are facing today, the emerging need for economic stabilization of national economies has outweighed regional development policy issues. However, economic recession and fiscal austerity have a critical 'geographical footprint' and it behoves regional scientists to carry on their responsibility of shedding light on these issues. This paper sets out to present recent research findings regarding the spatial impact of economic crisis to Greek regions and prefectures. It also discusses the policy response to regional recession.

Greece faces one of the most severe economic crises in its modern history being at the brink of bankruptcy, as a result of exogenous (i.e., the global financial crisis; see Felton and Reinhart 2008; Lapavitsas 2009; US Senate 2011; Kotios and Pavlidis 2012) and endogenous (i.e., prodigality, clientelism, bureaucracy, structural weaknesses; see Katsimi and Moutos 2010; Oltheten et al. 2003; Lyrintzis 2011; Petrakos et al. 2012) factors. Beginning in October 2009, fears of a sovereign debt crisis developed among investors concerning Greece's ability to meet its debt obligations due to strong increase in government debt levels (*The Economist*, 2010a, 2010b; Higgins and Klitgaard 2011). This led to a crisis of confidence, indicated by a widening of bond yield spreads and the cost of risk insurance on credit default swaps compared to the other Eurozone countries.

The recent[1] bailout loan signed between the Greek government and the EU-EC/ECB/IMF tripartite committee (the so-called 'Troika') comes with strict fiscal rules and austerity measures described in a memorandum of understanding, the Medium-Term Financial Strategy 2013–2016 (*see* Greek Ministry of Finance 2012).

In such a framework, and while the sovereign debt crisis was spreading to other countries (i.e., Spain, Portugal, Italy and Ireland), the achievement of the macroeconomic (fiscal and structural) objectives of the country – as for the EU – was, inevitably, the overriding priority for successive governments of that period. However, the Greek crisis has, also, a distinct spatial component that should not be neglected as:

1. the initial, pre-crisis, conditions (i.e., market size, accessibility, geomorphology, natural resources, productive structure) were, already, strongly differentiated among Greek regions;
2. the anti-crisis, austerity, measures taken in Greece, though horizontal in their nature, may have significantly differentiated implications across space;
3. the implementation of spatial policies in Greece may be hindered due to the country's stressful fiscal situation.

For Greece, a country that has been hit severely by economic downturn, research on the regional consequences of economic crisis is scarce. Lack of data and the fact that economic crisis is evolving (still in full swing) have been detrimental factors for a systematic account as regards the regional impact of economic crisis. A research project delivered by the Ministry of Development, Competitiveness and Shipping is one of the few attempts that explicitly examine the impact of economic crisis on the regions (Psycharis et al. 2011). The scarcity of research, also, applies to the international literature since only recently research papers on recent regional recessionary shocks have started to be published in scientific journals (Groot et al. 2011; Fingleton et al. 2012).

The paper sets out to detect the spatial footprint of the on-going economic crisis in Greece, assessing the resilience (neologism: 'crisilience') of the Greek regions and prefectures (NUTS 2 and NUTS 3 spatial level), from its outset of the economic crisis in 2009 until the most recent time data allow. In particular, the paper tries to provide convincing and empirically-supported answers to a series of critical questions:

• Do geographical co-ordinates affect the pattern and the intensity of the crisis?
• How different regions are affected by the economic crisis?
• Which regions proved to be more resilient?
• Is regional policy counter-cyclical to crisis?

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[1] This is the third successive bailout loan signed. For the previous ones, *see*, Greek Ministry of Finance (2010, 2011).

Table 1. Analysis' variables and units of measurement

	Variables	Units	Category
V1	physical population change	(births/deaths)	socio-demographic
V2	employment	(% of work force)	environment
	(un)employment	*(% of work force)*	
V3	per capita value of exports	(eur/inh. – Constant prices 2000)	economic
V4	per capita non-residential energy consumption	(MWh /inh.)	environment
V5	per capita volume of new constructions	(q.m./inh.)	
V6	per capita nights spent, foreigners	(nights/inh.)	
V7	per capita nights spent, citizens	(nights/inh.)	
V8	per capita savings	(.000. euro/inh. – Constant prices 2000)	citizens' welfare
V9	per capita residential energy consumption	(MWh/inh.)	
V10	per capita new car registrations	(registrations/1000 inh.)	
V11	per capita public investment	(eur/inh. – Constant prices 2000)	regional policy

To this end, an indicator for the assessment of resilience during the crisis (CrI) is constructed and estimated. CrI is comprised of an indicator for the assessment of the crisis's impact (IACI) and an indicator for the assessment of welfare (IAW). Each indicator utilizes statistical data including a series of socio-demographic, economic and welfare variables. The data are derived from different official sources (see description of variables in Table 1) and were assembled together in order to construct a database to support the analysis of regional resilience for the period 2006–2010. CrI and its components are concise, yet comprehensive, policy tools, allowing for the study of the spatial footprint of economic crisis in Greece.

Regional development has been a principal goal for the country and the European Union for more than thirty years, and therefore the consequences of crisis on regions are an essential part of our knowledge about the process of regional integration and cohesion in Europe.

This paper aims at contributing to the resilient discourse with many ways, such as the construction of resilience indicator, the application and the identification of regional resilience for the NUTS 2 and NUTS 3 regions in Greece and finally, with an examination of cyclicality of regional policy to economic downturn.

The paper is structured as follows: following this introduction, Section 2 surveys the recent scientific literature on regional downturn, paying special attention to the notion of regional resilience as well as to the methods for assessing regional resilience. Section 3 compiles the crisilience indicator index for the assessment of regional resilience (IARR) and its components (IACI and IAW), and conducts a descriptive statistical analysis of the variables taken under consideration. Section 4 describes and interprets the findings resulting from the estimation of the composite indicators. Section 5 discusses the policy responses to the crisis. Section 6 offers the conclusions of the paper and some policy recommendations.

2 Regional downturn: a survey of the recent literature

Output and employment are the most commonly used indicators for quantifying growth and downturn of economic activity. Appropriate data for quantifying regional shifts are very limited for the period under consideration, especially at regional levels. Despite the lack of statistical data and the primary importance of macroeconomic stability there have been some important recent attempts in the literature to estimate the geographical aspects of economic crisis.

One strand of research deals with the impact of real estate and mortgage market crisis on cities and local economies. The current crisis started as a crisis in the financial market and real estate. Aalbers (2009, p. 34) denotes that "housing bubbles, faltering economies and regulation together have shaped the geography of the financial crisis on the state and city level in the US [whereas] sub-prime and predatory lending have affected low-income and minority communities more than others and we therefore not only see a concentration of foreclosures in certain cities, but also in certain neighbourhoods". Martin (2011) depicts the geography of recession by analysing the locally varying impacts of global credit crunch in the US at macro and micro geographical levels underlying that geography stands as an essential element for analysing economic crisis. Holly et al. (2011) analyse the spatial and temporal diffusion of house prices in the UK, developing a model which captures the diffusion of crisis across cities and regions in the real estate market. Marshall et al. (2012) offer another viewpoint for credit crunch with the collapse of Northern Rock in 2007 connecting this case with the peripheral financial region of Newcastle where Northern Rock was based in an attempt to understand financial geographies that range beyond the major international financial centres that often dominate debates in economic geography.

At the European Union level, literature concerning the impact of the recent global recession on European countries and regions is at its first stage. In one of the very few studies, Groot et al. (2011) present some stylized facts as to the heterogeneous impact of the global recession on individual European countries and regions providing evidence that variation in the sectoral composition contributes to the variation in the effects of the current crisis, both at the country level and at the detailed regional level across the EU. From the heterodox (Marxian) urban and regional development discourse, Hadjimichalis (2011) considers the uneven geographical development as part of the wider global crisis of over-accumulation and discusses some forgotten notions of socio-spatial justice and solidarity as integral parts in European integration. Bachtler and Davies (2009) provide an early address for the geography of crisis in Western Europe and question appropriate ways of responding to it placing specific emphasis to regional policy. OECD (2009, 2011a) explicitly relates regional policy as a response to economic crisis focusing on the role of public investment as an instrument for counter-cyclical reaction to crisis.

Another strand of research on regional impacts of economic crisis which has received growing attention is related to the regional impacts of unemployment. OECD (2011b) highlights the differentiated impact on the loss of jobs within OECD countries due to economic recession concluding that "three-fourths of OECD regions that showed employment growth between 1999 and 2007 shifted to an employment decline between 2008 and 2009 [whereas] disparities in job losses have increased". Mussida and Pastore (2012) analyse regional unemployment in Italy and find that labour turnover is related to regional unemployment rate and determined by structural change. Fingleton et al. (2012) analyse the effects of recessionary shocks in regional unemployment with reference to the UK regions during the period 1971–2010 and provide evidence that there are quite large differences in the way that regions react to recessionary employment shocks. Patuelli et al. (2012) use spatial filtering techniques to depict the geographical distribution and persistence of regional/local unemployment rates in Germany and find widely heterogeneous but generally high persistence in regional unemployment rates.

The regional impact of economic crisis in Greece has given limited attention in the literature. Monastiriotis (2011) analyses the impact of austerity measures on regional income and inequalities, arguing that the horizontal measures are widening existing disparities something that may be difficult to redress in the future. Bakas and Papapetrou (2012) examine the nature of Greek unemployment allowing for cross-sectional dependence among Greek regions and for the presence of structural breaks and suggests that structural breaks should be taken into account

when considering general models that relate unemployment to other macroeconomic variables, at the national and regional level in Greece.

Arguably, the notion that is central in the geography of economic crisis is that of 'resilience'. In a recent paper, Martin (2012) develops the idea of resilience and examines its usefulness as an aid to understanding the reaction of regional economies to major recessionary shocks and makes a preliminary empirical analysis of previous and the recent crises for the UK regions. In another relevant paper, Foster (2012) points out that resilience represents both the capacity to respond to a shock and the performance of a region once a shock has occurred. Then, she proceeds with a construction of regional resilience index and makes an application to the US cities.

There have been a quite large number of studies that are trying to analyse the concept of resilience, to construct appropriate resilience capacity measures and indexes and to test empirically the implementation and results. Taking stock from these studies we are making a similar attempt for constructing an index and measuring regional resilience of the Greek regions.

2.1 The notion of regional resilience

The departure for the present research endeavour stems, mainly, from the literature of regional resilience. Resilience is an interdisciplinary concept that denotes: (*i*) the capacity of ecosystems, individuals, organizations or material to cope with disruption and stress and retain (regain) functional capacity and form; (*ii*) the capacity of a system to adjust and respond in ways that do no damage or jeopardize effective functioning, remaining on an existing developmental trajectory or making the transition to a new one; and (*iii*) the capacity of a system to absorb disturbance and recognize while undergoing change, so as to still retain essentially the same function, structure and feedbacks (Maru 2010; Simmie and Martin 2010). Resilience can, thus, be grossly characterized as flexibility (Briguglio et al. 2006, 2008). This indicates that examining for resilience requires the consideration of: (*i*) the amount of change that a system can undergo, while retaining its structure and functions; and (*ii*) the degree to which a system can create, sustain or reorganize its capacity to learn and adapt (Christopherson et al. 2010; Pendall et al. 2010).

As regards the field of regional science, in particular, regional resilience is interwoven with (Davies 2011): (*i*) the ability to withstand external pressures; (*ii*) the capacity to respond positively to external changes; (*iii*) the longer term adaptability (or learning capabilities); and (*iv*) the capacities of governmental authorities to engage in the appropriate kinds of planning, action and social learning. The former couple of dimensions refer to regional resilience in the short-run, while the latter refers to regional resilience in the long-run.

The 'decomposition' of the notion of regional resilience (Foster 2007; Martin and Sunley 2007; Bristow 2010; Longstaff et al. 2010), makes evident that regions should have: (*i*) diversity in the number of businesses, institutions and sources of energy and food (if outside suppliers are stopped from coming in, the bulk of what is needed can be provided locally); (*ii*) capacity to adapt to changing environmental conditions (and only in cases of failure the system forced to alter the big structures); (*iii*) capacity to reorganize in the event of a shock (supply their core needs without substantial reliance on transport); (*iv*) emphasis on small-scale localized activities embedded in the capacities of the local environment, and cognizant of and adapted to its limits (no one sector becomes locally dominant); and (*v*) a healthy core or supporting economy of family, neighbourhood, community and civil society, strong in reciprocity, co-operation, sharing and collaboration in the delivery of essential services. Hence, for leading regions, the issue

might be to maintain the existing regional economic structure and developmental trajectory. In contrast, for lagging-behind regions, the issue might be to effect a transformation to a new structure and trajectory.

Regional resilience has already been used in empirical research. Fingleton et al. (2012) analyse the resilience of UK regions to employment shocks. Taking stock from two basic notions of resilience namely the engineering resilience, when regional economy rebounds following a shock and ecological resilience, when shocks permanently affect the growth path of the regional economy they find that employment recessionary shocks typically have permanent effects on the regions.

Building resilience indicators has been an on-going project for research teams across the globe. A systematic account for resilience indicators construction and application has been made by Foster (2012). 'Economic Crisis: Regional Resilience' is a European-based research project, financed by the European Observation Network for Territorial Development and Cohesion, aiming at examining how European regions react to recession, how vulnerable they are and how they will bounce-back and also how to generate recovery (ESPON 2012).

Of course, the analysis of regional resilience is still evolving. Certainly, it does not offer a ready-made solution to problems of defining the attributes that regions would need to develop to cope with the vulnerabilities inherent in an uncertain world. However, it opens new perspectives in thinking about regional development.

2.2 Methods for assessing regional resilience: composite indicators as a mean to capture multidimensional phenomena

Statistical indicators are important for designing and assessing policies aimed at advancing the progress of an economy and, consequently, the progress of a society. In particular, in the period of the on-going economic crisis the accurate measurement of resilience and development comprises an issue of extreme importance.

Per capita GDP is the most commonly used measure of development, even though, in reality, its weaknesses have, long, been recognized. Indeed, *per capita* GDP is not an accurate measure of development since it may exhibit increase while incomes for the majority of citizens may change disproportionately (or even decrease) (Galbraith 1958). However, it is, often used as such; on the rationale that all citizens would benefit from their country's increased economic activity. The major advantage of *per capita* GDP as an indicator of welfare and development is its frequent, wide and consistent measurement. The majority of the countries provide regular information on *per capita* GDP (usually on a quarterly basis), following specific methods of measurement (Kuznets 1941), allowing comparisons (both between places and across time) to be made.

Though it is often positively correlated with welfare and development (O' Sullivan and Sheffrin 1996), *per capita* GDP has come under increasing criticism since its measurements present noticeable difference with widespread perceptions.[2] The need for the construction of a composite, more encompassing, index of development is imperious. Composite indicators are increasingly recognized as useful tools in analysis and public communication. This is because

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[2] In February 2008, the (then) President of the French Republic, Nicholas Sarkozy, unsatisfied with the present state of statistical information about the economy and the society, asked Joseph Stiglitz, Amartya Sen and Jean-Paul Fitoussi to create the Commission on the Measurement of Economic Performance and Social Progress (CMEPSP). The aim of CMEPSP has been to identify the limits of GDP as an indicator of economic performance and social progress, including the problems with its measurement; to consider what additional information might be required for the production of more relevant indicators of social progress; to assess the feasibility of alternative measurement tools, and to discuss how to present the statistical information in an appropriate way (Stiglitz et al. 2009).

they are able to capture and describe complex concepts with a simple measure that can be used to benchmark performance and to assist comparisons. Composite indicators, however, do stir controversy, since their use presents advantages and disadvantages (Saisana and Tarantola 2002; Nardo et al. 2005; Saisana et al. 2005). Yet, over recent years a proliferation in their use, in various policy domains, is evident (see for example NEF 2009; Annoni and Kozovska 2010; KOF 2011; UNDP 2009).

Given data limitations and the weaknesses of GDP as a single measure of economic development, the construction of composite indicators for measuring the regional impact of economic crises, and, in particular, the level of regional resilience is of primary importance. Until now, the only empirical attempt for the construction of a composite indicator for the measurement of resilience has been that of Foster (2011) who proposes the resilience capacity index (RCI). RCI is a single statistic summarizing a region's score on 12 equally weighted indicators – four indicators in each of three dimensions encompassing regional economic, socio-demographic, and community connectivity attributes. The RCI ranks 361 US metropolitan regions by their overall resilience capacity.

Summarizing, composite indicators are offering a good single indicator for assessing regional resilience during the crisis. Such composite indicators also have the advantage that it can be adapted to different countries and to specific circumstances.

3 Construction of the indicator of 'crisilience' and its components

3.1 Compilation of the indicators system

The objective of the paper is to detect the spatial footprint of the on-going (2009–) economic crisis in Greece, assessing the resilience (neologism: 'crisilience') of the Greek regions and prefectures (NUTS 2 and NUTS 3 spatial levels). To this end, an indicator for the assessment of resilience during the crisis (CrI) is constructed. CrI is comprised by an indicator for the assessment of the crisis's impact (IACI) and an indicator for the assessment of welfare (IAW). Each Indicator utilizes statistical data referring to a series of economic, structural, demographic and social variables. The data are derived from the Hellenic Statistical Authority (EL.STAT.), and cover the period 2006–2010. CrI and its components are concise, yet comprehensive, policy tools, allowing for the study of the spatial footprint of economic crisis in Greece.

The IACI is calculated annually, for each year included in the period under consideration, as the average of the standardized growth of the values of the variables under consideration, is expressed under the formula:

$$IACI_{r,t} = \frac{\sum_{i=1}^{n} SVGX_{i,t}}{n}$$

where: G = growth; n = number of variables under consideration; SV = standardized values; X = variable under consideration; t = year under consideration; i = 1st, 2nd, . . .nth variable under consideration and r = region under consideration.

The IACI takes values in the interval [0, 1], from relatively perfect negative impact to relatively perfect positive impact of the crisis.

The IAW is calculated annually, for each year included in the period under consideration, as the average of the standardized values of the variables under consideration, is expressed under the formula:

$$IAW_{r,t} = \frac{\sum_{i=1}^{n} SVX_{i,t}}{n}$$

where: SV = standardized values; X = variable under consideration; t = year under consideration; n = number of variables under consideration; i = 1st, 2nd, . . .nth variable under consideration; r = region under consideration.

The IAW takes values in the interval [0, 1], from poor welfare to relatively high welfare.

The CrI is calculated once, for the whole period under consideration, as the resultant of the standardized average value of the IACI and the standardized average value of the IAW, is expressed under the formula:

$$CrI_{r,T} = SV\left(\left(\left(1 + SV\left(\frac{\sum_{t=1}^{k} IACI_{r,t}}{k}\right)\right)^{\left(1+SV\left(\frac{\sum_{t=1}^{k} IAW_{r,t}}{k}\right)\right)}\right)\right)$$

where: $IACI$ = indicator for the assessment of the crisis' impact; IAW = indicator for the assessment of welfare; k = number of years under consideration; t = 1st, 2nd, . . .kth year under consideration; T = period under consideration; SV = standardized values and r = region under consideration.

The CrI takes values in the interval [0, 1], from relatively no "crisilience" to relatively perfect "crisilience".

In an augmented version, the CrI is expressed under the formula:

$$CrI_{r,T} = SV\left(\left(\left(1 + SV\left(\frac{\sum_{t=1}^{k}\frac{\sum_{i=1}^{n} SVGX_{i,t}}{n}}{k}\right)\right)^{\left(1+SV\left(\frac{\sum_{t=1}^{k}\frac{SVX_{i,t}}{n}}{k}\right)\right)}\right)\right).$$

The first ten variables that are listed in Table 1 are used for the construction of the CrI and its components:

All the variables are attributed an equal weight towards the estimation of the indices and are standardized in order to be able to bear mathematical treatment (otherwise, this would not be feasible since each variable is expressed in its own unit of measurement). Standardization of the variables is made under the rule:

$$SVX_i = \frac{X_i - X_{\min}}{X_{\max} - X_{\min}}$$

where *i*, min, max denote the *i*th, the minimum and the maximum observation of the variable *X* under consideration.

At this point, it has to mentioned that, in contrast to the usual practices, the maximum and the minimum standardized values of the variables under consideration refer to the whole period under consideration and not, separately, to each year. In this way, temporal comparisons become (even more) meaningful.

Also, it has to be mentioned that the CrI should be further enriched; unfortunately EL.STAT has not yet published the *per capita* GDP figures and the declared income figures for the years beyond 2010. Furthermore, again, owing to data limitations, it is not possible for an environmental variable to be incorporated into the CrI. We should also omit some variables that were not comparable across space or/and over time such as start-ups and closures of enterprises. However, variables that are incorporated in the construction of resilience index stand for socio-economic, demographic and well-being conditions in the Greek regions.

3.2 Analysis of variables and stylized facts

Variables used in the analysis reflect the economic, socio-demographic and welfare conditions in Greece. Table 2 provides a concise description of the values and the percentage change of the variables under consideration, at the national level, during the period 2006–2010 and portraits some very important initial findings.

The first observation deals with the population change in terms of birth/death rates and shows that there has been a deterioration of this index during the study period and especially during the years 2008–10.

In terms of employment there has been clear significant reduction of employment rates after the year 2008. On parallel, unemployment rates climbed from 8.9 per cent of the workforce in 2006 to 12.5 per cent in the year 2010 (25.7 per cent in 2012).

However, the value of exports which reflects the competitiveness of economy shows some positive shifts during the period under study. Competiveness has been a long debated issue for the Greek economy and shifts in exports and the geography of export activity are significant factors for economic recovery.

Per capita residential energy consumption which stands for a measure for evolution of manufacturing activity is steadily reducing after 2008. This fact reflects the lowering of productive activity after the outbreak of the crisis.

Construction activity was shrunk by 46.58 per cent (2008–10) and 59.07 (2006–2010). Construction has been traditionally an important sector for the economy. The shrinkage of this sector is anticipated to have important spatial impact because of the high dispersion of construction activity across space.

Contrary to the previous observations, tourism has been a sector which goes in the opposite direction. The number of nights spent by foreigners has been increased during the study period whereas internal tourism has increased significantly. These trends counteract the economic downturn and help in the stabilization of the economy.

However, *per capita* savings show a great reduction especially after 2009. This reflects the increased needs for households to meet payments for extra taxes in times of salary cuts and unemployment. In addition, fears that Greece would abandon the Euro drove people to withdraw savings seeking safer deposits. This fact has made some trouble in the financial sector of the economy.

As for the residential energy consumption, which stands for an indicator of welfare conditions for households, there has been a reduction after 2008. People are trying to make cuts or

Table 2. Percentage change of analysis variables in national level, 2006–2010

Variables		Values					Change %						
		2006	2007	2008	2009	2010	2006–07	2007–08	2008–09	2009–10	2008–10	2006–10	
V1	Physical population change	106.3	102.0	109.7	108.9	105.6	–4.10	7.59	–0.73	–3.02	–3.73	–0.67	
V2	em ployment	91.1	91.7	92.4	90.5	87.5	0.66	0.76	–2.06	–3.31	–5.30	–3.95	
	(un)employment	8.9	8.3	7.6	9.5	12.5	–6.74	–8.43	25.00	31.58	64.47	40.45	
V3	*per capita* value of exports	1221.3	1231.3	1240.3	998.4	1074.8	0.81	0.73	–19.50	7.66	–13.34	–12.00	
V4	*per capita* non-residential energy consum ption	2.0	2.1	2.1	2.1	1.9	5.50	2.44	–3.24	–8.64	–11.60	–4.46	
V5	*per capita* volum e of new constructions	6.0	5.6	4.6	3.2	2.5	–6.83	–17.76	–31.21	–22.34	–46.58	–59.07	
V6	*per capita* nights spent, foreigners	3.9	4.3	4.3	4.1	4.3	11.21	–0.60	–3.11	4.53	1.28	11.96	
V7	*per capita* nights spent, citizens	1.3	1.6	1.6	1.7	1.6	17.13	1.42	9.15	–8.28	0.11	18.92	
V8	*per capita* savings	13.0	14.2	15.7	16.2	13.8	9.40	10.67	2.79	–14.64	–12.27	6.23	
V9	*per capita* residential energy consum ption	1.6	1.6	1.6	1.6	1.6	1.21	0.56	–0.39	–0.24	–0.62	1.14	
V10	*per capita* new car registrations	23.9	24.9	23.7	19.4	12.3	4.13	–4.95	–17.86	–36.48	–47.83	–48.36	
V11	*per capita* public investm ent	304.5	330.2	353.3	281.1	192.7	8.44	7.00	–20.43	–31.46	–45.47	–36.73	

Source: EL.STAT (2006–2011), own calculations.

compensate energy costs in order to cope with economic crisis. Finally, new car sales, which is also a proxy for the welfare conditions, have been decreased dramatically just after 2008.

The next step of the analysis regards the spatial dispersion of variables under consideration. Figures 1 and 2 depict the percentage changes of the variables under consideration for the Greek regions and prefectures, respectively, between the years 2008 and 2010.

Reduction of birth/death rate depicted in Table 1 has a very interesting regional pattern. Map V1 in Figures 1 and 2 shows that Attiki and Northern regions reveal negative shifts of birth/death rates, whereas, South-West regions and the islands positive ones. Employment rate depicted in map V2 reveals a downward trend almost everywhere. As for the exports Map V3 shows that there is a growing export activity from prefectures and regions outside the main economic centres and conurbations of the country, some of which are dependent upon agricultural sector (Thessaly and Western Greece and parts of the Peloponnese). The non-residential energy consumption (Map V4) has been reduced in places with high manufacturing activity (i.e., Continental Greece) revealing the reduction of production activity across space. The highly dispersed construction activity (Map V5) shows severe reduction almost everywhere. In contrast, tourism (V6, V7) and more importantly internal tourism have increased in many places across the country counteracting the negative trends in the downward trend of local economies. Savings have been reduced almost everywhere (V8), as well as new car sales (V10). As for residential energy consumption (V9) it has been reduced mainly in the most populated areas including Attiki and Thessaloniki. Contrary to these trends public investment has been reduced almost everywhere indicating a pro-cyclical response to economic downturn.

4 Spatial pattern of economic crisis

After presenting the spatial pattern of individual variables the paper proceeds with the results that are based on the composite indicator. The implementation of regional resilience index to Greek regions and prefectures yields some interesting results. Figures 3 and 4 depict the result for the resilience indicators for NUTS 2 and NUTS 3 regions respectively.

Starting from the NUTS 2 geographical level, the Southern Aegean Islands stands out as the most resilient region, whereas Attiki, which contains the capital city of Athens, appears to be less resilient. Both are ranked at a high development level. A plausible explanation for their difference in resilience performance is related to the sectoral composition of these two regions. The Southern Aegean Islands is the most developed region of the country and its economy is basically reliant on international tourism. Tourism has been among the most resilient sectors of the Greek economy and therefore regions that are specialized in tourism-based activities are also more resilient to crisis. The same explanation applies to Crete which is ranked third in resilience performance.

However, Ipeiros, which ranked second in resilience performance (and third in the ACI Indicator) is one of the least developed regions of the country and owes its positions to other set of factors. Ipeiros has recently been upgraded in the transport network of the country. It has a rapidly expanding port with modern facilities which is an entrance gate to the country and an export gate to Italy and the rest of Europe. Ipeiros is the intersection where the Egnatia axis in Northern Greece meets the Western Axis of the country that passes over the Rion-Antirion Bridge. In addition, the mountain region of Ipeiros has developed tourism activities and has a long tradition in producing quality agricultural products.

On the contrary, the economy of Attiki, and that of the capital city of Athens in particular, is specialized in sectors of the tertiary section such as banks and real estate, financial intermediaries and insurance companies that are more exposed to international fluctuations and more affected by economic crisis. As a result, Attiki is the most affected region by economic crisis.
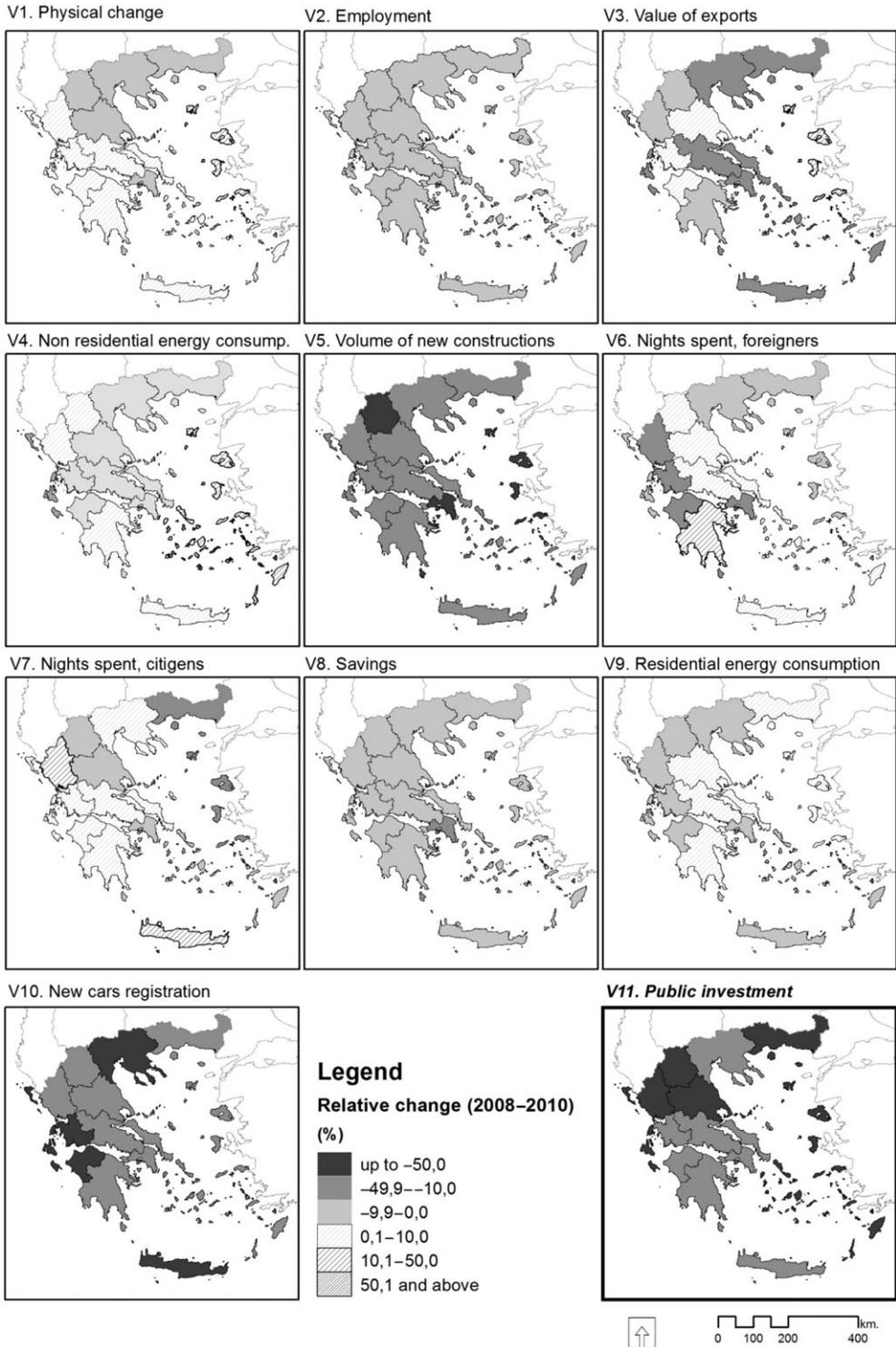
Fig. 1. Percentage change of analysis variables in NUTSII level, 2008–2010
*Source*: EL.STAT 2006–12, own calculations.

V1. Physical change

V2. Employment

V3. Value of exports

V4. Non residential energy consump.

V5. Volume of new constructions

V6. Nights spent, foreigners

V7. Nights spent, citigens

V8. Savings

V9. Residential energy consumption

V10. New cars registration

Legend

— NUTSII Borders

Relative change (2008–2010)

(%)

up to -50,0

-49,9--10,0

-9,9-0,0

0,1-10,0

10,1-50,0

50,1 and above

V11. Public investment

km.
0   100 200   400

Fig. 2. Percentage change of analysis variables in NUTS 3I level, 2008–2010
Source: EL.STAT 2006–2012, own calculations.

CrI [Indicator for the Assessment of Resilience during the Crisis]
(2008–2010)
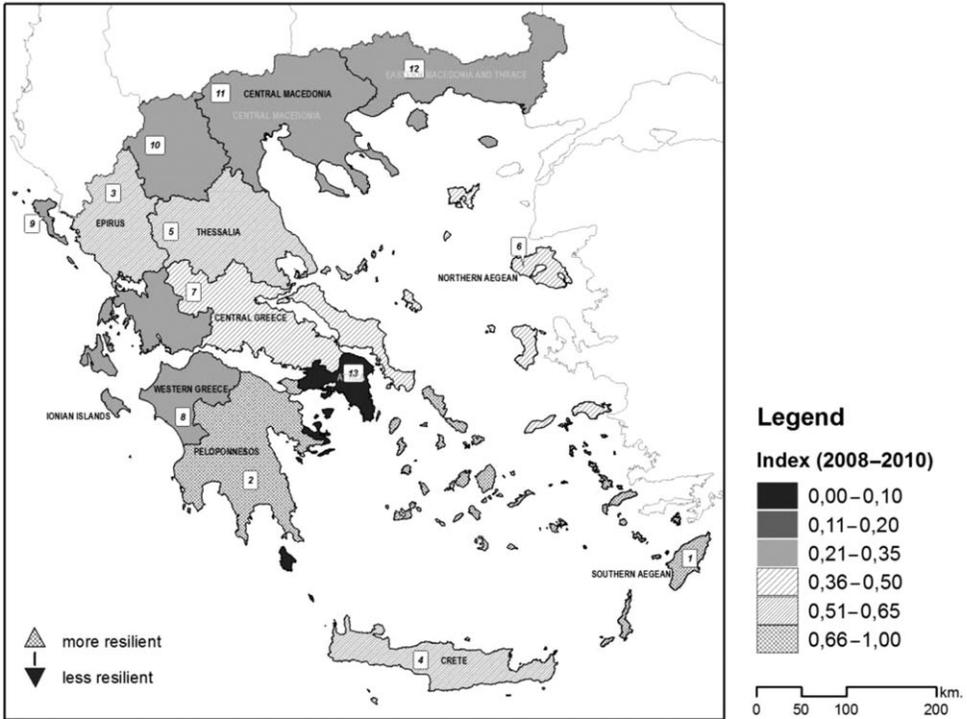
IAW [Indicator for the Assessment of Welfare]
(Average 2008–2010)
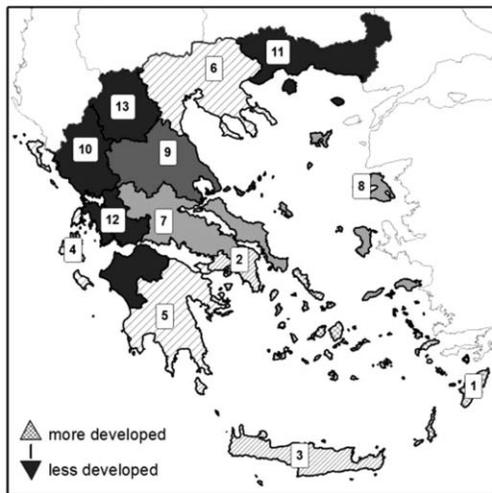
IACI [Indicator for the Assessment of the Crisis' Impact]
(Average 2008–2010)
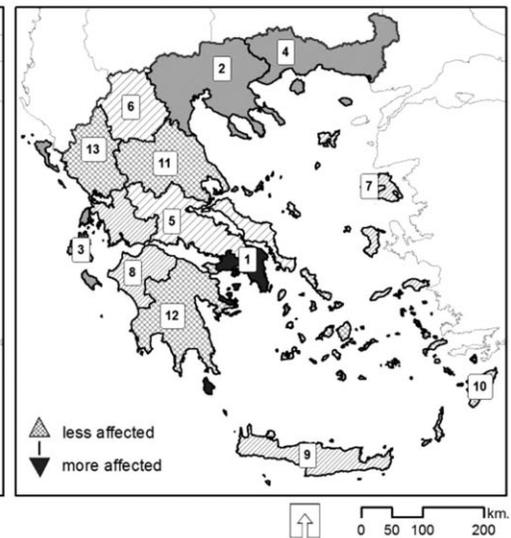
Fig. 3. Mapping the results of composite indicators for NUTSII level, 2008–2010
Source: EL.STAT 2006–2012, own calculations.

CrI [Indicator for the Assessment of Resilience during the Crisis]
(2008–2010)
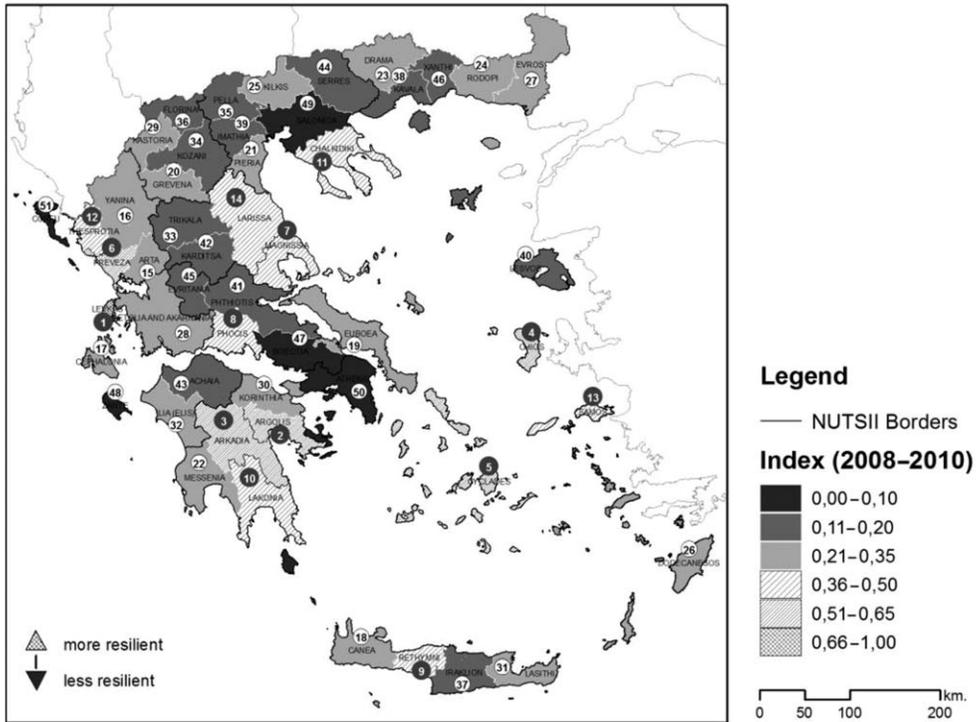
IAW [Indicator for the Assessment of Welfare]
(Average 2008–2010)
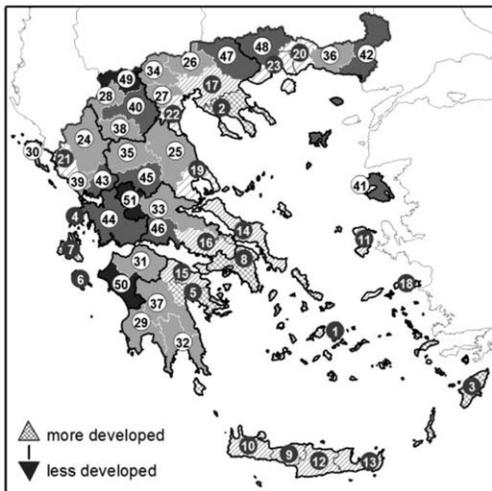
IACI [Indicator for the Assessment of the Crisis' Impact]
(Average 2008–2010)
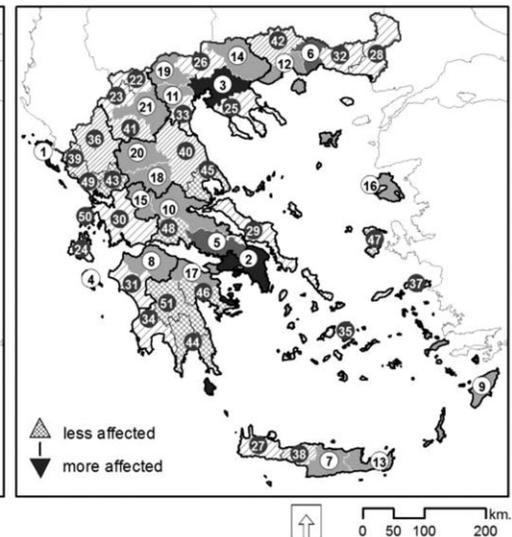
Fig. 4. Mapping the results of composite indicators for NUTSIII level, 2008–2010
Source: EL.STAT 2006–2012, own calculations.

Other less resilient regions are the border regions of Western Macedonia, East Macedonia and Thrace. The backwardness of these regions has further deteriorated by economic crisis. The same applies to the Northern Aegean Islands which are among the least developed islands of the country. Finally, the manufacture-oriented Continental Greece region and Voiotia in particular have also been vulnerable to economic recession.

As regards the NUTS 3 geographical level, among the most resilient prefectures are the islands of Lefkas, Cyclades, Rethymno (Crete) and Chios; two prefectures in the North-West part of the country: Preveza and Thesprotia with a growing harbour and end meet for Egnatia and Ionia Axes; adjacent to the Thessaloniki prefecture of Chalkidiki which is a well-known tourism destination especially for tourists from the Balkan countries and the Russian Federation; the culturally rich with heritage monuments Argolida (archaeological sites of Tyrinths and Epidaurus theatre).

Contrary to this, among the less resilient to crisis prefectures are the mountainous and lagging-behind prefectures of Evritania, Karditsa (in central Greece on Pindos array), Florina, Kastoria and Grevena (in Western Macedonia) and Rodopi (in Eastern Macedonia and Thrace), and finally, Voiotia, the location of manufacturing, most of which is 'exposed' from the adjacent greater Athens area. The geographical pattern of resilience shows that the Northern and Central parts of Greece along with the least developed islands are less resilient to crisis. Also, less resilient to crisis are prefectures specialized in manufacturing and the densely populated areas of Attiki and Thessaloniki.

Summing up, crisis has impacted on regions in multiple ways. Islands with good tourism endowment are more resilient to crisis whereas less developed mountainous and boarder prefectures are less resilient.

In addition, urbanized economies with exposed sectors to international crisis such as Athens and, to a lesser extent, Thessaloniki are also less resilient to crisis. Areas with high concentration of manufacturing activity are also vulnerable to economic crisis. These results are in line with the literature which predicts that manufacturing areas are more vulnerable to crisis (Groot et al. 2011).

5 Policy responses to economic downturn

Public investment is considered as the most appropriate policy tool for public responses to economic downturn at national and regional level. Normative economic theory anticipates counter-cyclical policy reactions to economic cycle (Alesina et al. 2008). However, empirical research provides evidence that policies at national and regional level are pro-cyclical to economic cycle (Lane 2003; Abbott and Jones 2012). Figures 5 and 6 depict the changes in public investment spending across Greek regions, and Figure 7 plots the change of public investment spending against the index of regional resilience. Results indicate that, during the period 2006–2010, there is a dramatic reduction in public investment in all but six prefectures of the country. This is something expected, since public investment at the national level has almost been halved compared to the pre-crisis period and most prefectures experience reductions above that of the country average. Results indicate that there is a positive correlation between public investment reduction and regional vulnerability. This fact supports the pro-cyclicality of public investment to regional resilience. The less resilient the region is, the higher the reduction in public investment spending and vice versa. This shows that the regional economy is trapped in a vicious cycle; a downturn spiral that deepens the recession is followed by a reduction in public investment. This result is in line with Lane (2003, p. 2668) who finds that in OECD countries "the most pro-cyclical component of government spending is government investment". However, fiscal stabilizers and counter-cyclical policy either with European

Public Investment *per capita* for the years 2006 and 2010
and (%) change for the period 2006–2010

Fig. 5. Regional allocation of Public Investment at NUTS 2 level, 2006–2010
Source: Ministry of Development, Competitiveness and Shipping 2006–2012, own calculations.

structural assistance or inward investment is necessary for counterbalancing the crisis and act as catalysts for the recovery.

6 Conclusions and policy recommendations

The economic crisis, which is still in full swing, has affected all regions and prefectures in the country. The focus of the paper has been the study of the impact of economic recession on Greek regions and prefectures, using a composite resilience indicator. Analysis yields some interesting results for scientific discussion and policy formulation.

Public Investment *per capita* for the years 2006 and 2010
and (%) change for the period 2006–2010
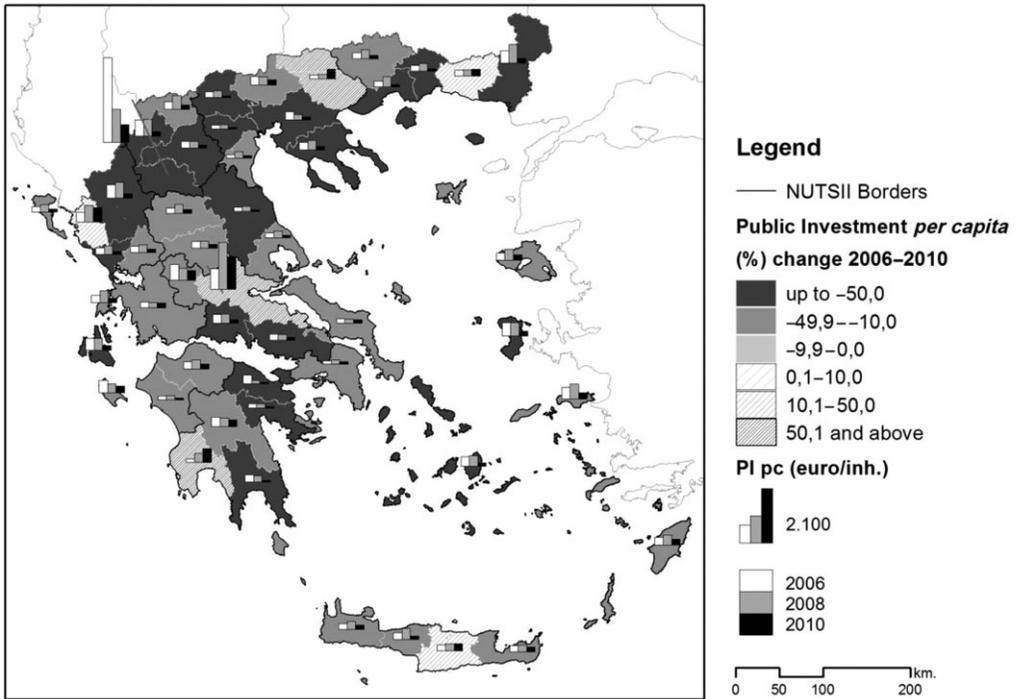
Public Investment *per capita* as (%) of the national average
for the years 2006 and 2010
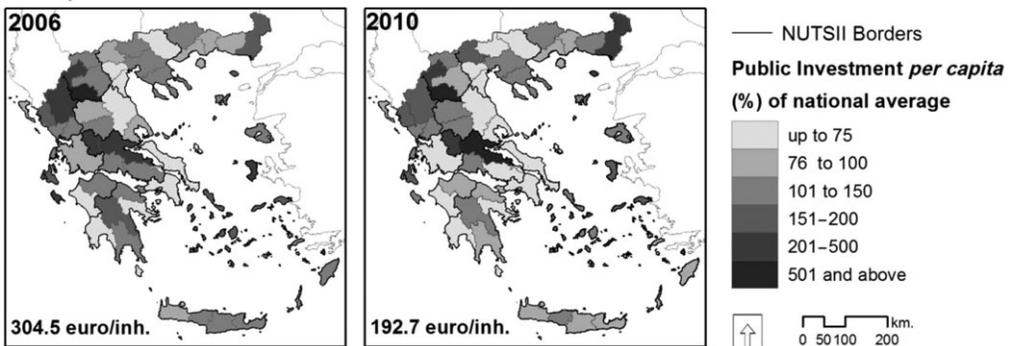
Fig. 6. Regional allocation of Public Investment at NUTS 3 level, 2006–2010
Source: Ministry of Development, Competitiveness and Shipping 2006–12, own calculations.

First, results indicated that economic crisis has impacted on all regions of the country. Especially, unemployment has rocketed in unprecedented levels showing a high degree of dispersal across space. Construction has also been hit severally and has damaged the regional economics since most of the economic activities of regions are related to the specific sector. Manufacturing activity is narrowing and areas with high rates of industrial concentration are suffering from a high degree of decline. Areas with sectors more exposed to international crisis that are usually located in large urban agglomerations are also experiencing a high decline. Contrary to these trends, tourism seems to be more resistant to crisis. In addition, areas with
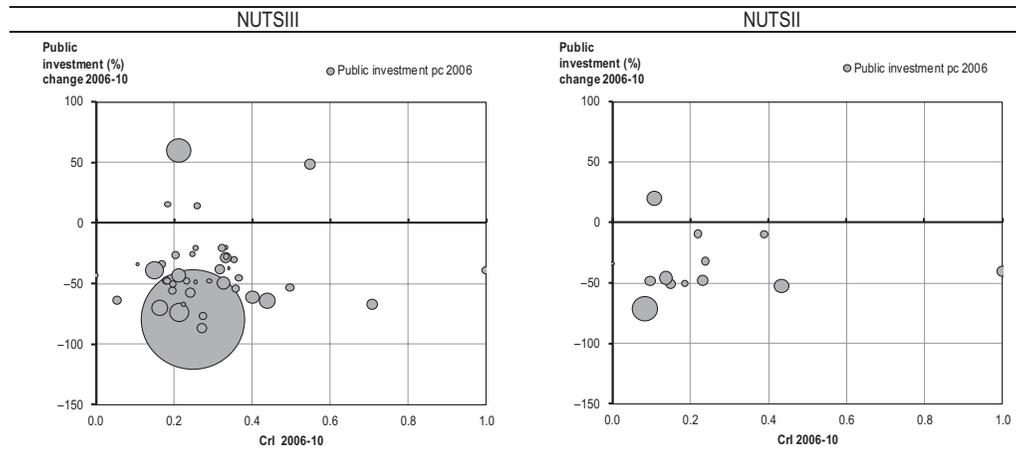
Fig. 7. Bubble plot public investment percentage change 2006–2010, CrI and public investment *per capita* 2006 (size) for NUTS 3 and NUTS 2 level

traditional agricultural production and with export-oriented activities are revealing signs of higher resistance to crisis.

Second, sectoral composition matters. Island regions with highly developed tourism activities are usually more resistant to crisis, whereas large metropolitan regions and regions expertise in manufacturing are more vulnerable. Less resilient to economic crisis have been the regions of Attiki and Epirus and more resilient have been most of the islands and some less developed regions with traditional, albeit, export oriented sectors.

Finally, public policy has been cyclical to crisis. As a result, regional economies are trapped in a vicious cycle which leads to a spiral race to the bottom. Under these circumstances the role of counter-cyclical public policy could be the catalyst for the recovery.

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Resumen. Mediante un balance de la investigación sobre la resiliencia regional y la construcción de un indicador compuesto de la resiliencia regional, este artículo se propone detectar la resistencia y vulnerabilidad de las regiones y prefecturas griegas a la crisis económica. El análisis se basa en un conjunto de datos elaborados recientemente a partir de variables sociodemográficas, económicas y de bienestar para las regiones griegas que permiten comparar la situación antes y después de la crisis. Los resultados destacan la multitud de formas en que la crisis causa impactos en las regiones. Las áreas metropolitanas y las regiones que se nutren de actividades manufactureras parecen haber sido más vulnerables a la crisis, mientras que los lugares que se nutren del turismo, como las islas, suelen ser más resistentes. La política regional parece ser procíclica respecto a la recesión económica.

要約：本論文では、地域の耐性についての過去の研究蓄積に基づき総合地域耐性インデックスを作成し、経済危機に対するギリシャの地方と県の耐性/脆弱性を調べる。経済危機前後の比較可能なギリシャ地方に関する社会人口動態変数、経済変数、福祉変数の新しい詳細なデータセットをベースに分析を行った。分析結果は、危機が地域に与えた影響の多面性を示すものである。製造業を基盤とする大都市や地方が危機による大きな影響を受けたのに対し、観光業を基盤とする島などの地域では一般的に強い耐性を見せている。地域政策は景気の後退を加速させたようである。