Measuring Regional Economic Resilience across Europe:

Operationalising a complex concept

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Abstract

This paper describes an approach developed to measure regional economic resilience across Europe which is novel in three key dimensions. Firstly, it seeks to date regional downturns as opposed to assuming that all regional economies are affected by economic shocks at the same point in time; secondly, it measures the amplitude and duration of economic downturns and subsequent recoveries; and thirdly, as well as measuring recovery, it measures the resistance of regional economies to economic shocks. The paper applies this methodology to selected European countries to provide an analysis of differential regional responses to several economic shocks since the early 1990s. The paper then reflects upon the utility of this methodology for operationalising regional economic resilience in cross-comparative studies.

Keywords: Resilience, European Regions, Economic shocks, Recovery

JEG classification: C22, E32

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Abstract

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1. Introduction

The effects of the post-2008 economic crisis across Europe have been widespread and significantly contagious but also highly geographically uneven, thereby drawing attention to differences between regions in their vulnerability to economic shocks and their ability to adapt to serious disruptions in the economic environment (Jones et al, 2010; Martin, 2011; Hadjimichalis and Hudson, 2014). This has intensified the interest of evolutionary economic geographers in the concept of regional economic resilience which offers the potential to illuminate the capacities of local and regional economies to withstand and recover from economic shocks, and to adapt their development paths accordingly (Davies, 2011; Fingleton et al, 2012; Martin, 2012). Given the breadth of the disciplinary origins and applications of the resilience concept however, coupled with the relative newness of evolutionary theorizing in economic geography, the conceptual framing and clarity of the notion of regional economic resilience remains the subject of considerable academic debate (Bristow and Healy, 2014; Martin and Sunley, 2014; Boschma, 2014).

Nothwithstanding this, economic resilience has quickly gathered credence as a concept with policy-makers and practitioners seeking to understand both why some places are better able than others to withstand economic shocks and/or recover quickly from them, and what they themselves might do to influence these capacities (Dawley et al, 2010; CLES, 2010). Indeed, policy discourse around economic development at national, regional and local scales is increasingly replete with talk of the importance of 'building a resilient economy' (Osborne, 2014).

Recent years have witnessed considerable growth in the number and variety of resilience indicators and toolkits being used by practitioners eager to understand whether a particular local or regional economy is resilient, and policy-makers keen to assess and benchmark the resilience of their economies relative to others (see, for example, CLES, 2010; Greenham et al, 2013; IPPR North, 2014; ARUP, 2014). However, the practical development of indicators has clearly run ahead of conceptual thinking on resilience. There is indeed no single agreed approach to the measurement of resilience and the growing diversity of indicators risks further diluting the clarity and utility of the resilience concept (Christopherson et al, 2010; Martin and Sunley, 2014). Existing indices remain largely unproven and past indices have proved to be inaccurate in predicting the resilience of economies to the most recent economic crisis (Briguglio et al, 2006). Yet robust measures of resilience are clearly needed, not least to help illuminate what Rose and Krausmann (2013) refer to as 'actionable variables', or the key elements that can be influenced by regional actors in processes of shock recovery. In our rush to identify what *makes* an economy resilient to economic shocks we are in danger of losing an objective means of first identifying which economies were resilient to an economic shock and which were not.

Operationalising the concept of resilience is by no means an easy task however. First and foremost, the developing literature on regional economic resilience indicates that it is a highly complex and multi-dimensional concept. The increasingly prominent evolutionary conception of resilience sees it as embracing both performance outcomes or a region's state following shocks, as well a more processual entity capturing the capacities or attributes a region has to enable it to adapt in the face the change has wrought (Foster, 2012; Martin, 2012; Boschma, 2014; Bristow and Healy, 2014). Consequently, any approach to measurement faces the challenge of capturing this conceptual complexity in a manner which

remains meaningful and useful, whilst addressing additional questions including whether resilience is being measured in absolute terms or relative to the performance of others, as well as questions about the timing and nature of the shock and recovery. These issues are further complicated in the case of comparative regional analysis where shocks and stresses may affect regions at different times and in a different order of magnitude (Foster, 2012).

The purpose of this paper is to contribute to this debate by developing an approach for operationalising the concept of regional economic resilience in a cross-comparative analysis of the effects of the post-2008 global financial crisis on European regions. We develop an approach which focuses on measuring resilience in terms of post-shock outcomes, but which adapts available methods for dating regional business cycles to capture differences in both the timing of when the shock hit regions, and the amplitude and duration of both the downturns experienced and subsequent recoveries. The paper is now structured as follows. The next section examines the challenges which surround operationalising the complex, evolutionary conception of regional economic resilience. In section three, we detail the distinctive features of our approach, whilst section four illustrates some key results from applying this approach to the regional experiences of the recent economic crisis across Europe. Section five provides reflections on the utility of this approach and the paper concludes by identifying how this may help advance the operationalisation of resilience in cross-comparative research.

2. The challenges of operationalising resilience

Recent scholarly contributions have made significant progress in understanding how regional economic resilience may be conceptualized. In contrast to the engineering

conception of resilience which focuses on the resistance of a system to shocks and the speed of its return or 'bounce-back' to a pre-shock state or equilibrium (Pendall et al, 2010), evolutionary economic geographers increasingly advocate an evolutionary, dynamic notion of resilience in line with the understanding that regional economies are characterized by complex, non-linear and non-equilibrium dynamics (Martin and Sunley, 2007; Boschma and Martin, 2010). This asserts that regional economies have empirically identifiable long-run and path-dependent development trajectories, with the resilience concept providing a valuable focus for understanding the specific impact of shocks and their role in shaping these trajectories and paths (Martin and Sunley, 2014). As such, there is an emerging consensus that regional economic resilience may be defined as the capacity of a regional or local economy to withstand, recover from and reorganize in the face of market, competitive and environmental shocks to its developmental growth path (Cooke, 2012; Martin and Sunley, 2014; Bristow and Healy, 2014).

Evolutionary theorists also assert that resilience must be conceived as a multi-dimensional and indeed processual entity. This embraces the need to understand not only the nature and duration of the shock and the region's vulnerability to it, but also its capacities to withstand or resist the shock in the first place, the robustness of its firms and institutions in responding to it, and the extent and nature of the regional economy's recovery from it (Martin 2012; Martin and Sunley, 2014). This complexity is the source of one of the critical problems which has surrounded much of the resilience literature particularly in relation to its measurement, and that is the tendency to conflate and confuse resilience *outcomes* and resilience *capacities* (Bristow and Healy, 2014).

This problem can perhaps be usefully understood and illuminated by drawing parallels with how resilience is understood and conceptualized in different disciplinary contexts. For example, psychologists understand the resilience of individuals in relation to shocks or traumas such as ill-health as being multi-dimensional (see, for example, Schoon, 2006). It is in part revealed by certain outcomes, such as the ability to avoid or resist illness in the first place, or the speed of recovery from illness (perhaps measured by the number of days of absence from the workplace). However, just looking at those indicators alone would not tell you much about why one person was more resilient than another. Nor would it tell you if an individual was likely to be resilient to future ailments. For this you would have to understand their resilience or adaptive capacities – the means they have to both help them resist and recover. These are the assets that individuals can mobilise and manage in the face of a shock, whether these be inherited genetic predispositions, or the capacity to reduce their exposure or vulnerability to risks (such as through changing their environment, diet or lifestyle). They can also take actions to mitigate the impact of the illness (for example by taking medicines, or appropriate rest), and respond or develop coping mechanisms through its duration so that key functions and activities are continued (such as asking colleagues or friends to cover work or other tasks, or drawing on savings to pay for health care or lost earnings etc). Equally, indicators of resilience outcomes alone do not provide sufficient insight into whether past events have weakened or strengthened an individual's constitution or sensitivity to their environment, nor about the surrounding environment itself. Individuals may be resilient to smaller shocks, but less resilient to larger shocks, such as a more virulent form of illness, or to a series of shocks.

The critical point is that the shock impacts differently on different individuals who have different capacities to anticipate, respond and cope. Understanding the nature of the shock

and how the external environment has changed is, however critical, and it is increasingly acknowledged that in all contexts, resilience is performed or emerges when systems are confronted by a shock or crisis (Davoudi, 2012). Thus, as Martin and Sunley (2014) observe, it is only when a shock occurs that it is possible to ascertain whether, and to what extent, the ongoing evolutionary adaptation of a region's economy has imbued it with resilience.

This implies that in measuring resilience, it is critically important to distinguish between the measurement of a region's specific post-shock outcomes, or its revealed resilience, and measurement of the region's resilience capacities. Indicators of adaptive capacity, many of which feature in some of the developing policy and practice metrics of resilience referred to earlier, do not reveal resilience. They simply point to resilience capacities or the adaptive mechanisms and processes which imbue a regional economy with the means to be resilient (as Martin and Sunley, 2014). They are the factors that need to be examined in order to understand how and why resilience outcomes vary. These factors may be shaped by a wide range of structural and behavioural factors and attributes, the relative importance of which is subject to increasing debate and which is likely to require both quantitative assessment and a more localized and qualitative ontology (Bristow and Healy, 2014; Martin and Sunley, 2014).

There are several challenges to be addressed in measuring resilience outcomes, particularly in cross-comparative research. Firstly, there is a need to identify some meaningful 'reference state', regime or path, against which the impact of a shock can be measured and the extent and nature of recovery from that shock be judged (Martin and Sunley, 2014). Are resilient economies those that continued to grow in the face of an economic shock, or those

that recovered from a shock? If it is those that recovered, then at what point can recovery be judged to have occurred?

The appropriate metric for identifying this reference state also needs to be considered. Measuring resilience as performance or *outcome* also requires identification of comparable economic indicators (such as GDP and employment), an understanding of how to deal with mixed results and trade-offs (e.g. sometimes output will show positive performance whereas employment will not), as well as an understanding of what the perceived resistance or recovery state is in the absence of a known equilibrium. This is particularly challenging when it is apparent that shocks may have a diverse range of hysteretic effects on the development paths of regions, permanently changing the composition of their economies or the behaviour of key actors within them (Martin, 2012). A related challenge is to determine whether resilience is being analysed in absolute terms (how all regions performed relative to the shock) or in relative terms (which regions performed better or were more resilient than others). Resilient outcomes may be judged relative to a region's own reference state or 'norms' (pre-shock levels, patterns and fluctuations in these performance indicators). They may also be judged in comparative context (with other regions in the same nation or in other nations).

Secondly, there is a need to define the shock or disturbance under analysis. At the macroeconomic level, economic shocks come in many shapes and guises including: financial shocks; fiscal shocks; exchange rate shocks; commodity price shocks; productivity/technology shocks; regulatory shocks, and, through disasters, shocks to capital stocks (Ahrend et al, 2011). At a local level we may also see shocks derived from (local)

decision-making processes, such as the closure or down-scaling of major employers. These shocks may overlie more 'slowburn' processes of economic restructuring and transformation (Pendall et al, 2010).

A key challenge for any study examining economic resilience is identifying when a shock has actually occurred. Taking the argument that an economy is always reacting to changing circumstances, that it is never actually in a state of 'equilibrium' (Martin, 2012), means that it is always beset by economic shocks, some minor and some major. It is only when these are of a certain magnitude, or occur in a particular context, that the effects become observable. In this regard, economic shocks can be compared to physical earthquakes. Small regular tremors pass without observation except by the most sensitive instruments. More sizeable earthquakes cause greater levels of damage, depending on the extent to which a place had planned and prepared for such an event.

For some phenomena – such as the closure of a major local employer, or the closing of access to a key market – dating a shock can be relatively straightforward. For other phenomena, such as the recent financial crisis, this can be more difficult to discern. In an authoritative review of the literature on identifying financial shocks, the IMF noted that 'the dating of debt and banking crises is typically based on qualitative and judgmental analyses' (Claessens and Kose, 2013, p.22). The challenge is exacerbated when considering the prevalence of shocks across wider territorial spaces, such as the European Union. Shocks are a recurrent feature of economic life but their incidence and geography is highly variegated, with only a few affecting multiple economies sufficiently to be classified as a system-wide shock likely to have affected all regions and impacted different regions with

similar force, and thus suitable for cross-comparative analysis. Examples include, the recessions of the 1970s instigated by OPEC oil price increases (Dow, 1998), and the European Exchange Rate Mechanism (ERM) crisis of the late 1990s (Jordà et al, 2012).

In this complex setting, identifying the onset of a particular system-wide shock for comparative analysis can be challenging. Whilst it may be tempting to look for a particular incident from which to date a shock, this can serve to confuse cause and effect. For example, although the collapse of the US firm Lehmann Brothers is often cited as a key point in the recent financial crisis, the roots of this lay in the sub-prime mortgage crisis following the collapse of the US housing bubble (Gamble, 2009). The effects of this reverberated around much of the world through a series of complex interactions (Martin, 2011; Hadjimichaelis and Hudson, 2014), coupled with second and third order effects channelled through financial markets, trade links, and behavioural changes, whereby citizens amended their consumption and savings behaviour on the basis of their wider expectations of the future (Hadjimichaelis, 2011; Smith, 2013; Hannon, 2014).

In the face of such complexity, developing an anatomy of the shock or crisis is critical in understanding the degree to which it has impacted upon regions with equal force at similar times. A regional economy may clearly be resilient to one form of shock, but not another (Martin and Sunley, 2014). Even broadly similar shocks may have a different frequency in different regions or start at different times (Foster, 2010). As such, it is a mistake to seek a single year as the fixed turning point from which to analyse resilience to a system-wide shock, as it risks mistreating the circumstances of those areas that were affected by the shock earlier, or those affected later, by reducing all data to an average date. A more

accurate approach would be to treat each region as an individual entity and consider its response to the shock according to its own unique evolutionary trajectory.

A further challenge concerns the time period given for resilience outcomes to be revealed. Existing literature suggests that this is very much a matter of judgement. In a study of regional economic resilience in the US, Hill et al (2011) consider a region to be resilient if (as a minimum) it returns to its prior growth path within a relatively short period of time, namely within four years. More generally, questions surround the relationship between short-term resilience to shocks and a region's long-run regional development pattern. Martin and Sunley (2014) argue that short-term measures of resilience as 'bounce-back' to some pre-shock state or norm, have to be understood as constitutive of long-term regional growth paths and development trajectories. As such, understanding short-term resilience outcomes may be critical to understanding longer-term patterns of regional convergence and divergence.

A final challenge is the scale of analysis. Much analysis is undertaken at the national level, but there is increasing interest in the economic resilience of sub-national units, such as regions (Fingleton et al, 2012), cities (Capello et al, 2015), or other administrative or statistical units (Doran and Fingleton, 2014). Resilience to economic shocks may vary by scale however: national economic resilience may not necessarily mean constituent regions and localities, with their diverse characteristics and development paths, will necessarily exhibit resilience to the same shock (Martin, 2012).

3. Measuring economic resilience

3.1 Constructing the reference state: a business cycle approach

One of the classic conundrums for studies of resilience is how that resilience should be measured. Whilst some writers have taken the approach of developing a basket of indicators (Briguglio et al 2006; CLES, 2010), this may conflate cause and effect. In order to understand what might make a region resilient to economic shocks we need to be able to measure its resilience in a way that does not lead to later problems of autocorrelation.

We have chosen to use two data series; firstly the level of employment in a region and, secondly, the level of Gross Domestic Product (GDP). Pragmatically, both are consistently available on a comparative basis across the EU territory. Employment is a more meaningful measure than GDP as it counts the number of people employed in a region and is less prone to revision (see Coyle, 2014). In addition, it has a social value as there is a tendency in the minds of the public and politicians to regard the possession of a job as a strong indication of the well-being of an economy. However, as GDP is a standard measure of economic well-being and tends to be used to measure entry and exit from recession, we also consider this. We use real (in 2005 constant prices) GDP data since this offers a better perspective when tracking income and output resilience over a period of time.

Following Martin (2012), our reference state is based upon a measure of absolute resilience - that is whether an economy resisted the economic shock; recovered from the economic shock, or has yet to recover from the economic shock. We further divide those economies that have not yet recovered from the economic shock into those that have begun to witness

an upturn in economic activity and those that are experiencing continued downturn. We choose to use an absolute measure for two reasons. Firstly, one can argue that whilst one economy may be more resilient than another, if both are mired in economic decline, neither have actually proved to be resilient to the economic shock itself. Secondly, measures of comparative resilience, such as Martin's sensitivity index (2012), prove difficult to operationalise on a comparative basis across different national economic circumstances owing to methodological limitations.

To understand how resilient regions are, we first need to date their business cycle turning points. We can then calculate the amount of GDP or employment loss between the peak and trough turning points of the cycle. In our approach we treat each region as a separate time series and then date the individual business cycle turning points. This allows us gauge resilience by measuring how much output or employment is lost over downturns, and to calculate the time to recovery. This approach builds on Sensier and Artis (2014) which dates countries within the UK employment cycles, and adds flexibility to the approach of Martin (2012) which assumes that all regions have the same turning point dates as the national employment series.

This investigation centres on the classical business cycle, measuring absolute falls in economic activity rather than deviations around a trend which are referred to as the growth cycle (see Harding and Pagan, 2002 for definition and dissection of the classical cycle). We favour this approach since we are interested in specifically measuring the sensitivity of regions to economic shocks in a manner that accords with traditional approaches to understanding crisis impacts (i.e. in terms of absolute falls in employment and output rather

than variations around trend growth rates). This paper applies the cycle dating methodology to regional employment and GDP data in the ESPON 31 European countries[1] to provide an analysis of differential regional responses to several economic shocks since the early 1990s.

For 28 countries we draw on data from the Cambridge Econometrics European Regional Database (see: http://www.camecon.com/subnational/subnationaleurope/regionaldatabase.aspx). Data was provided at the NUTS 0, NUTS 1, NUTS 2 and NUTS 3 spatial scales. Whilst data for much of our sample is available back to 1980, our analysis focused on the period 1990 to 2011 for which a comprehensive dataset was available. To complement this we include comparable data provided by EXPERIAN plc for the remaining three countries of Switzerland, Croatia and Iceland. This data is provided at the NUTS 1 level, and estimated for NUTS 2.

For the purposes of our work, we have defined regions as synonymous with the NUTS 2 regional classification of Eurostat. Although there are conceptual challenges with this approach (McLeod, 2001), the availability of consistent datasets at this scale outweighs these difficulties. For comparative purposes we also make use of data at the NUTS 3 territorial scale, which we refer to as 'local' in order to differentiate from the regional scale.

Following Artis, et al (2004) the economy can be in either of two mutually exclusive phases: expansion phase (E_t) or recession phase (R_t). The convention is that a peak terminates an

[1] These countries are Austria, Belgium, Germany, France, Finland, Greece, Italy, Ireland, Luxembourg, Netherlands, Spain, Portugal, United Kingdom, Denmark, Sweden, Estonia, Latvia, Lithuania, Czech Republic, Poland, Bulgaria, Slovakia, Slovenia, Cyprus, Malta, Hungary, Romania, Norway, Croatia, Switzerland and Iceland.

expansion and a trough terminates a recession. To enforce the alternation of peaks and troughs it is useful to distinguish turning points within these two phases:

$$E_t \equiv \begin{cases} CE_t \\ P_t \end{cases}$$
$$R_t \equiv \begin{cases} CR_t \\ T_t \end{cases} \qquad (1)$$

From the continuation of expansion (CE_t) we can make a transition to the peak (P_t) or continue the expansion, but not vice versa as only $P_t \rightarrow CR_{t+1}$ is admissible. Analogously, from continuation of recession (CR_t) we can make a transition to the trough (T_t) but $T_t \rightarrow CE_{t+1}$ with the probability of 1. The dating rules impose a minimum duration of a phase of 1 year as we are analyzing annual data (the popular/media definition of a recession is a fall in output in two consecutive quarters). We also impose the minimum length of the entire business cycle (from peak to peak) to be 2 years. The maximum length of cycle is unlimited and if two business cycle phases occur in quick succession then the maximum (highest peak) is dated as the start of the cycle and the minimum (lowest trough) is the end of the cycle, this could then take in two cycles (a 'double dip' recession) or more.

To determine turning points we calculate the first difference of the natural logarithm of employment and GDP series separately. When the transformed series is negative we code this value as a "1" for recession and when it is positive as a "0" for an expansion. We date the peak turning point as the observation before the recession and the trough turning point as the observation before the expansion. We compare our dating algorithm computed in Gauss to one available for download in Stata (sbbq.ado by Philippe Bracke, 2011 see https://ideas.repec.org/c/boc/bocode/s457288.html). This code is for the Harding and

Pagan (2002) algorithm and was created for quarterly data but has been adapted for our annual data. We then check that peaks and troughs alternate.

{FIGURE 1 ABOUT HERE}

To operationalise our concept of resilience we refer to the stylized employment cycle in Figure 1, where peaks are marked "P" and the trough "T" and we note the years where these are reached for the NUTS 2 regions. The percentage of employment lost following a shock is calculated as the employment level at the trough less the employment level at the peak, divided by the peak level. The amplitude/depth of the downturn is measured by the height from peak to trough, the duration of the downturn is measured in years by AB, and the duration of the full cycle (peak to peak) is AY. We are also interested in the amount of time it takes the region to recover to its pre-shock peak and this is shown by RC on the graph. This will give us an indication of how quickly the region has recovered to its pre-shock level. The steepness of the downturn is calculated as the amplitude/duration. This is the remaining side of the triangle i.e. the gradient of the lines S1 into downturn and S2 recovery to the next peak.

With regards to regional resilience, we say that a region is "resistant" (RS) to an economic shock if the growth rate of regional employment remains positive during the period of the shock that is experienced in the national (aggregate) series. For those regions that experience contractions, if they return to their pre-shock peak then we say they have "recovered" (RC). For those regions that have "not recovered" we categorize them as either having reached their trough and employment has started to rise again (NR1), or as still to reach their trough (NR2). The last year of our sample is 2011. For each region we compare a scale of resilience across Europe for the most recent crisis in a map. This provides us with a

picture of where regions are located that were (1) resistant to the last shock; (2) have recovered or are yet to recover; (3) have reached the trough turning point; or (4) are still in decline up to 2011. We carried out an analysis of the observed resilience of the 31 national economies in the ESPON territory; 289 NUTS 2 regions within this same space and 1,322 NUTS 3 territories, using both employment and real GDP data.

3.2 Dating the shock

Economic downturns are a recurrent feature of national and regional economies. Many of the shocks that influence this pattern are regionally, or nationally, specific. For a comparative analysis of resilience, a more widespread incidence of economic shocks is required. In order to identify the incidence of shocks across the ESPON space we calculated the number of regions which experienced a downturn in employment in any one year from 1992 to 2011, alongside a similar analysis for downturns in GDP (Figure 2). Since 1992, there is no year when there has not been at least one region experiencing a loss of gross employment or GDP, with the total number of regions experiencing a decline in GDP always being fewer than for employment, apart from 2008-9 in the most recent crisis. The analysis indicates two clear periods of pan-European economic downturn: the first around the 1990s and the second more recent shock from around 2008/9. A third shock with a smaller incidence can also be identified around 2003 (during this period some regions in Austria, Belgium, Czech Republic, Denmark, Germany, Sweden, Portugal, Hungary, Poland and Romania were in recession).

The differing nature, scale and origins of these two major system-wide shocks help point to their ultimately asymmetric effects. The crisis of the early 1990s represented the cumulative effect of a mix of exogenous and domestic shocks which differed between countries (see

Dow, 1998). Norway went into recession in 1988 after the world oil price halved in 1987, hitting its exports. In the UK, following the deregulation of the financial system in the mid-1980s, there was a boom fuelled by increased consumer confidence and favourable terms of trade which lead to large increases in household and corporate debt. The Government raised short-term interest rates in 1988-9 to exert downward pressure on inflation which coupled with unsustainable levels of debt lead to a loss of confidence, a house price crash and fall in real GDP 1990-1 (see Sensier et al, 2002). The boom in Germany, associated with reunification in 1990 and increased spending and investment in East Germany, came to a halt going in 1991 when federal taxes and interest rates were raised to curb inflation. The collapse of the Soviet Union in 1991 and subsequent trade shock to Finland lead to a real estate price crash wich affected many of its European trading partners.

The 2008 economic crisis is considered to be globally widespread in its effects, although geography played a complex role in both its formation and fermentation (French et al, 2009). A sub-prime mortgage crisis which had its origins in certain localised US housing markets was rapidly spread internationally through the interdependence of states, localities and institutions within global financial networks (Martin, 2011). As the crisis mutated from a financial crisis in the banking sector to a fiscal crisis of the state, it conditioned a 'dynamic of cascading geographic effects' characterised by abundant variations in both impacts and responses (Harvey, 2011; p. 17). The scale and uniqueness of its effects is further revealed by the fact

that it is the only occasion during the period of observation that more economies experienced a decline in GDP than in levels of employment.

{FIGURE 2 ABOUT HERE}

Based on the turning points identified, we map the unfolding of the economic crisis across Europe for regional employment in Figure 3. The first signs of the emerging crisis were revealed in 2006, with the effects of the economic shock gathering pace through 2007 and 2008. Regions in Bulgaria, Germany, Hungary, Italy, Portugal, Romania and the UK were amongst the first to experience employment declines. By 2009, a fully-fledged crisis had engulfed the European economies with 238 regions recording downturns in their employment levels. During 2009, however, the first signs of recovery were also apparent, with regions in Austria, Belgium, Germany, France, Hungary, Malta, Sweden and the UK all having reached their trough employment level. This variable temporal geography forcefully demonstrates the importance of not treating the shock as an event that affects all regions simultaneously, even implicitly.

{FIGURE 3 ABOUT HERE}

3.3 Timescale for resilience: how long is long enough?

To be resilient it is not, of course, sufficient to simply recover to pre-shock peak levels of economic activity. Most economies achieve this eventually. The question is the timescale over which this occurs. Here it is instructive to learn from past experience. Examination of the last major pan-European economic downturn around the onset of the 1990s illustrates that the rate of recovery to pre-shock employment levels is widely distributed (Figure 4). The long recovery 'tail' is clearly visible in Figure 4, but it is also evident that the spread of regions across different durations is relatively stable between four to ten-year recovery durations. Further analysis of this data suggests that it took four years for 20% of regions to recover to pre-shock employment levels following the early 1990s crisis, providing a possible benchmark for comparison with current speeds of recovery. Two-thirds of regions had recovered to pre-shock employment levels within a decade of entering employment downturn.

{FIGURE 4 ABOUT HERE}

Evidence from the 1990s recession also highlights how a significant proportion of regions (17.6%) never returned to peak levels of employment, despite the subsequent long economic boom (Figure 5). Blanchard and Summers (1986) describe European unemployment hysteresis where unemployment growth was persistent and lead to an permanent increase in unemployment after economic shocks. From Figure 5 we can see that employment did not recover in many regions of Eastern Europe including Estonia, Latvia, Lithuania (which also did not recover its GDP level), Romania and Poland, as also found by Cuestas et al (2011, p. 514) who suggest "the degree of persistence appears to reflect the different levels of economic and institutional development in the countries and possibly also the role of the government". In Western Europe 4 regions in Sweden did not recover along

with one in Finland and some of the former East Germany which is to be expected (after re-unification leaving behind full employment). Although the Spanish regions employment level recovered from the 1990s recession, Garcia-Cintado et al (2014) document how Spanish regional unemployment has been persistently high for the last decade. Krugman (2011) describes how future capacity can be depressed by lack of investment and austerity measures after a crisis leaving a portion of the workforce permanently unemployable.

{FIGURE 5 ABOUT HERE}

A small, but much less significant, number of regions (1.4%) also exhibited hysteresis in levels of GDP. These hysteretic effects caution against any assumption that returning to previous peak levels of employment (or GDP) should necessarily form a natural objective following an economic shock. It is also suggestive of the important interplay between economic shocks and longer-term processes of structural transformation. Figure 5 also identifies those 'resistant' regions that did not experience an economic downturn during this period, ranging from 16 regions (5.8%) which maintained employment growth throughout the wider downturn and 45 (16%) which maintained GDP growth.

4. Economic Resilience Revealed

Our analysis reveals that at the national level only four economies – Germany, Luxembourg, Poland and Switzerland - were able to resist the economic shock and maintain, or increase, their level of employment (Table 1). Only one economy – Poland – was able to resist a fall in its level of GDP. By 2011, five economies had recovered to their pre-shock employment level, whilst eight had recovered to their pre-shock level of GDP. Twenty-two economies remained mired in the aftermath of the shock, with ten still to experience an upturn in their

levels of employment. The situation was similar for levels of GDP activity, although here more national economies had achieved a turning point.

{TABLE 1 ABOUT HERE}

At a regional level, around a tenth of regions (12%) did not experience any fall in recorded employment levels, whilst almost a quarter (23%) had experienced a fall in employment but, by 2011, had recovered to their pre-crisis peak. On this basis we suggest that around one-third of regions in the ESPON European space were resilient to the economic shock of 2008/09.

In contrast, two-thirds of regions were still to recover by 2011, divided evenly between those that had passed the trough of the downturn, and those still to register the end of employment decline. Of those that were still to reach a turning point, only ten had first recorded a downturn in employment post-2009 and so it is not the case that this simply reflects the timing of the onset of economic downturn.

The distribution of regional economic resilience, as measured by employment, is set out in Figure 6, which illustrates a strong geography of resilience. This geography is clearly influenced by national patterns, reinforcing recent evidence on the importance of national effects in regional resilience (Dijkstra et al, 2015a). The severity of crisis impacts and the evidence of low resilience in peripheral parts of southern and eastern Europe, particularly Spain, Greece, Italy, Latvia and Estonia is strongly evident, again reinforcing findings from early comparative studies of crisis effects (e.g. Groot et al, 2011) and emerging country-specific studies of resilience (such as Palaskas et al, 2015; and Di Caro, 2015a). However, important pockets of recovery and non-recovery are also apparent within this overall geography, highlighting the value of a more comprehensive cross-comparative analysis and an approach which dates regional crisis impacts and measures resilience in terms of both resistance and recovery.

{FIGURE 6 ABOUT HERE}

A similar, though not identical, geography can be identified when we map the economic resilience of regions using GDP data (Figure 7). One of the features of the recent crisis was that, overall, employment levels proved to be more resilient than levels of economic output. From Figure 7 it is apparent that it was only in Poland that regions were able to maintain pre-crisis levels of GDP activity. However, more regions have recovered or begun the recovery process than is the case for employment. Some clear geographical patterns of resilience emerge, which echo those identified in the case of employment. What is also apparent is that there is less heterogeneity between regions within nations in terms of employment resilience than GDP resilience. This may reflect the relative homogeneity of regional labour markets and their responsiveness within national economies, and/or regional price differences within and between countries (see below).

{FIGURE 7 ABOUT HERE}

Comparing the two approaches, around half of regions exhibit a similar level of resilience under either the employment or GDP measure; with slightly more regions exhibiting stronger employment resilience than the numbers exhibiting stronger GDP resilience (Figure 8).

{FIGURE 8 ABOUT HERE}

Resilience can also be a more localized phenomenon, with neighbouring areas experiencing different patterns of resilience, depending upon specific local particularities. Overall, a slightly greater proportion of NUTS 3 territories were able to resist the crisis than was the case at the NUTS 2 scale, and a slightly lower proportion of those that had not yet recovered have begun an economic upturn {TABLE 2 ABOUT HERE}.

5. Reflections on the approach

This analysis usefully highlights that the economic crisis of 2008/09 was not a single event but rather a series of closely connected events that together amounted to a major economic shock. Different places were affected by these events at different times. Dating the shock as occurring in 2008/09 simply reflects the fact that this was, on average, when most economies were affected. It overlooks the early and late entrants. The business cycle approach adopted for this work is a major innovation in approaches to measuring the resilience of economies to economic shocks, as it allows a more nuanced measurement of the particular response of each region.

One implication of using the business-cycle approach is that we must recognise that economic circumstances are rarely static. Whilst the crisis did not start at the same time for all regions, nor did it end at the same time. The consequences are also long-lasting, as witnessed by the launch of quantitative easing by the European Central Bank (ECB) in January 2015 (ECB, 2015). Regional performance against key indicators is continuously changing in response to a myriad of external and

internal factors. This harks back to the important question of what we are measuring the region's resilience to - the initial shock or the second, third or even fourth wave consequences of this? The case of Poland is pertinent here. Whilst the Polish economy as a whole did not experience a downturn in employment during the crisis, it did begin to falter from 2010 and had not recovered by 2013 (Eurostat, 2015). The question is whether this suggests that the economy was not resilient to the initial shock itself. In the absence of alternative evidence we argue that for the purposes of a cross-comparative analysis it is valid to suggest that the Polish economy was indeed resilient to the initial economic shock, but has proved less resilient to the longer-lasting malaise of the European economy and the effects of later shocks, such as the EU-Russian sanctions. This requires further analysis however.

The use of employment or GDP as the primary indicators of resilience can be debated. This does not change the overall efficacy of the approach, as indeed other indicators could be used. *Inter alia*, this might include unemployment or employment rates, or household incomes. All have their advantages and disadvantages. Our work also demonstrates that the use of GDP rather than employment provides moderately different outcomes. This may reflect different structural characteristics of the regions concerned and regional price difference between and across countries, both of which warrant further analysis. However, this is also due to the choices made by actors regarding desired outcomes. That actors make choices between maintaining employment and retaining output levels was clearly demonstrated in the past crisis. These choices also differed from those made in previous downturns (Gregg and Wadsworth, 2010). Similarly, national contexts also vary, with countries such as Sweden placing a higher emphasis on maintaining income equalities within society than, for the example, the UK. Is one measure better than another? That may prove to be a political choice. The clear value of the approach is that it enables an objective assessment of which economies were resilient in terms of employment outcomes, or GDP outcomes, and those that were not. This

provides the foundation for cross-comparative analysis to understand the reasons for this, and why other economies were not resilient.

There is a risk in choosing to use an absolute measure of resilience rather than one that is relative, of overlooking those economies that did better than might be expected, despite the economic shock. This could be the case for regions in countries such as Greece, Ireland, Portugal or Spain for example where their performance has been better than the average across the country. Whilst this argument has validity when considering regions within a single country, for the purposes of a more widespread analysis it is problematic. This is because it could suggest that a region that experiences a major reduction in employment is more resilient than another that experiences a small number of job losses, simply because of their performance against the national average in their respective countries.

Similarly, we have avoided the temptation to analyse growth rates in an economy. There may be different paths to resilience, some of which involve short deep responses; others that are of longer duration but shallower. Neither is necessarily better. The crucial detail is the ability of an economy to adapt to the new circumstances and restore levels of economic output and/or employment. Likewise we do not compare pre-shock growth rates with those post-shock. The risk is that pre-shock growth rates were unsustainable and undesirable in that they created the conditions for the economic shock itself (as was arguably the case in Ireland). Whilst focusing on levels of output and/or employment may not entirely get around this problem, we argue that growth rates are more likely to be unsustainable than employment and output levels.

One potential criticism of the approach outlined here is that it is only able to shed light on the ability of an economy to respond to an economic shock in the short-term. It thus provides valuable insights on the ability of an economy to 'bounce-back' from a shock, but is less informative regarding longer-term transformations or 'renewal' (Martin, 2012). This may offer an imbalanced perspective as it is possible that resilience in the short-term may mask weaknesses that impede resilience in the longer-term. We acknowledge this perspective but suggest that this does not affect the value of the approach as a mechanism for presenting a robust baseline for cross-comparative studies. The need to explore how to understand and evaluate long-term regional transformation in response to economic shocks represents a critical area requiring further research.

In addition, our analysis has not examined how resilience in one region may be a function of resilience in neighbouring regions. There is some evidence to suggest that spatial interdependence between regions through, for example, domestic trade linkages may shape the resilience of certain regions (Di Caro, 2015b). However, both the means of assessing such interpedence and the nature of its effects needs to be subject to further development and wider application. This represents an interesting area for further research.

A clear message of the analysis undertaken for this work is that different shocks have different outcomes. Regions that were resistant to the effects of the economic shocks of the early 1990s were, on the whole, not resistant to the economic shock of 2008/09. Comparison with the 1990s downturn also illustrates differences in the nature of resilience. During that downturn less than 5% of regions were resistant to the employment effects of the downturn, compared to 12% during the current crisis. In contrast, almost a fifth of regions (19%) demonstrated GDP resistance, compared to just 5% during the most recent crisis. Equally, since the onset of economic decline linked to the recent crisis, 23% of regions have recovered to their pre-shock employment levels within three years. In comparison, following the downturn of the 1990s, it took four years for 22% of regions to recover to pre-shock employment levels. Experience following the 1990s downturn further

illustrates the longer-term structural changes that can influence levels of economic recovery, raising important questions about the nature of longer-term transformation and adaptation.

Economic resilience is not, of course, synonymous with our traditional understanding of economic strength. Analysis of the distribution of resilience across Figures 6 and 7 demonstrates that several strong economies i.e. those with high levels of GDP, such as Île-de-France (Fr) and Emilia-Romagna (It), have proved not to be resilient to the economic shock, whilst others, Such as Brandenburg (De) and Podlaskie (Pl), which are less developed have proved to be resilient. This may also suggest that there are different pathways to resilience and reminds us that resilience cannot be treated as a necessarily desirable concept especially where resilience outcomes are not progressive or transformative (Bristow and Healy, 2014). Again, one is not necessarily better than another but suggests that a deeper analysis of the processes at work is required, rather than simply seeking to replicate a small number of common policy objectives across all regions.

6. Conclusions

This paper has outlined an approach to operationalising the concept of resilience in the challenging context of cross-comparative research. The method developed has focused on developing a method for measuring resilience outcomes in terms of both GDP and employment for regions across Europe in respect of economic crises. It is novel in respect of its development of a method for dating the onset of the effects of a shock at the regional level. This allows for the development of a rich analysis of the shock and its spatial and temporal dynamics. It has also allowed for detailed analysis of the differences in amplitude and duration of shock recovery processes across regions. As such, it has developed a means of identifying the reference state against which resilience outcomes can be measured in comparative contexts, and provided a valuable means of categorising regions according

to the different phases of their resilience performance i.e. whether they are resistant, recovered or not recovered. It thus provides an objective means of identifying which economies were resilient to an economic shock and which were not, in a manner which is easy to replicate.

This analysis has certainly captured the most resilient economies and the least, and whilst there may be some debate at the margins, it provides a very valuable baseline for future research. The fact that some economies enter a crisis earlier and others later, means that this more detailed understanding is essential if we are to fully understand regional resilience. Whilst one might get away with a single reference year for resilience analysis in a single country, one cannot do so at a European scale (which is where the real value of cross-comparative analysis can be seen owing to different policy contexts).

This analysis thus focuses on revealed resilience. It does not in and of itself tell us anything about resilience capacities or why different regions exhibited different resilience outcomes in relation to the economic shocks in question. Neither does it tell us whether resilient outcomes are necessarily desirable. Critically, a degree of judgement will surround what resilience outcomes are regarded as desirable. For example, a return to previous 'norms' may not be required – some region's may want more growth, others more stability, others no growth, particularly if transformative agendas are in evidence (such as meeting economic objectives within redefined environmental and social capacities and goals). However, in providing a robust measure of a region's reference state in terms of resilience performance, it develops a metric which may be subject to further analysis against various different components of resilience capacity. The critical point is that it avoids conflating resilience capacities (causes) and resilience outcomes (effects) in one measure. As such, it provides a potentially more useful platform for the diagnosis of regional resilience for policy and practice

purposes. It also usefully highlights that resilience is a complex, multi-dimensional entity that is unlikely to be measurable by one simple indicator or composite index alone.

Further research is now needed to build on this baseline and, in particular, to develop a more rigorous understanding of the different factors shaping observed resilience outcomes, or the relationship between resilience capacities and resilience outcomes. Further analysis is also needed of the role of important national effects and spatial interdependencies between regions in shaping observed resilience outcomes. There also remain unanswered questions concerning whether regional trajectories *before* the crisis relate to how resilient regions ultimately were *to* it. This represents an exciting agenda for spatial economic analysts.

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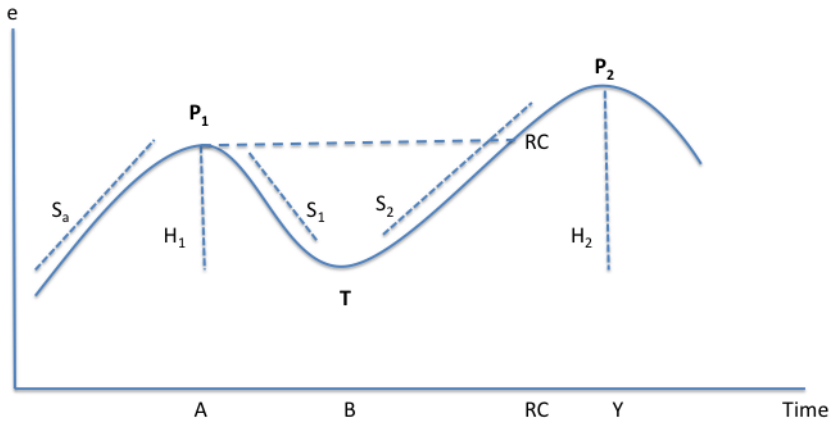
Figure 1: Stylised Employment Cycle



P = Peak

T = Trough

RC = Recovery

S = slope of growth path

Figure 2: Count of Regions in ESPON 31 experiencing Employment Downturn (red) or GDP Downturn (blue)

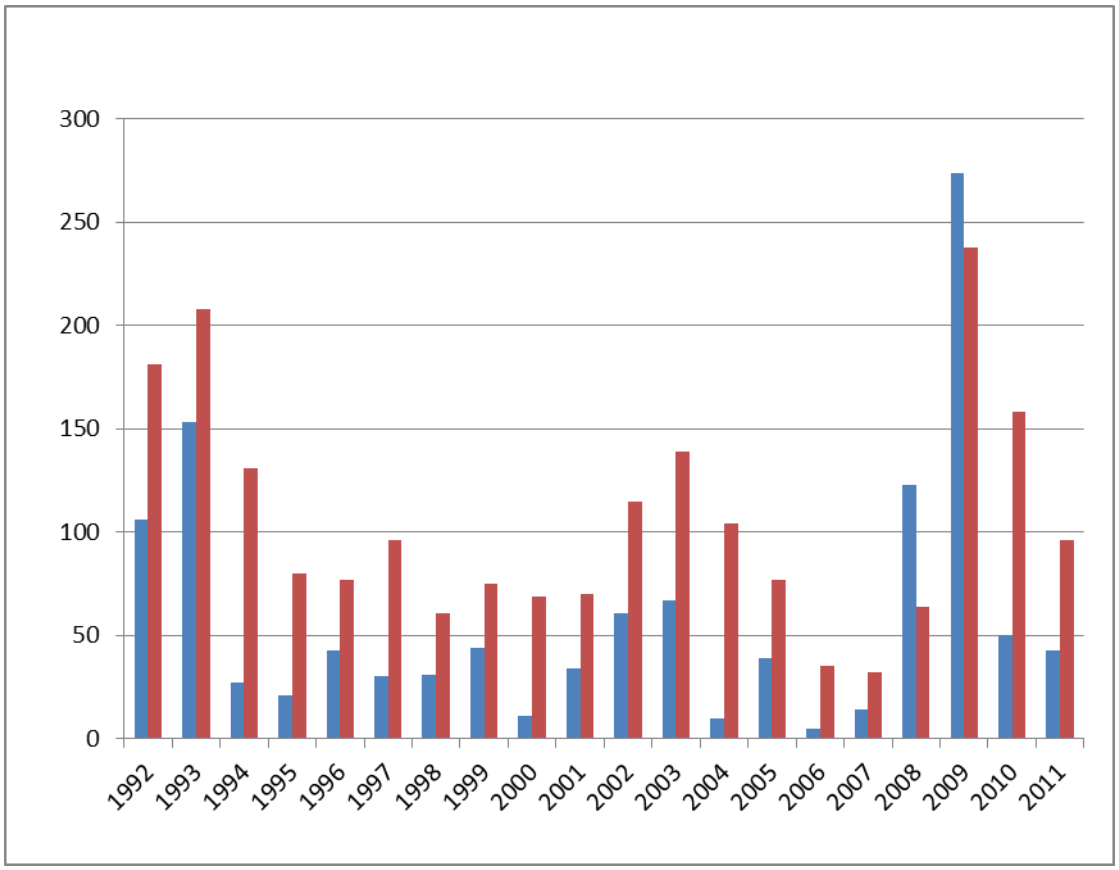
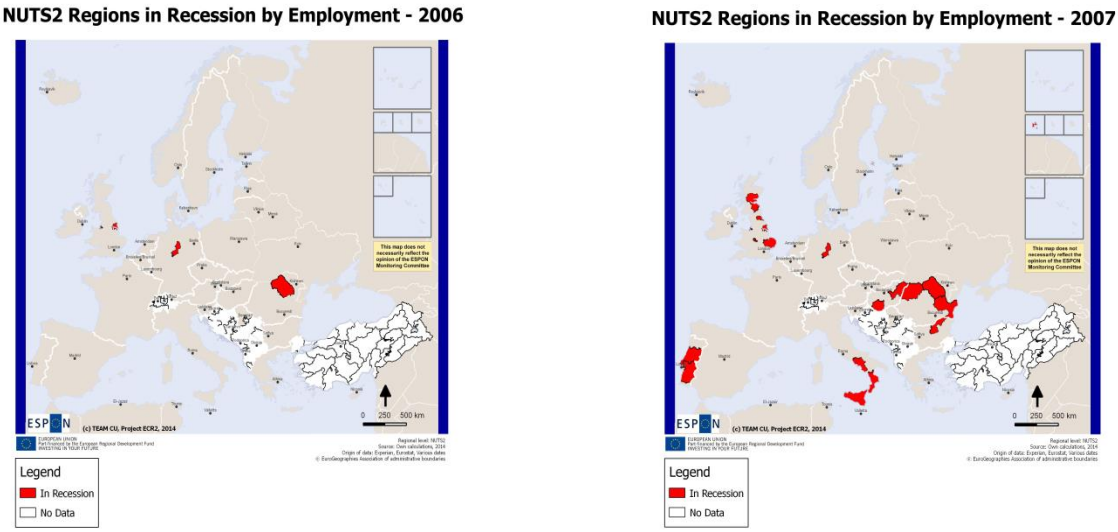
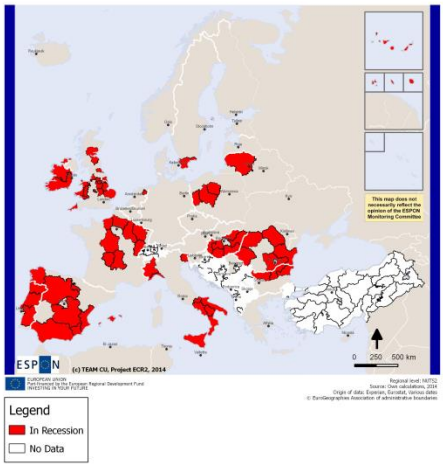


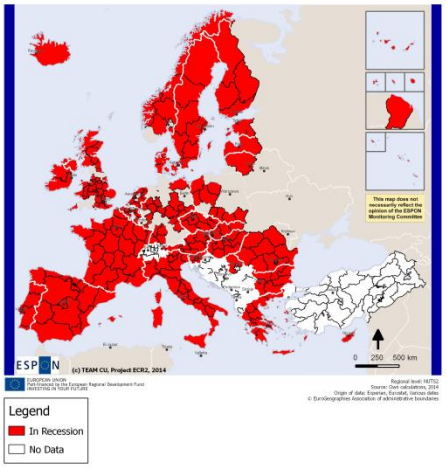
Figure 3: Temporal spread of economic crisis (2006-2011)



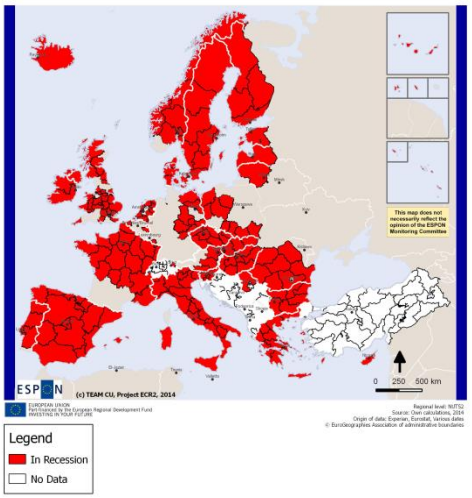
NUTS2 Regions in Recession by Employment - 2008



NUTS2 Regions in Recession by Employment - 2009



NUTS2 Regions in Recession by Employment - 2010



NUTS2 Regions in Recession by Employment - 2011

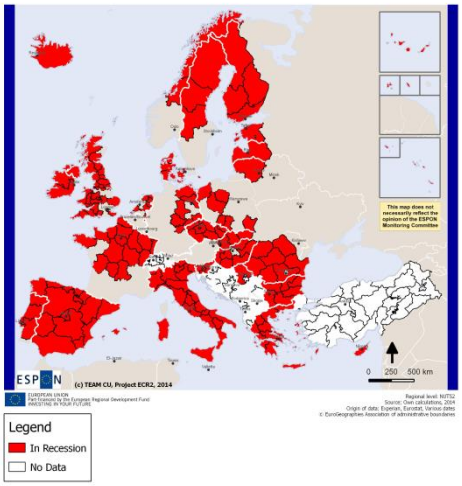
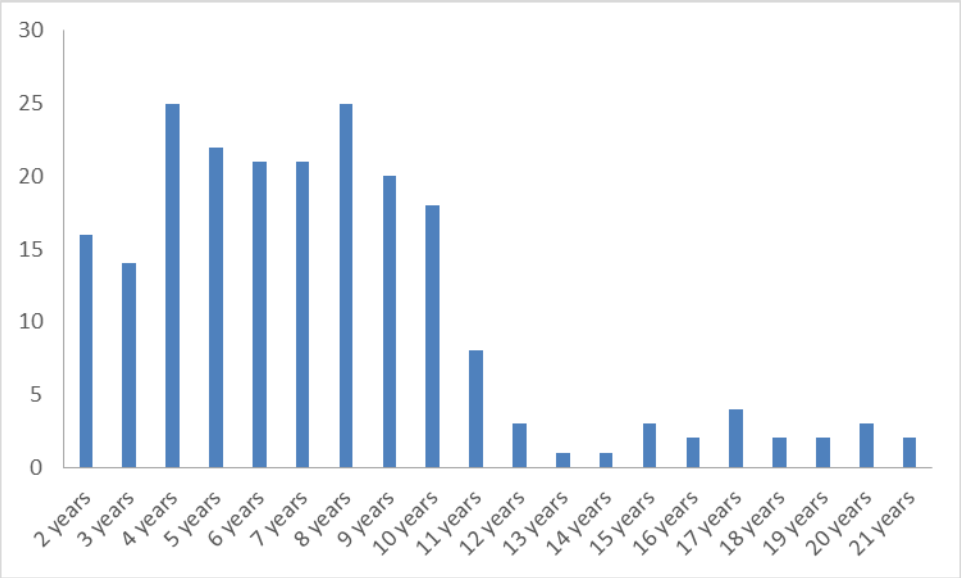


Figure 4: Speed of recovery to pre-crisis peak employment levels (early 1990s, number of NUTS 2 regions)



Source: adapted from Cambridge Economics datasets

Figure 5: Historical resilience outcomes (economic shock of early 1990s)

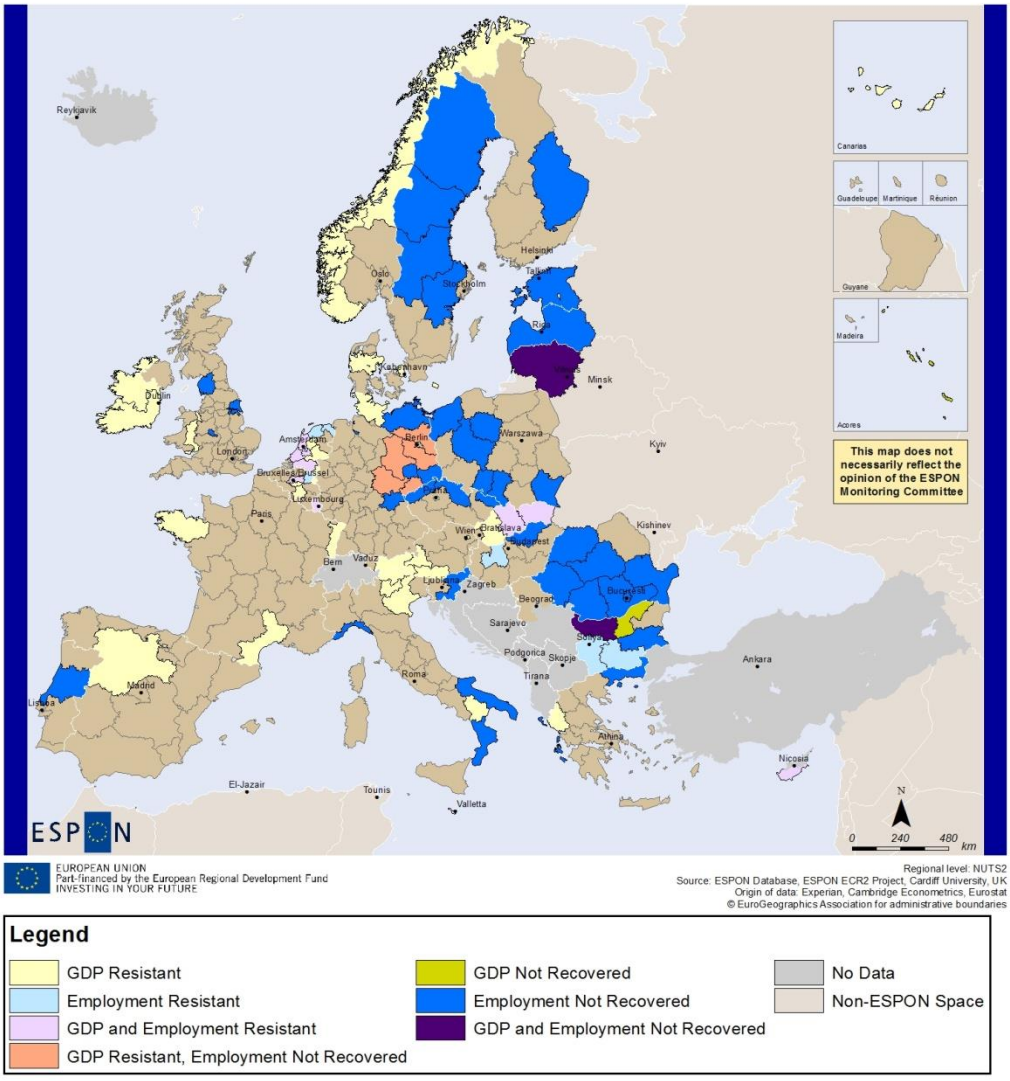


Figure 6: Distribution of regional economic resilience (NUTS 2, employment, peak year to 2011)

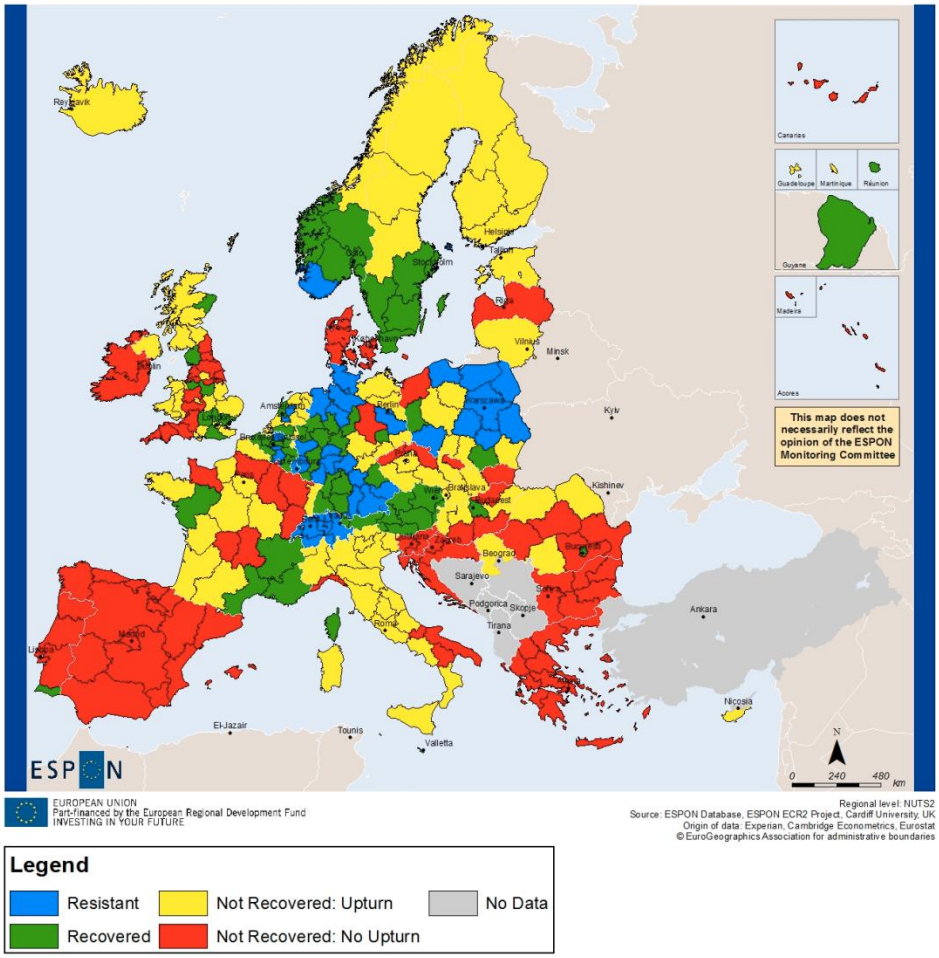


Figure 7: Distribution of regional output resilience (NUTS 2, GDP, peak year to 2011)

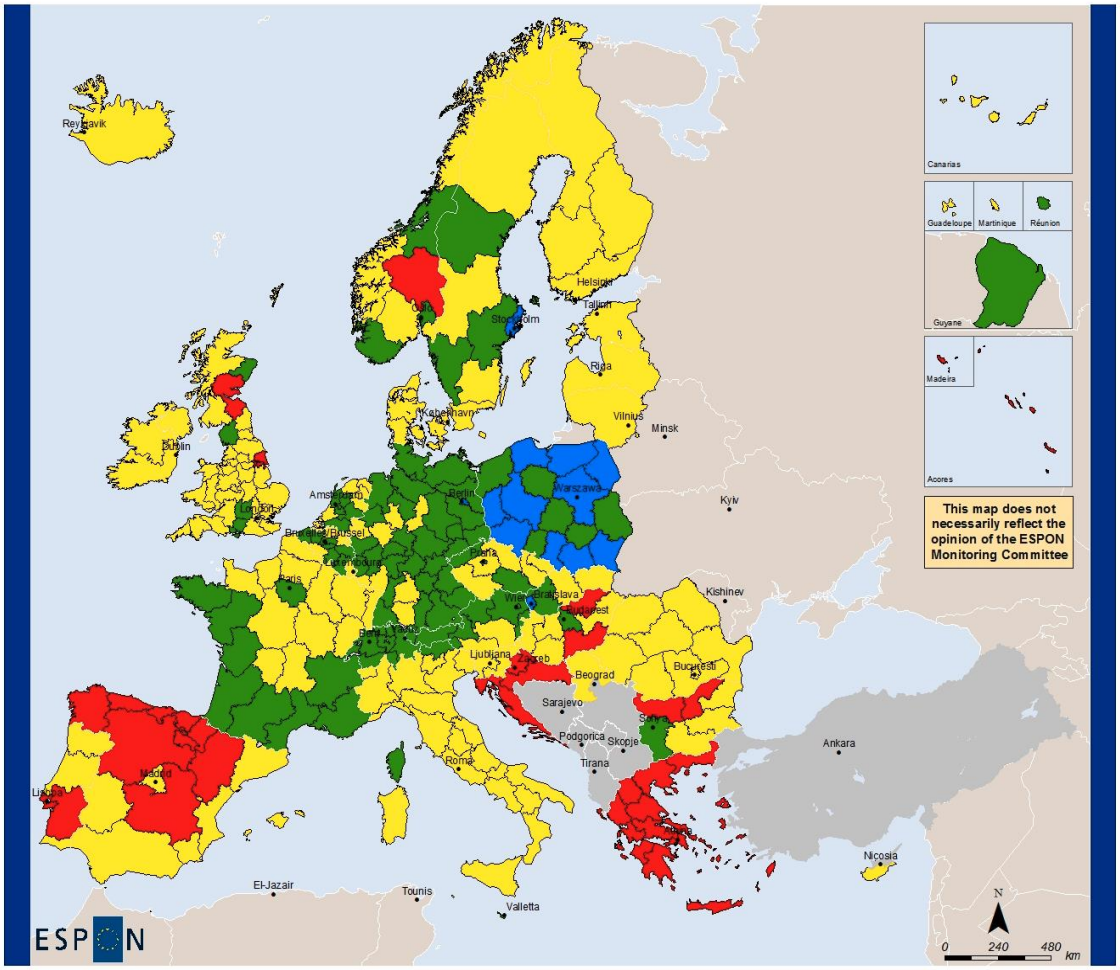
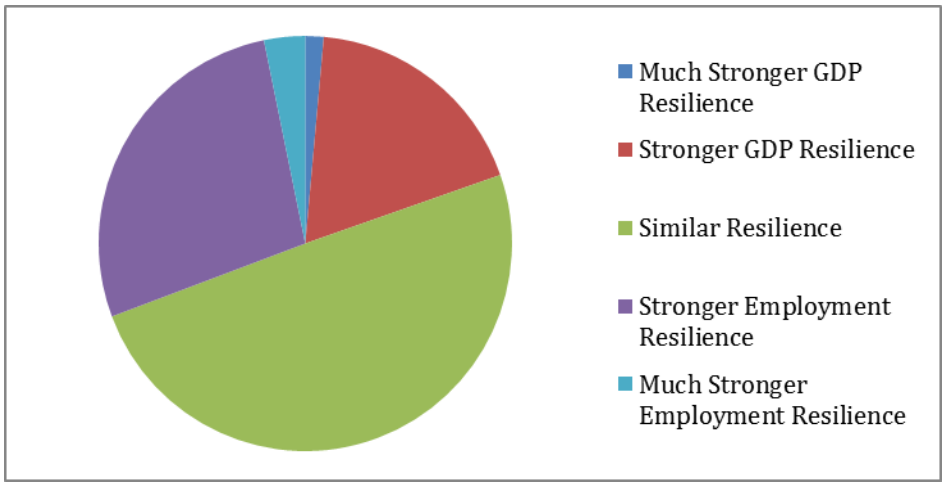


Figure 8: GDP vs Employment Resilience



Source: ESPON ECR2

Table 1: National patterns of resilience to the 2008 economic crisis[2]

	Employment measure	***GDP measure***
Resisted	LU, DE, CH, PL	PL
Recovered by 2011	NO, SE, MT, AT, BE	DE, NO, SE, CH, AT, FR, MT, SK
Not Recovered: upturn experienced by 2011	IS, UK, FR, NL, IT, FI, LT, EE, CY, CZ, SK, HU	IS, UK, IE, LU, NL, PT, ES, IT, DK, FI, EE, LV, LT, CZ, SL, HU, RO, BU, CY
Not recovered: no upturn experienced by 2011	IE, PT, ES, DK, LV, SL, HR, RO, BU, EL	HR, EL

2 Country abbreviations follow standard European norms and are based on national language conventions eg Greece = EL (Ellada)

Table 2: Employment Resilience of NUTS 3 Territories

Resilience	*NUTS 3*		*NUTS 2*	
	Number of regions	*Proportion (%)*	*Number of regions*	*Proportion (%)*
Resistant (RS)	214	16.2	32	11.5
Recovered (RC)	314	23.8	68	24.5
Not recovered but in upturn	364	27.5	87	31.3
Not recovered and no upturn	430	32.5	91	32.7

Source: ESPON ECR2 (number of observations: NUTS3=1,322, NUTS2= 278)