

Regional economic resilience, hysteresis and recessionary shocks

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Abstract

The notion of ‘resilience’ has recently risen to prominence in several disciplines, and has also entered policy discourse. Yet, the meaning and relevance of the concept are far from settled matters. This article develops the idea of resilience and examines its usefulness as an aid to understanding the reaction of regional economies to major recessionary shocks. But in so doing, it is also argued that the notion of resilience can usefully be combined with that of hysteresis in order to more fully capture the possible reactions of regional economies to major recessions. These ideas are then used as the basis for a preliminary empirical analysis of the UK regions.

Keywords: Regional economic growth, recessionary shocks, resilience, hysteresis

JEL classifications: R10, R11, E32

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1. Introduction

Although the idea of ‘resilience’ has been used for some time in the physical, engineering and ecological sciences, and has found its way into such disciplines as psychology and organization science, it is only very recently that it has attracted attention from regional analysts, spatial economists and economic geographers. In one of the first discussions, Reggiani et al. (2002) argued that the notion of ‘resilience’ should be a key topic in the study of the dynamics of spatial economic systems, especially concerning how such systems respond to shocks, disturbances and perturbations. Over the past 5 years, other urban and regional analysts have begun to take up this call and to consider the applicability of the concept in their work (for example, see Rose and Liao, 2005; Vale and Campanella, 2005; Stehr, 2006; Foster, 2007; Hill et al., 2008; Swanstrom, 2008; Pendall et al., 2010; Pike et al., 2010; Simmie and Martin, 2010).¹ This growth of interest has been stimulated by several factors and developments. Without question, a major influence has been the succession of major natural and environmental disasters that have afflicted local communities in different parts of the world; these have rightly concentrated attention on how quickly local and regional populations recover from

1 See also the other contributions to the Special Issue of the *Cambridge Journal of Regions, Economy and Society* (2010) on ‘The Resilience Region’. There have also been special economic geography sessions on ‘resilience’ at the 2010 annual conferences of both the Association of American Geographers and the Royal Geographical Society-Institute of British Geographers.

such ‘shocks’ and emergencies.² Secondly, in thinking about such issues, regional and urban analysts have been influenced by the development of ‘resilience’ notions and models in other disciplines, and especially ecology and panarchy, in both of which a core interest is in how ecosystems and socio-ecological systems respond to major disturbances and disruptions. Thirdly, at the same time, the idea of resilience resonates with the growing importance of an evolutionary perspective within economic geography (see for example, Boschma and Martin, 2007, 2010; Simmie and Martin, 2010), and the recognition that major shocks may exert a formative influence over how the economic landscape changes over time. And fourthly, in this context, the deep financial and economic crisis that swept across much of the globe over 2008–2010, and the consequential austerity policies that many states have had to put in place to restore public finances in the wake of that crisis, have also directed attention to the resilience of local and regional economies to these events.

However, although still gathering momentum, the exploration of the notion of resilience in economic geography has already proved somewhat contentious. For one thing, there is much ambiguity and difference of view as to the precise meaning of the notion of regional or local economic resilience, how it should be measured, whether resilience is a positive or negative attribute and what it implies for policy intervention (see Christopherson et al., 2010; Hudson, 2010; Pendall et al., 2010). To a large degree, this lack of consensus reflects the different uses and interpretations of the notion of resilience found across the social sciences, and indeed across the natural, physical and biological sciences: resilience is not a unitary concept with a precise and universally agreed definition. According to Pendall et al. (2010), the idea of resilience would seem to be an example of the ‘fuzzy concepts’ that Markusen (1999) complained of as being all too common in regional studies. For another thing, transferring a concept developed to analyse the dynamics of one type of system, especially ecosystems, to the analysis of another, quite different, type of system, namely a regional or local economy, is itself problematic. An ecosystem is quite different from a regional economy, and while metaphors and analogies based on the former can certainly be highly illuminating in thinking about the latter, such abduction raises all sorts of ontological issues, not least about the ‘resilience of what, to what’ (Carpenter, Walker *et al.*, 2001). And for yet another, to some writers, ‘resilience talk’ conjures up worries that the notion can all too easily be captured by neo-liberal apologists, to bolster arguments in favour of the need for ‘flexibility’, ‘self-help’ and ‘competitive fitness’. For these and other reasons, some economic geographers remain hesitant about the notion of regional resilience (for example, Hassink, 2010; Hudson, 2010; Pike et al., 2010).

The response to this hesitancy should not be to rush to dismiss the concept, however, but to devote some effort to try to give it more precision and clarity, and to see how far and in what sense it might help inform our understanding of regional economic

2 Examples would include the catastrophic impact of the 2004 Indian Ocean Tsunami on the Ache territory in Indonesia; of Hurricane Katrina on New Orleans in 2005; of the 2010 earthquake in Haiti; of pollution from the 2010 BP Deepwater Horizon offshore oilrig explosion on US Gulf state coastal communities; of the unprecedented scale of the floods in Pakistan following the exceptionally severe Monsoon rains in 2010; of the floods in Queensland Australia in 2010–2011; of the earthquake in Christchurch, New Zealand in 2011; and of the earthquake and associated tsunami in Tohoku, north east Japan, in 2011. In addition, the prospect of growing pressures, stresses and instabilities caused by global climate change has brought the issue of ‘resilience’ to the fore.

development and change. This is the motivation behind this article. More specifically, my aim is to explore how the notion of ‘resilience’, for example as used in ecological work, can be combined with that of ‘hysteresis’, as used in economics, to examine how regional economies react to recessionary shocks. Major recessions can be viewed as ‘system-wide’ shocks that periodically interrupt and disrupt the process of economic growth and development. During the 1960s, 1970s and into the early 1980s, a significant literature developed around the study of regional business cycle dynamics—how regions react to recessions, and why different regions react differently (for a survey see, Domazlicky, 1980). Research into such issues typically drew on Keynesian business cycle theory. Over the past 25 years, this type of work has been overshadowed by research on regional convergence and divergence, spatial economic agglomeration, clusters, regional innovation systems, global supply networks and the like. Yet the past three decades have hardly been recession free. Three major recessionary shocks have occurred across most of the advanced economies during the past 30 years: in the early 1980s, the early 1990s, and, of course, most recently between 2008 and 2010.³ Further, the evidence suggests that within countries like the USA, the UK and other European economies, these three major recessionary shocks have been far from geographically even in their incidence (see Martin, 1997; Baddeley et al., 1998; Florida, 2009; Wilkerson, 2009; Martin, 2010b).

Arguably, therefore, the issue of ‘regional cyclical sensitivity’ has never been more relevant: the ‘geography of recession’ is itself of critical importance. But further, how regions respond to major recessionary shocks may also be highly pertinent to the question of long-run regional growth patterns, and hence to the existence, persistence and evolution of long-run regional disparities in economic prosperity. In this regard, some recent work on the impact of shocks on national growth paths suggests that countries which experience severe and/or frequent economic disruptions (recessions, financial crises and political upheavals) tend to have lower growth rates over the long run (Cerra and Saxena, 2008; Cerra et al., 2009). There is evidence that severe recessionary shocks tend to depress a country’s long-run growth rate. Patterns of long-run national income convergence and divergence may thus be linked to how different countries have reacted to recessionary and other shocks. This raises the intriguing question of how recessions affect regional growth paths. Do regions differ in the extent to which their economies recover and rebound from severe recessionary shocks? Do regions that are more severely affected by such shocks grow more slowly than other regions as a result? These are questions that seem to lend themselves to exploration using the notion of resilience, and this is the aim of this article. But in so doing, I also argue that the notion of resilience might usefully be combined with that of hysteresis, as used in economics, in order to more fully capture the possible reactions of regional economies to major recessionary shocks. The article is essentially in two main parts: the first sets out some of the components of a possible conceptual framework for thinking about regional economic resilience to recessions, while the second uses this framework as a basis for some preliminary empirics on the UK regions.

3 The collapse of the so-called ‘dotcom’ bubble in 2000–2001 is sometimes also identified as a recession (especially in the USA), but it was neither as pronounced nor as widespread as the three main recessions referred to here.

2. Thinking about regional economic resilience to recessions: towards a conceptual framework

According to its strict Latin root, *resilire*, to leap back or to rebound, the idea of ‘resilience’ refers to the ability of an entity or system to ‘recover form and position elastically’ following a disturbance or disruption of some kind.⁴ Most of the recent uses of the term in regional or urban applications refer to this idea of the ability of a local socio-economic system to recover from a shock or disruption. Thus, Foster (2007, p. 14) defines ‘regional resilience as the ability of a region to anticipate, prepare for, respond to, and recover from a disturbance’. Or again, Hill et al. (2008, p. 4) see resilience as ‘the ability of a region... to recover successfully from shocks to its economy that either throw it off its growth path or have the potential to throw it off its growth path’. But to be analytically useful, a more detailed exposition is needed. In fact a perusal of the various literatures that refer to resilience ideas suggests at least three different (but not unrelated) interpretations or uses of the term (Table 1).

2.1 ‘Engineering’ resilience and regional economic ‘rebound’

Probably the most frequently invoked meaning or definition of the notion is that of so-called ‘engineering resilience’. This focuses on the *resistance* of a system to disturbances (shocks) and the speed of return to its pre-shock state.⁵ In many discussions, the system is assumed to be in ‘equilibrium’ before the shock, so that resilience is defined in terms of the stability of a system near its ‘equilibrium’ (or ‘steady’) state (e.g. Holling, 1973; Pimm, 1984; Walker et al., 2006). A system that is more resistant (less vulnerable or less sensitive) to shocks and/or which returns quickly to its pre-shock ‘equilibrium’ state or configuration is deemed to be more ‘resilient’ than a system which, when subjected to the same shock, not only has a much more pronounced reaction to it, but also takes longer to move back to its ‘equilibrium’ or steady state.

Economists have not tended to use the notion of resilience, but this definition, with its focus on stability of a system near its equilibrium, clearly resonates with the idea (assumption) of self-correcting forces in mainstream economics. Under this perspective, the economy is assumed to be self-equilibrating: any shock that moves the economy from its equilibrium state automatically activates compensating adjustments that bring it back to that equilibrium. It may be that those compensating, self-correcting adjustments take a while to have effect, but the assumption nevertheless is that the economy will sooner or later return to its pre-shock equilibrium state.

A key issue arising from this view of resilience thus has to do with whether we believe the assumption of equilibrium is relevant to regional or local economies. Some writers seem prepared to make that assumption. Thus according to Pendall et al. (2010)

Regional growth in output and population or rates of unemployment, poverty or labour force participation can be considered at least partly equilibrium phenomena. Since all these subjects

4 Chambers Dictionary definition.

5 This is close to the definition found in physics, where resilience is the property of a material to absorb energy when it is deformed elastically and then upon removal of the deforming force to resume its initial form.

Table 1. Different interpretations of resilience

Interpretation/type of resilience	Main focus of interest
'Engineering' Resilience (found in physical sciences)	Ability of a system to return to, or resume, its assumed stable equilibrium state or configuration following a shock or disturbance. Focus is on resistance to shocks and stability near equilibrium
'Ecological' Resilience (found in ecological sciences)	The scale of shock or disturbance a system can absorb before it is de-stabilized and moved to another stable state or configuration. Focus is on 'far from equilibrium' behaviour of system
'Adaptive' resilience (found in complex adaptive systems theory)	The ability of a system to undergo anticipatory or reactionary reorganization of form and/or function so as to minimize impact of a destabilizing shock. Focus is on adaptive capability of system

offer significant interest for researchers and policy-makers alike, the single equilibrium version of resilience offers one important and legitimate metaphor for understanding regions (p. 73).

But unlike (some) physical or ecological systems, a regional or local economy need never be in equilibrium, yet can be characterized by an identifiable, and relatively stable, growth trend or path (Martin, 2010a).⁶ In such circumstances, it seems that all that is required for this basic view of resilience as 'bounce back' to hold, is simply that, following a shock, the regional economy returns to its pre-existing position or path or to where it would have been in the absence of that shock, regardless of whether or not that position or path is an 'equilibrium' state of affairs.

In fact, this interpretation of engineering resilience as 'bounce back' to an underlying growth path bears a close affinity to the so-called 'plucking model' of economic fluctuations (Friedman, 1993; Kim and Nelson, 1999). According to the 'plucking model', the path of an economy's output (or employment) can be likened to a string attached to the underside of an upward-sloping board, which is 'plucked' downward at irregular intervals by recessionary (or other) shocks. The board represents a slowly rising upper limit or ceiling on output set by an economy's resources, the way they are organized and their productivity. Though the extent of decline caused by a recessionary shock will vary from downturn to downturn, output is assumed to rebound in each case to the (upward-sloping) ceiling level. In other words, the plucking model predicts that recessionary shocks should be *transitory*, and should have no permanent effect on the economy's long-run growth ceiling or growth trend. It is further argued that there is likely to be an asymmetry in this reaction, in that the size of the downturn due to the recessionary shock is predictive of the size of the recovery or boom that follows, but the scale of the latter does not predict the size of the next contraction.⁷

6 The relevance of the notion of equilibrium is in any case a much debated issue in economics itself (see for example Setterfield, 1997, 1998; Harris, 2005; Lang and Setterfield, 2006).

7 Much of the recent economics research into the 'plucking model' has been concerned with devising econometric methods to identify the existence and extent of this asymmetry (see for example, Goodwin, 1993; Kim and Nelson, 1999; Kim and Piger, 2002; Sinclair, 2010).

This scenario is illustrated in highly stylized fashion in Figure 1. Regional output, or employment, is shown on the vertical axis and time on the horizontal. The slope of the time path of output (or employment) reflects a steady rate of growth that, following the ‘plucking model’ idea, will depend, among other things, on the region’s human, capital and environmental resources, and how they are utilized. A region’s growth trend, more than that for a national economy, is likely to be strongly influenced by its attractiveness, compared with other regions, to inflows of capital, labour and technology; it may also reflect local policy priorities and interventions. Now assume a recessionary shock affects the region. Output and employment fall. With recovery, regional output and employment grow back to where they would have been in the absence of the shock, and thereafter the pre-shock growth rate is resumed. Of course, the precise pattern of decline and recovery may not be the same for output and employment, but for the notion of ‘engineering’ resilience, or its economic equivalent, the ‘plucking model’, to hold with respect to either regional output or employment, both would return to their pre-recession growth paths.

Note, however, that this ‘plucking’ model version of regional economic resilience to recessionary shocks makes no assumptions or statements about the impact of such a shock on the region’s economic structure. In reality, of course, some changes in regional economic structure are almost certain to occur, as they do more or less continuously in the absence of shocks. And such structural change may feed back to influence a region’s resilience to future recessions: a region’s resilience, in other words, may itself evolve over time (see Simmie and Martin, 2010, for a discussion of this process). So a question arises as to whether the concept of regional economic resilience as defined by the ‘plucking model’ should also consider the extent to which a regional economy also retains its form (structure) following a recessionary disturbance. A regional economy could resume its pre-shock growth path even though it experienced some structural and institutional change as a result of the shock. Thus even in the ‘engineering’ or ‘plucking model’ case, how we define regional resilience would depend on what aspect of regional

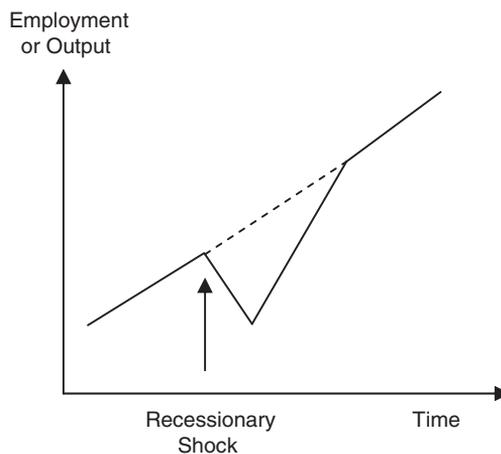


Figure 1. Impact of a recessionary shock on a region’s growth path: region returns to pre-shock growth trend.

economic performance and stability we are focusing on: growth rate, economic structure, institutional arrangements, etc.

2.2 'Ecological' resilience and regional economic 'hysteresis'

The second definition of resilience found in the literature is that of so-called 'ecological resilience'. This conception focuses on the role of shocks or disturbances in pushing a system beyond its 'elasticity threshold' to a new domain. In this case, resilience is measured by the magnitude of disturbance or shock that can be absorbed before the system changes form, function or position (Holling, 1973, 1996, 2001; McGlade, 2006; McGlade et al., 2006; Walker et al., 2006). According to this definition, then, resilience is the capacity of a system that is maintained by one set of mutually reinforcing processes and structures to tolerate disturbance without reorganizing (or collapsing) into a system maintained by a different set of processes and structures. It assumes that systems are characterized by *multiple* stability domains, and that if a shock pushes a system beyond its 'elasticity threshold', the system may move to a different domain or state. It is not absolutely clear from this definition, however, as to what, precisely, constitutes resilience. In some uses of the notion, resilience is measured by the size of shock a system will tolerate (absorb) before it becomes unable to return to its former stability domain or path. The larger the shock that can be so absorbed, the more resilient is the system in question. In other accounts, the notion refers to the ability of the system, when pushed beyond its 'elasticity threshold', to move quickly to a new stable configuration or path. In this instance, much would surely depend on the nature of the new (stable) state or configuration the system moves to. If the new post-shock configuration or state is 'inferior' to its pre-shock predecessor in some way, then such a system would presumably be regarded as having low resilience as compared to a system which was able to move to a new, post-shock configuration or path that is in some sense or other 'superior' to that which obtained prior to the shock or disturbance. This issue assumes particular relevance in relation to the idea of regional economic 'hysteresis'.

From its origin in the natural sciences, in studies of the magnetic and elastic properties of metals and materials, the concept of hysteresis has subsequently found its way into economics (Georgescu-Roegen, 1967; Elster, 1976; Cross and Allen, 1988; Cross, 1993; Göcke, 2002; Setterfield, 2010).⁸ Even mainstream economics now admits of the possibility of multiple equilibria, or stability domains, and that an economy can be moved from one such equilibrium or domain to another as a result of a shock or disturbance. Economists often use the concept of 'hysteresis' to describe this phenomenon.⁹ But again, the assumption of equilibrium is not essential to the notion.

8 The following analogy may help to illustrate the idea of hysteresis. Assume a spring is suspended vertically, and that initially a small weight is then attached. The spring will stretch. The weight is then removed, and the spring returns to its original shape and state. Then the spring is subjected to the same treatment using successively heavier weights. At some point, the weight applied to the spring will be such that when it is removed, the spring will not return to its original shape and state, but will be left permanently stretched. The downward pressure on the spring will have exceeded the spring's 'elasticity threshold': hysteresis can be said to have occurred.

9 Much of the discussion of hysteresis in economics has been associated with the impact of recessionary shocks on the (national) labour market, and especially how major recessions can lead to a permanent upward shift in an economy's so-called 'natural (or non-accelerating inflation) rate of unemployment (see Cross and Allan, 1988; Franz, 1990; Cross, 1993). A deep or prolonged downturn, so the argument runs,

Romer (2001), for example, defines hysteresis as a situation ‘where one-time disturbances permanently affect the path of the economy’ (p. 471), that is where the effect or ‘memory’ of the disturbance is left behind in the economy even after the disturbance or shock has passed, a process also known as ‘remanence’ (Cross et al., 2009, 2010). Further, according to Setterfield (2010) hysteresis almost invariably involves structural change in the economy. If the shock is severe enough, it may alter the behaviour of economic agents, change the sectoral composition of the economy and set the economy on a new trajectory of path-dependent development. He goes on to argue that this conceptualization of hysteresis can be considered to be a form of path dependence because it implies that even a ‘temporary’ event—here a recessionary shock—can have permanent effects. But rather than all the past influencing the future, as in ‘complete memory’ path dependence, hysteresis or remanence is a process of ‘selective memory’ (recent ‘extreme’ event) path dependence. He also acknowledges that there is no need to invoke multiple equilibria in this interpretation of hysteretic path dependence (see also Martin, 2010). There is, then, a close relationship between the idea of ‘ecological’ resilience—specifically in the case where a shock is such that it displaces a system beyond its ‘elasticity threshold’ (see Carpenter *et al.*, 2005)—and the notions of hysteresis and remanence.

Several different possible ‘hysteretic’ outcomes of a recessionary shock can be identified, and these could well differ as between employment and output responses, depending on labour productivity, the capital intensity of production, the labour hoarding strategies of local firms, the relational links of local firms with other firms in other regions or overseas and a host of other factors. Figure 2 gives two cases, again depicted in highly stylized form, where a recession causes a hysteretic downward shift in a regional economy’s growth path. In the first case (Figure 2a), the recession permanently lowers the level of output or employment, but the region’s growth rate of output or employment recovers to its pre-shock rate. This could arise, for example, where the recession destroys a significant proportion of a region’s productive capacity and jobs. Whether the region’s unemployment rate is permanently raised as a result would depend on the extent to which those workers made redundant subsequently migrated out of the region or withdrew from the local labour force. Assuming that the closure of firms and shake-out of labour were not selective as between more and less productive sectors, firms and workers, then the region’s economy may be able to resume its pre-recession growth rate, but on a permanently lowered trend path. Endogenous growth theory would also support a downward hysteretic effect of a deep recession. If future benefits of learning by doing are not fully internalized by workers, then recessions are periods in which opportunities for acquiring experience are foregone. Even if output and employment growth resumes after the recession, there would be a permanent loss in productivity compared with the pre-recession position.

Figure 2b shows the more ‘pathological’ case where the impact of the recessionary shock is such that the destructive aspects of economic downturn more than outweigh, and may actively militate against, any compensating ‘creative’ growth of new firms and jobs in other sectors. The heavy deindustrialization of a region by a deep recession may

increases the likelihood of long-term unemployment, which in turn erodes a worker’s skills, dents his or her employability and increases their dependency on welfare benefits, all thereby reducing an unemployed person’s prospects of being re-employed even when the economy recovers. As a result, an economy’s unemployment rate may not return to its pre-recession rate, but become stabilized around a new, higher ‘natural’ (equilibrium) rate.

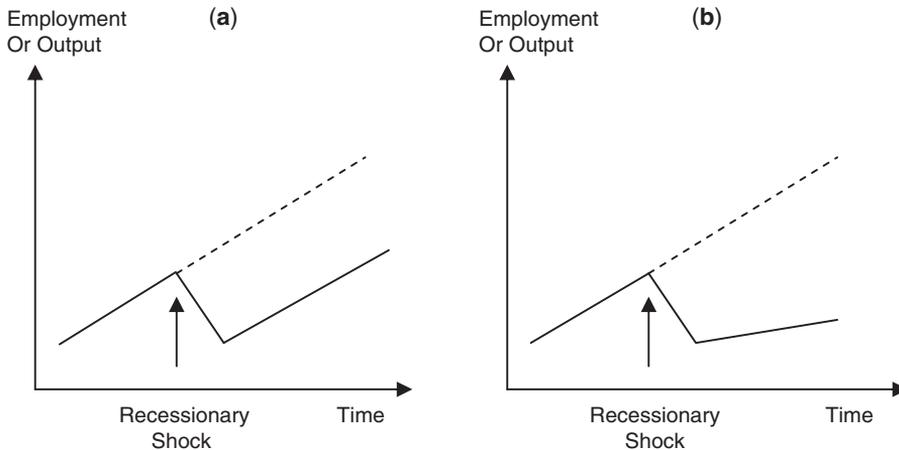


Figure 2. Negative hysteretic impacts of a recessionary shock on a region's growth path: (a) permanent decline in level, resumption of pre-recession growth rate. (b) permanent decline in level and lowered growth rate.

typify this pattern. In such a case, the destruction of large sections of the region's industrial base may have negative multiplier effects on other local sectors of activity, such as supporting suppliers and business services. It may so reduce the region's employment and associated incomes that local purchasing power is seriously reduced with additional knock-on effects on a whole range of consumer services. There may also be recession-induced effects on labour supply (increased outmigration and lower participation), on capital flows (a fall or even reversal of inward investment), and a decline in local entrepreneurialism (because of a more risky local business climate). A depressed economy is unlikely to provide a conducive environment for the creation of new firms and jobs or for productivity enhancing investments. As a result of these and other related effects, a permanent contraction of the region's whole economy may occur, and not just of its least efficient firms and workers. Thus, both the region's level of output and employment, and its post-shock growth rate, are lowered. In each of these two cases, the regional economy in question could be said to have a low resilience to shocks.

Most discussions of hysteresis in economics refer to the negative effects of shocks. But it is possible for positive effects to occur. Two such 'positive' hysteretic reactions in relation to the impact of a recessionary shock on a regional economy are shown in Figure 3. In both examples, the regional economy more than 'rebounds' from the recessionary downturn, and initially experiences rapid growth out of the recession, at a rate above the pre-shock growth rate. This might be due to highly optimistic business expectations, the availability of spare capacity to expand output and jobs, perhaps some initial opportunities to increase productivity, an initial wave of new firm formation and similar factors. The issue is whether this post-shock recovery rate of growth can be sustained. If the scope for continued rapid growth becomes exhausted, or if the regional economy approaches its 'growth ceiling', for example because it is unable to attract the additional resources (capital and labour) required, or the potential for

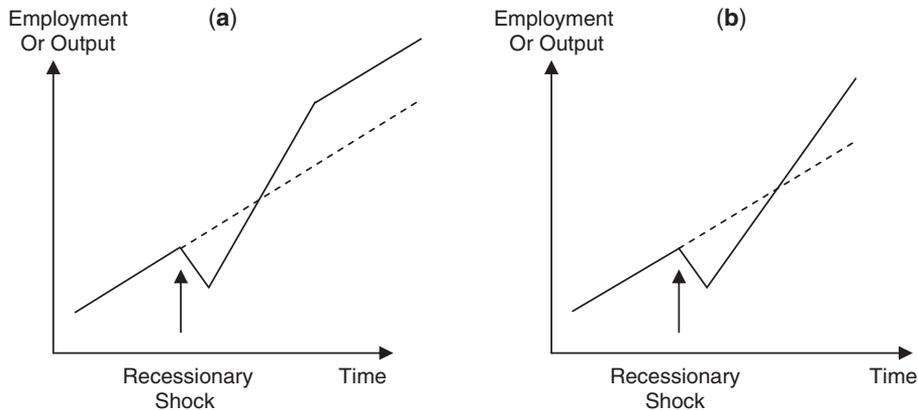


Figure 3. Positive hysteretic impacts of a recessionary shock on a region's growth path: (a) recovery to higher level, resumption of pre-recession growth rate. (b) recovery to a sustained higher growth rate.

continued productivity improvements declines, then the economy may then return to its pre-shock growth rate, though at a permanently higher path of output (or employment) (Figure 3a). If, on the other hand, the region is able to attract in labour and capital from elsewhere, or witnesses the emergence of new sectors of activity, and/or a new wave of productivity- and growth-promoting innovation, then the rapid growth out of recovery may well be sustained (Figure 3b). Further, a deep economic crisis may facilitate beneficial economic, political and institutional reforms that lead to a permanent increase in regional output growth (Caballero and Hammour, 1994; Gali and Hammour, 1993), and possibly also of employment growth, though that will depend on the nature and sources of the growth in output. Regional economies that exhibit positive hysteretic effects of either type would presumably be regarded as highly resilient.

2.3 'Adaptive resilience' and regional economic realignment

The possibility of positive hysteretic outcomes provides a link to the third use or interpretation of the notion of resilience, that of 'adaptive' resilience (Table 1). This interpretation is one that derives from the theory of complex adaptive systems. Supposedly, what distinguishes complex adaptive systems is the way they exhibit self-organizing behaviour, driven by co-evolutionary interactions among their constituent components and elements, and an adaptive capacity that enables them to rearrange their internal structure spontaneously, whether in response to some external shock, or in reaction to some internal emergent mechanisms or 'self-organised criticality' (Martin and Sunley, 2007). Regional economic resilience in this framework could be viewed as having to do with the capacity of a regional economy to reconfigure, that is adapt, its structure (firms, industries, technologies and institutions) so as to maintain an acceptable growth path in output, employment and wealth over time. Such adaptability will depend on the rate of entrepreneurship and new firm formation in the region, on the innovativeness of existing firms, and their ability and willingness to shift into new sectors and product lines, on access to finance for investment, on the diversity of the

region's economic structure, on the availability of labour of the right skills, and similar factors.

This view of resilience is then quintessentially an evolutionary one: resilience is a dynamic *process*, not just a characteristic or property, and it resonates closely with the Schumpeterian notion of 'gales of creative destruction'. A deep recession may sweep away outmoded and unproductive activities, the removal of which opens up opportunities for the development of new sectors and a new phase of growth. Whether the creative aspects of this process outweigh the destructive is, of course, a vital issue. The adaptive capabilities of a region's economy—its firms, workers, institutions and policy actors—may well depend on the nature of the region's pre-existing economy; that is, adaptation is likely to be a path-dependent process (see Martin, 2010), shaped by the region's industrial legacy and the scope for re-orientating skills, resources and technologies inherited from that legacy. How regional economies adapt over time, and why some regions appear more successful in this respect than others, are largely unresearched issues, but such adaptation is arguably a key source of economic resilience.¹⁰

2.4 Four dimensions of regional resilience

These different interpretations of resilience suggest that at least four interrelated dimensions are needed to begin to give full meaning to the notion as a description of how regional economies respond to recessionary or other such shocks (Figure 4).

The first is that of *resistance*, that is the vulnerability or sensitivity of a regional economy to disturbances and disruptions, such as recessions. The second is that of the speed and extent of *recovery* from such a disruption. Of interest here is whether the speed and extent of recovery are determined by the degree of resistance to the shock in the first place. The third aspect concerns the extent to which the regional economy undergoes structural *re-orientation* and what implications such re-orientation has for the region's output, jobs and incomes. The fourth dimension concerns the degree of *renewal* or resumption of the growth path that characterized the regional economy prior to the shock. In addition, these different aspects or dimensions of regional economic resilience may interact in different ways, to produce different outcomes of the sort illustrated stylistically in Figures 1–3 above. They are, moreover, linked by virtue of the various factors and characteristics that shape a region's reaction to a major recessionary shock. Such factors will include the regional economy's prior growth performance. A regional economy that has a strong underlying growth dynamic is likely to be more resistant to a recessionary downturn, or, if it is severely impacted, more likely to recover quickly and resume that dynamic. It might be expected, therefore, to suffer less structural disruption, or alternatively be able to adapt successively into new growth sectors. The converse set of reactions might be hypothesized for a region that has a weak underlying pre-shock growth dynamic.

Economic structure is often thought to play a particularly key role in shaping a region's sensitivity or resistance to shocks. In an insightful, though curiously neglected, study, Conroy (1975) demonstrated in some detail how a region's

10 Glaeser's (2005) brilliant study of Boston's ability to reinvent its economy despite repeated periods of crisis and decline illustrates how, in this particular case, a strong base of skilled workers has been crucial to local economic resilience.

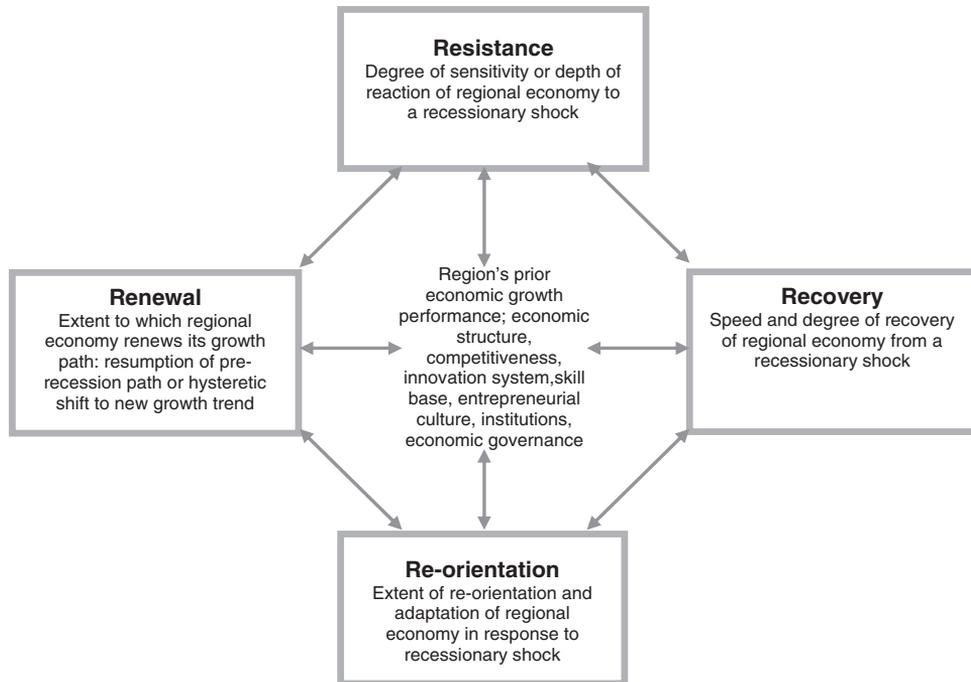


Figure 4. Four dimensions of regional economic resilience to a recessionary shock.

industrial ‘portfolio’—its particular mix of economic activities and the relationships and interdependencies between them—can influence the reaction of a region’s economy to recessionary disturbances and fluctuations (see also Sherwood-Call, 1990; Siegel et al., 1994, 1995; Dissart, 2003; Ormerod, 2008). Other things being equal, a diverse or varied economic structure (‘portfolio’) is often assumed to provide greater regional resistance to shocks than does a more specialized structure, since different industries themselves have different sensitivities to business fluctuations, changes in export markets, major shifts in monetary conditions (exchange rates and interest rates) and so on (in effect a ‘spreading of risk’, to continue the investment portfolio analogy).¹¹ However, precisely how a diversified regional economy reacts to recession will also depend on the degree of sectoral inter-relatedness (whether direct or indirect) that can exist even in a diversified structure, so that the latter does not necessarily guarantee a high resistance. As Conroy showed, where such interdependencies are significant—or, as he puts it, where there is a significant degree of co-variance between sectors—a downward shock to one or just some of a region’s industries may well ripple through and have consequential depressive effects on much of the region’s economy as a whole. And conversely, whether a highly specialized regional economy is more sensitive to cyclical downturns than a diversified

11 There are of course several alternative measures of regional economic diversity (see for example, Jackson, 1984; Siegel et al., 1995; Raj, 2008). Most measures are purely statistical, such as the Ogive Index and the Herfindahl Index. Hypothesizing the relationship between regional economic diversity and economic stability requires an appropriate theory.

regional economy will depend on the nature of that specialization. Conventionally, however, manufacturing and construction industries have been viewed as being more cyclically sensitive than private service industries, and the latter more sensitive than public sector services, which are often assumed to be largely immune to economic recessions. The spatial distribution of these activities across localities and regions might then be expected to be relevant in explaining geographical differences in resistance to recessionary shocks. But at the same time, much will depend on the precise nature (causes) of the recessionary downturn.

A region's economic structure; the competitiveness and innovative propensity of its firms; the relational linkages of its firms with networks of other producers and customers in other regions and other countries; the skills of its workforce; its entrepreneurial culture, its institutional forms; the stance taken by and the resources and measures available to any local policy bodies (such as regional or local development agencies); and the region's economic governance arrangements, will all shape the resistance and response of a region's economy to, and its recovery from, a shock. But regional economic resilience is also about political economy: not only about how the region's firms and industries react and adjust, but also about how local institutional, cultural and political conditions mediate and respond to those reactions, about how national policy may help or hinder a region's recovery, and about the very nature, boundaries, and relational character of regional and local economies as arenas of economic governance and policy activism. A political economy perspective on regional resilience would focus, for example, on the employment relation and wage-profit relation within firms, that is on how far and in what ways local employers seek to recast the terms and conditions of work in an attempt to cut costs, increase productivity and restore profitability in response to economic downturn. Such strategies raise the critical issue of what 'resilience' means for firms as compared to workers: what might be sources of 'positive' resilience for a firm—such as forcing through more flexible working practices and conditions—may entail negative consequences for its employees. Further, how national policy makers respond to a major recessionary crisis can be quite crucial in influencing the economic resilience of different regions and localities. The specific policies adopted by the central government—of fiscal expansion or contraction, or monetary loosening or tightening, or growth-inducing capital spending on public infrastructure, for example—will condition the scope for and form of firm behaviour differently in different regions, especially according to the economic specialisms of those firms (whether, for instance, in manufacturing or in construction, or in financial and business services). Similarly, whether and to what extent national governments introduce specific measures to assist regions particularly badly hit by recession will also influence the map of regional and local economic resilience. The choice of 'resilience agenda'—the policy strategies and responses introduced to aid regional economic recovery and rebuilding following a major recessionary crisis (or perhaps local economic collapse following the closure of a major employer)—may itself be the subject of considerable political debate and even ideological conflict, not only between different levels of government (national versus local), but also between different stakeholder groups at the regional or local level.

And then there is the issue of how 'resilience' depends on and is shaped by the very nature and relevance of the geographical units that are used to define and delimit the regional and local economies to which the notion is meant to apply. The regions and localities we study are rarely functionally meaningful economic entities, but instead are

often demarcated—for data collection, administrative or political reasons—along somewhat arbitrary lines. In some instances, it might be possible to define meaningful city-regions or local economies on the basis of, say, travel to work or other similar criteria. But in many cases, this is not possible and we have to work with the official entities for which data are available. Such arbitrariness is almost inevitable. What it means, of course, is that we need to recognize that such regional entities are not only fuzzy, but also quintessentially highly open externally and possibly distinctly discontinuous internally. Different sectors and sublocalities will be linked into quite different networks of external relations, flows and structures, and thus may also display different degrees of resilience to shocks. This certainly complicates the idea of ‘regional’ resilience. But it by no means renders it invalid. What I have tried to set out in this section of the article are some basic, generic conceptual ideas which themselves do not rely on or presuppose any specific definitions of ‘regional’ or ‘local’ economies, but which might guide analysis of the particular empirical regions or localities that we choose to study. Of course, in using such resilience concepts in empirical work and case studies, the question of the nature and meaningfulness of the spatial units being used to define regional or local economies may well come to the fore, and require further elaboration or even revision of the idea of resilience in that specific context. However, if officially defined regions display different patterns of long-run growth and cyclical response this at least suggests that, notwithstanding the definitional fuzziness and internal economic heterogeneity of such regions, some type of regionally identifiable resilience dynamic is at work, and that the local sectoral, business and institutional bases of that dynamic are then worthy of more detailed analysis. This I suggest is the case with the empirical evidence for the UK standard Government Office Regions analysed in the following section. And of course, what may be arbitrarily defined regions from a economic functional point of view often have their own region-specific official policy or governance authorities, which at least imbues them with some degree of institutional coherence, and the potential basis for regionally specific policy responses and interventions. For example, regional development or policy bodies may in some cases be able proactively to implement local economic strategies explicitly aimed at improving the long-run resilience of local firms and industries, or be able to provide assistance and support to local firms and workers to help promote recovery from the disruptive impacts of a particular recessionary or other type of shock.

3. Some exploratory empirics: the resilience of the British regions to major recessions

To explore whether these notions on resilience and hysteresis might be of value in analysing regional growth paths in the presence of major periodic recessionary shocks, this section presents some preliminary empirics for the major British regions. In terms of the different dimensions of resilience summarized in Figure 4, the main aim is to identify regional differences in *resistance*, *recovery* and *renewal*. The fourth dimension, of structural *re-orientation* and adaptation, is touched on only briefly and in very broad terms, since a detailed analysis of this complex aspect of resilience is a major task in its own right, and is not possible here. The regions are the standard Government Office regions (NUTS1 level, using the European Commission nomenclature). Although these

Table 2. A tale of three recessionary shocks: output and employment contractions in the UK economy

	1979–1983 recession		1990–1993 recession		2008–2010 recession	
	Output	Employment	Output	Employment	Output	Employment
Production ^a	–14.6	–18.2	–6.7	–14.1	–14.7	–9.8
Services	–2.4	–1.9	–1.1	–2.7	–4.6	–1.4
Total	–6.6	–7.3	–2.4	–6.9	–5.7	–2.8

Notes: Contractions are measured in percentage terms from peak to trough in output and employment, respectively; output is GVA in 2006 prices; quarterly data in each case. The troughs in output typically occur sooner than those in employment, and the latter also takes longer to recover.

Source: Calculated from data available at <http://www.statistics.gov.uk/statbase/>.

^aProduction industries include: manufacturing, mining, energy, water and construction.

are widely acknowledged as not necessarily constituting the most meaningful functional economic areas, they have long been used to analyse and debate regional economic growth inequalities across the UK, and have also been used as the spatial framework for official regional policy.¹²

3.1 A tale of three major recessionary shocks

As mentioned above, three deep recessions have affected the UK economy over the past 40 years: 1979–1982, 1990–1992 and 2008–2010 (Table 2). Each has exerted a major downward shock to both output and employment, though for the two earlier recessions the drop in employment was noticeably greater than that in output. The most recent recession has been somewhat different in that, to date and at the time of writing, the decline in output has exceeded that in employment. But with the Government's sharp cut-backs in public expenditure, further significant job losses may yet follow so that, ultimately, the fall in employment could once again exceed that in output, as I discuss at the end of this part of the article.

In what follows, analysis is confined to the movements in employment rather than output. Employment tends to take much longer than output to recover from recession, and is thus arguably the more critical variable, since a major decline in employment in a region or locality can have profound consequences for the local labour market. And mentioned earlier, a regional or local economy may resume output growth following a recession without a corresponding recovery in employment, thereby creating major problems of adjustment for local unemployed workers. How far and in

12 Since 1998, the standard Government Office regions have had their own Regional Development Agencies, although the new Coalition Government has announced that these will be wound up by March 2012, to be replaced by a patchwork of new Local Enterprise Partnerships (essentially local authority areas or groups of such).



Figure 5. Growth and recessionary shocks in UK employment, quarterly, 1972(1)–2010(2). *Notes:* Employment is total employment. *Source:* Calculated from data available at <http://www.statistics.gov.uk/statbase/>.

what ways regional employment rebounds following recession is thus arguably a more insightful indicator of a regional economy's resilience.¹³

The impact of these three recessionary shocks on the growth path of UK national employment is shown in Figure 5. However, this national picture obscures quite disparate—in fact, strongly divergent—employment growth patterns among the major regions of the country (Figure 6). These different trends are no doubt the product of a host of different underlying forces and processes, the complexity of which is not the focus here. But what is also evident is that the different regions have reacted very differently to the main recessionary shocks over this period. In terms of resistance to recession, at least, these broad official regional economies appear to exhibit different degrees of resilience.

3.2 Regional resistance to recessions

One very simple way of measuring the resistance aspect of resilience of the regions to recession is the ratio of decline in employment or output in a region to the respective decline in the country as a whole: that is, $\Delta E_r/E_r = \beta_r(\Delta E_N/E_N)$ or $\beta_r = (\Delta E_r/E_r)/(\Delta E_N/E_N)$ where $\Delta E/E$ is the percentage change in employment, and β_r is a 'sensitivity index'. If the index β_r for a given region is greater than unity, we may say that the region in question has a low (relative) resistance (high sensitivity) to a recessionary shock. And conversely, if a region has a ratio of less than unity it has a high (relative) resistance (low sensitivity).

13 This was the rationale behind Blanchard and Katz's (1992) focus on employment in their classic study of the long-run evolution of US regional economies.

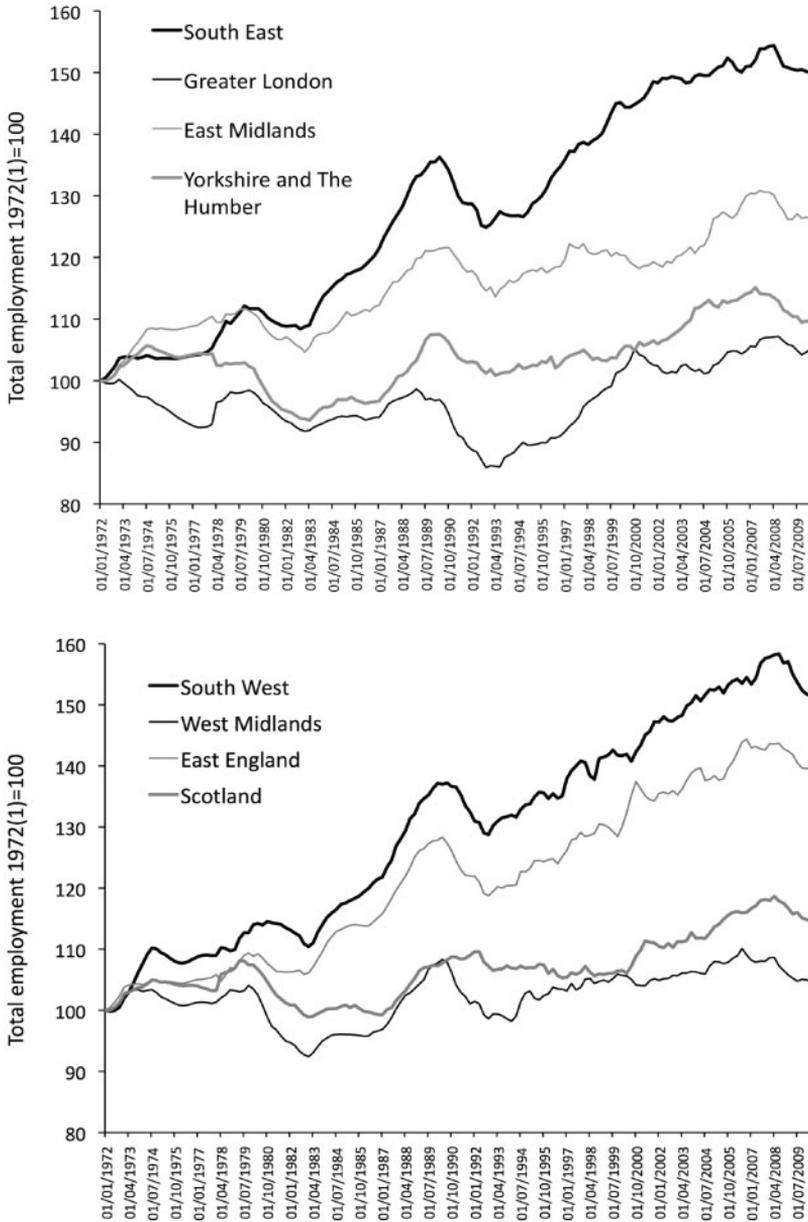


Figure 6. Employment growth paths in the UK regions, quarterly, 1972(1)–2010(2), indexed to 1972(1)=100. *Source:* Calculated from data supplied by Experian, London.

These simple indexes are revealing. First, there is considerable variation in resistance (or sensitivity) to recession across the regions, especially in the downturns of the early 1980s and early 1990s. For example, all the old industrial regions of peripheral and northern UK (North East, North West, Wales and Scotland) and the West Midlands reacted much more severely to the early 1980s recession than the regions of the south

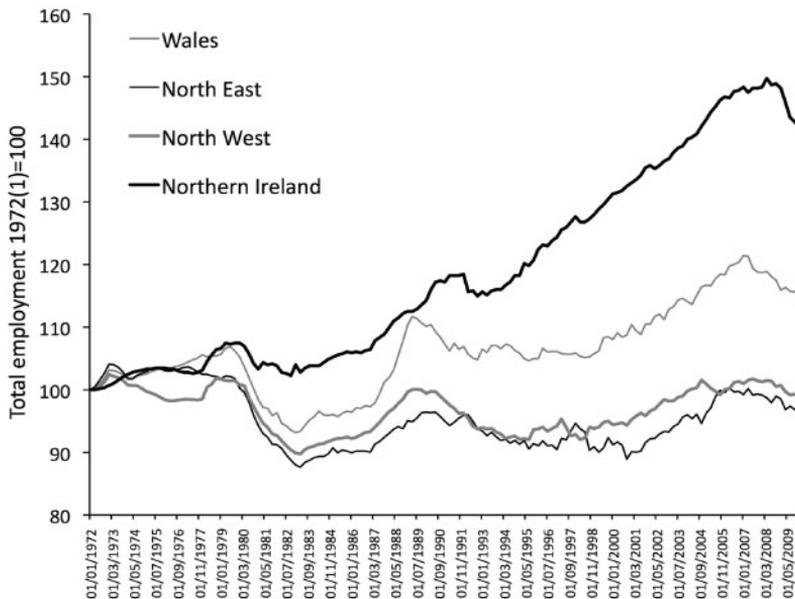


Figure 6. Continued.

and east, apart from Greater London. Second, what also emerges is that the pattern of resilience (resistance) has varied between recessionary shocks. The geographical incidence of the recession of the early 1990s was markedly different from that of the early 1980s. This time, the impact was far greater in Greater London, the South East, Eastern England and the two Midlands regions, than in the industrial north and periphery, almost the reverse in fact of the regional incidence of the previous downturn. With respect to the most recent recession, the pattern of regional sensitivity thus far has differed yet again from the earlier downturns. Despite the fact that the banking crisis of 2007–2008 was widely predicted to result in massive job losses in London, this region registered the lowest relative fall in employment of all the UK regions in the recession.

What accounts for these spatial and temporal variations in regional resistance to recession? As mentioned above in relation to Figure 4, economic structure, and especially the relative dependence on production industry, is generally regarded as having a major influence on the sensitivity of regional economies to recessionary shocks. The recession of the early 1980s was primarily based in manufacturing and other production industries, so it was inevitable that the old industrial regions of the North East, North West, West Midlands, Wales and Scotland would experience the most pronounced shock (Table 3), particularly since these same regions had shown only weak employment growth in the preceding 1970s (Figure 6).¹⁴

14 These regions had been deindustrializing in the 1970s, but the recession of the early 1980s, a downturn arguably intensified by the monetarist policies pursued by the Thatcher Government, greatly intensified the process (see Martin and Rowthorn, 1986; Martin, 1992).

Table 3. Regional responses to two major recessionary shocks: employment change in production and services (per cent)

	1979–1983 recession		1990–1993 recession	
	Production	Services	Production	Services
South East	-12.1	4.7	-24.6	-3.1
Greater London	-17.9	-3.5	-25.5	-8.2
Eastern	-11.9	7.8	-18.6	-3.0
South West	-9.6	4.8	-15.9	-0.5
East Midlands	-15.7	4.4	-16.5	0.7
West Midlands	-21.9	1.5	-21.0	-3.2
Yorks-Humber	-23.1	1.7	-16.3	1.1
North West	-25.0	-4.1	-19.2	0.1
North East	-26.3	-5.5	-19.1	1.0
Wales	-26.7	-2.2	-10.8	-1.3
Scotland	-22.3	-1.5	-12.9	2.5
Northern Ireland	-22.7	2.4	-8.3	3.7
UK	-19.4	0.6	-18.8	-2.3

Note: Production industries include: manufacturing, mining, energy, water and construction. *Source:* Calculated from data supplied by Cambridge Econometrics: these data are yearly rather than quarterly, so the recessions are defined in terms of peak and trough years (as measured by national employment).

Further, in some of these worst effected regions, the dramatic fall in production employment was compounded by a fall, albeit much less severe, in service jobs, whereas in some of the regions in which the impact of the recession on the production sector was less pronounced (South East, Eastern, South West), service employment actually increased. In the recession of the early 1990s, the older industrial regions of the north and periphery were much less affected than the south and east, the exception being the West Midlands, which once again was severely impacted. And unlike the early 1980s recession, services proved vulnerable to this downturn, especially so in the South East and London, adding to the contraction in manufacturing and related activities in these areas.

The two recessionary shocks were thus somewhat different in nature and regional impact. The reasons for the different reactions of the UK regions to these two recessions have not received much analysis, but an interesting argument is that part of the explanation resides in the effect that the early 1980s recession and subsequent structural change had on the regions. More specifically, it has been suggested that the dramatic decline in the manufacturing and production industries in the northern regions in the early 1980s recession and the continued deindustrialization in those areas in the subsequent recovery permanently altered the resistance of those regions to future recessionary shocks:

the manufacturing and production sectors, the main source of regional imbalance in the past, [will] no longer dominate shifts in the employment structure to the same extent. Future shocks will have a more balanced regional incidence than has been the case in the past (Jackman and Savouri, 1999, p. 27).

The argument was that future recessionary shocks would be felt more equally across the country. It is certainly the case that the early 1980s recession destroyed large numbers of manufacturing and production jobs in the northern regions of the UK, as is evident in Table 3. And the share of these sectors in total employment continued to decline across all regions during the boom periods of 1983–1990 and 1993–2008. But in terms of *relative* specialization, as measured, for example, by location quotients, the decline in dependence of the northern regions on this form of economic activity for their employment is less striking than perhaps assumed by Jackman and Savouri, and indeed even by 2008 the North East, North West and Yorkshire-Humberside regions were still considerably more relatively specialized in manufacturing and production than the South East and London (Table 4). Of course, what matters is the sectoral composition of a region's production activity, and whether in this context the main destructive impact of the early 1980s recession and its aftermath was concentrated in the dominant cyclically prone and structurally and competitively weak industries in the northern regions.

The evidence tends to support this point. Thus in Yorkshire-Humberside, for example, the two main sources of employment in 1979 were coal mining, and textiles and clothing, with 83,000 and 124,000 workers, respectively. By 1990, the numbers employed in these two had shrank to 25,000 and 68,000. In the North East, jobs in the dominant employers, coal mining, and basic metals and metal products, declined from 42,000 to 13,000, and from 61,000 to 37,000, over the same period. These same two sectors had also been the primary sources of employment in Wales in 1979, accounting for 40,000 and 86,000 jobs; but by 1990 the numbers employed in these industries in the region had shrunk to 8000 and 47,000. Likewise, over this period, employment in textiles and clothing, the main sector in the economy of the

Table 4. Regional dependence on production industries, selected years (per cent of total numbers employed and location quotient)

	1971		1979		1983		1990		1992		2008	
	%	LQ										
South East	34.3	0.86	30.6	0.84	27.1	0.83	24.8	0.75	20.5	0.77	15.6	0.66
Greater London	30.1	0.69	24.3	0.66	21.5	0.64	17.7	0.53	14.9	0.55	10.3	0.47
Eastern	39.0	1.05	34.9	1.01	30.7	1.00	27.5	0.91	24.2	0.98	18.9	1.00
South West	33.5	0.80	29.6	0.83	26.5	0.81	25.3	0.80	22.3	0.86	17.4	1.01
East Midlands	48.9	1.30	43.3	1.27	38.2	1.24	34.3	1.26	30.2	1.40	23.0	1.43
West Midlands	50.4	1.56	44.6	1.41	38.1	1.34	33.9	1.32	29.6	1.41	20.9	1.34
Yorks-Humber	46.5	1.21	40.9	1.16	34.4	1.05	30.7	1.08	27.4	1.16	20.8	1.15
North West	44.1	1.10	38.1	1.15	31.9	1.09	29.5	1.08	25.6	1.15	18.7	1.14
North East	45.1	1.16	40.7	1.09	33.7	1.06	30.5	1.04	25.9	1.12	20.0	1.17
Wales	41.0	1.17	36.3	1.15	31.3	0.86	28.1	0.97	26.2	1.13	20.4	1.20
Scotland	39.6	0.93	34.5	0.92	29.4	0.86	26.6	0.85	23.5	0.91	17.6	0.88
Northern Ireland	39.7	0.89	33.0	0.91	26.8	0.82	26.2	0.86	24.1	0.99	19.9	1.09
UK	39.9	1.00	34.9	1.00	30.9	1.00	27.0	1.00	23.6	1.00	17.6	1.00

Note: Production industries include: manufacturing, mining, energy, water and construction.

Source: Calculated from data supplied by Cambridge Econometrics. The data are mid-year estimates.

North West had halved, from 190,000 to 95,000. In addition, if this dramatic run-down of previously key industries was accompanied by a selective survival of the more competitive and productive firms across the slimmed down industrial base of these regions, then in combination these processes could possibly help explain the greater resistance of these regions to the early 1990s recession.

3.3 Regional recovery and hysteresis

However, what Jackman and Savouri failed to consider was the hysteretic effects that a major reduction in the industrial base of the northern regions may have had on their future growth prospects. As was argued above, a deep downturn in a region's economy, particularly if it leads to the destruction of a significant proportion of its economic base, may result in a downward hysteretic shift in the region's growth path (Figure 2a) and even a post-shock reduction in its growth rate (Figure 2b). This focuses attention on the speed and extent of *recovery*. To investigate this issue, Figures 7 and 8 plot the relationship across the UK regions between regional resistance (as measured by the sensitivity indices in Table 5) and regional recovery, as measured by average growth rate, for the early 1980s and early 1990s recessions, respectively. The results for the early 1980s recession suggest that, while other factors were obviously at play, and the relationship is far from perfect, the lower was a region's resistance to the recession, the slower was its subsequent rate of recovery (Figure 7). Further, by partitioning the relationship into quadrants, defined by the national resistance index (1.00) and national post-recession employment growth rate, the four southern regions of the South East, South West, Eastern and East Midlands stand out as having been both the most resistant to the recession and as having experienced the fastest post-recession employment growth. The North East and North West stand out in strong contrast: not only were they badly hit by the recession, they then experienced a very slow post-recessionary recovery in employment. The results for the early 1990s recession and its aftermath are somewhat different (Figure 8). This time round, there was no significant relationship across regions between the scale of recessionary contraction and the subsequent rate of recovery. But the quadrant comparisons are still telling.

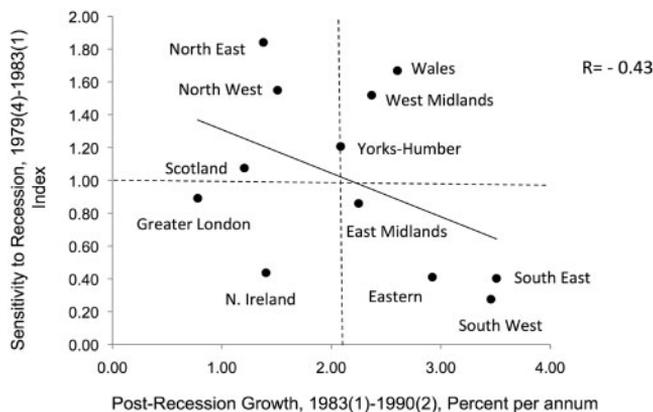


Figure 7. Regional resistance to and recovery from early 1980s recession: total employment. *Source:* Calculated from data supplied by Experien, London.

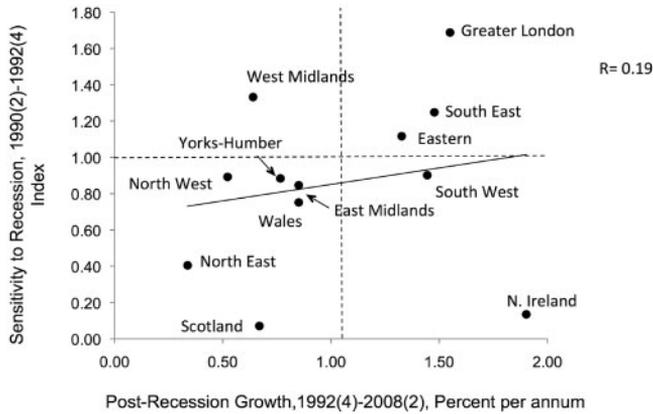


Figure 8. Regional resistance to and recovery from early 1990s recession: total employment. *Source:* Calculated from data supplied by Experian, London.

Table 5. Resistance to recession across UK regions: ‘sensitivity’ β -indices of relative employment contraction in three downturns

	1979(4)–1983(1)	1990(2)–1992(4)	2008(2)–2010(2)
South East	0.40	1.24	0.91
Greater London	0.89	1.69	0.60
Eastern	0.39	1.39	0.86
South West	0.28	0.90	1.37
East Midlands	0.86	0.85	0.98
West Midlands	1.52	1.33	1.20
Yorks-Humberside	1.21	0.88	1.15
North West	1.55	0.89	0.88
North East	1.84	0.40	0.73
Wales	1.67	0.75	1.43
Scotland	1.08	0.08	1.11
Northern Ireland	0.44	0.13	1.81

Note: A high value of the ‘sensitivity index’ implies a low resistance, and conversely (see text). *Source:* Calculated from data supplied by Experian, London.

They show that despite the fact that Greater London and the South East were much more vulnerable to the recession than the North East, North West, Wales and Scotland, they nevertheless proved more successful in recovering from it, achieving rates of employment growth well above the national average.

What also is evident is that the North East and North West regions had a markedly slower rate of recovery from both recessionary shocks: in this sense—in terms of ‘bounce back’—these two regions appear to be much less resilient than regions in the south and east of the country. Furthermore, such was the combined impact of the early 1980s recession and the slow recovery rate from both that shock and from the early 1990s recession, that neither regional economy had fully returned to its 1979 level of

employment before the recession of 2008–2010 began (Table 6). In both regions, the evidence suggests that the deep downturn of 1979–1983 had a negative hysteretic impact on their long-run employment paths, of the sort stylized in Figure 2a or even Figure 2b.

Indeed, one of the most striking features to emerge from this analysis is the marked contrast in resilience and long-run growth as between the North East and South East regions. This is particularly evident in Figure 9, which shows in detail how these two regions reacted to and recovered from the two recessions under discussion. It would seem that even if the South East is severely impacted by recession, its economy recovers rapidly and strongly and that over time the region is able to sustain a rate of employment growth well above the national average: it is characterized by a high degree of resilience in terms of recovery and renewal of growth (Figure 10). At the other extreme, even after 30 years, employment in the North East had barely returned to its 1979 level following the hysteretic impact of the 1979–1983 recession. Of course, while many other factors have been at work, there would seem good grounds for arguing that the marked divergence in long-run employment growth performance between these two regions of the UK has been shaped, in part at least, by their differential resilience to recession, and the hysteresis suffered by the North East.

Table 6. Peak and trough employment levels, North West and North East regions: a negative hysteretic impact of the 1979–1983 recessionary shock?

Employment in millions	1979(4) (Peak)	1983(1) (Trough)	1990(2) (Peak)	1992(4) (Trough)	2008(2) (Peak)
North West	3.429	3.206	3.357	3.156	3.415
North East	1.203	1.033	1.131	1.101	1.159

Source: Calculated from data supplied by Experian, London.

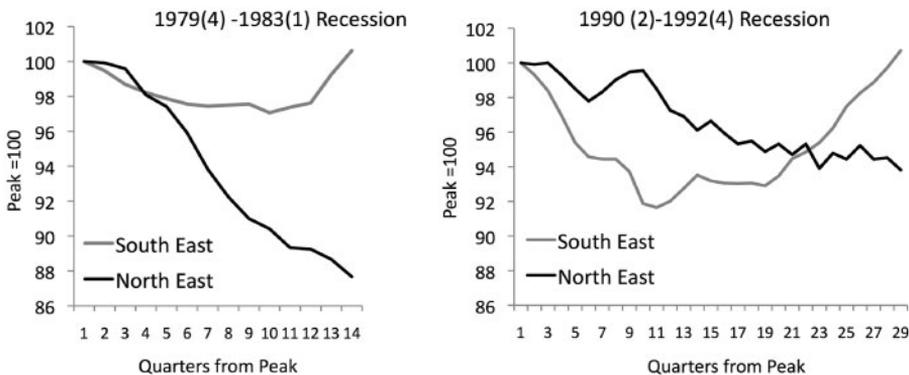


Figure 9. Resistance to and recovery from recession: the South East and North East regions compared—total employment. Source: Calculated from data supplied by Experian, London.

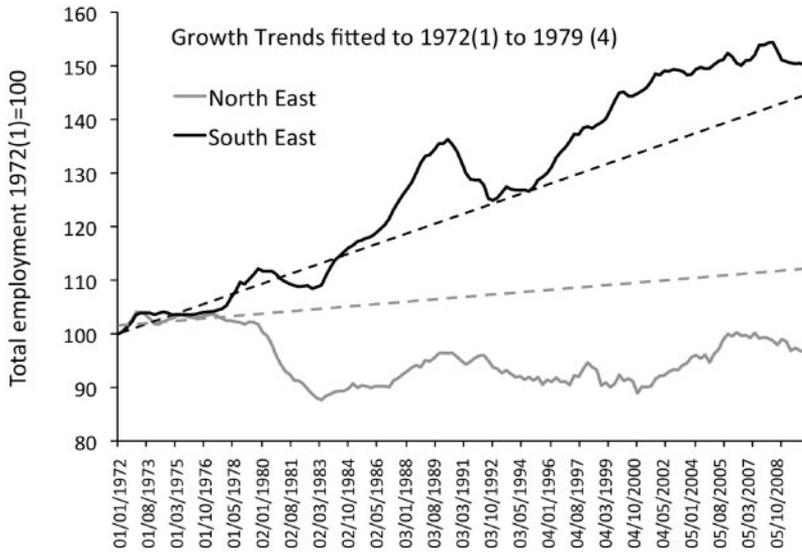


Figure 10. Resilience versus hysteresis: the South East and North East compared. *Source:* Calculated from data supplied by Experian, London.

3.4 Structural re-orientation and regional adaptive resilience

The fourth dimension of resilience referred to in Section 2 was that of regional economic *reorientation* or realignment (Figure 4), whereby a major shock gives rise to, or accelerates pre-existing, changes in a region's economic structure. Such changes may themselves be a source of negative or positive hysteresis, leading to a new (lower or higher) growth trend. As was mentioned above, some degree of structural change occurs more or less continuously, so what matters in respect to the issue of regional resilience is whether and to what extent such change restores a region's employment path following a major recessionary shock, that is on how fast and how successfully a region's economy adapts from slow-growing or declining sectors into fast-growing ones. The negative hysteretic impact of the early 1980s recession on the North East's employment path (Figure 10) suggests that this region's economy significantly lagged those of other regions and especially that of the South East in this process.

The broad sectoral patterns of employment change in these two regions are shown in Table 7. The general direction of sectoral employment change in both regions over the successive recessions and recoveries studied here has been the same, most notably a progressive contraction of manufacturing and expansions of employment in finance, insurance and business services, and in the public sector. But the scale of these shifts has been larger in the South East, with the numbers of new jobs in finance, insurance and business services during recovery periods far exceeding the jobs lost in manufacturing in recessions and recovery periods combined. In the North East, in contrast, the numbers of new jobs created in finance, insurance and business services in the recovery phases have fallen far short of the cumulative numbers that have disappeared from manufacturing. In addition, the South East economy has experienced a substantial net shift of its employment structure into retail, distribution, hotels and catering,

Table 7. The structural composition of employment change in recession and recovery, South East and North East regions compared (thousands of employees)

	Recession 1979–1983	Recovery 1983–1990	Recession 1990–1993	Recovery 1993–2008
South East				
Agriculture	–0.7	2.8	–12.4	–8.3
Mining, extractive, utilities	–7.5	–10.4	–5.5	–12.1
Manufacturing	–116.5	–13.7	–131.3	–119.1
Construction	25.4	148.9	–113.6	69.0
Retail, distribution, hotels, catering	25.4	200.1	–66.6	159.6
Transport, communications	0.8	37.1	–23.5	42.2
Finance insurance and business services	46.5	252.0	–5.8	364.3
Other private services	4.1	54.0	–28.9	83.9
Public services	19.1	123.7	31.9	116.8
Total	–27.5	794.5	–355.7	696.3
North East				
Agriculture	–5.6	–2.3	0.0	–5.7
Mining, extractive, utilities	–12.2	–24.4	–13.0	–3.8
Manufacturing	–95.4	–21.9	–35.2	–55.0
Construction	21.8	21.1	–16	14.8
Retail, distribution, hotels, catering	–34.8	16.0	–5.0	14.1
Transport, communications	–7.7	4.0	–4.0	2.7
Finance, insurance and business services	0.9	34.6	4.9	57.1
Other private services	2.4	7.3	1.8	8.2
Public services	1.1	36.1	10.1	82.1
Total	–173.1	70.5	–56.4	114.5

Source: Calculated from data supplied by Cambridge Econometrics. The data are mid-year estimates.

whereas in the North East this component of structural re-orientation has been relatively weak. The picture that emerges, then, is one in which the South East economy has been far more successful in adapting its structure towards the faster growth sectors than has the North East, which as a result failed to establish a favourable employment growth path following the recession of the early 1980s. This aspect of regional resilience clearly merits much more detailed investigation.

3.5 What of the recent crisis and recession?

Given these findings, what then are likely to be the implications of the most recent recession on the employment paths of the UK regions? As we have seen (Table 5), with respect to employment, the impact of the 2008–2010 recession has been much less differentiated between northern and southern regions compared with the previous two downturns. And, overall, employment fell less than output. But there has been much debate over the additional impact of the major cut-backs in public expenditure and public services that are planned to occur up to 2015. There have been various estimates of the contraction in public sector employment that will result from the Coalition Government's fiscal austerity programme: estimates of the public sector jobs that could be lost over this period have ranged from 300,000 to almost 500,000. These figures

would be equivalent to a fall of between 5% and 8%. And the cuts in public spending could have adverse knock-on effects on manufacturing and private service jobs. The Government's view is that the losses in public sector jobs will be more than compensated by the growth in private sector employment. But whether redundant public sector workers will be reabsorbed into private sector jobs, and how this process works out across different regions and localities, are, however, debatable issues.

Indeed, there has been much debate over how these direct and indirect effects will play out across the country because both the scale and composition of public sector employment vary from region to region, and from locality to locality, and because different local public authorities are choosing to make the cuts in public expenditure imposed by central Government in different ways. Further, as we have seen from the foregoing analysis, the regions also differ significantly in their underlying growth dynamic. Even at the broad regional scale being examined here, it is evident that most of the northern and peripheral regions of the UK have become more dependent on the public sector for output growth and for employment than those of the south and east of the country (Table 8). Thus, other things being equal, the adverse employment impacts of the spending cuts are likely to be greater in the northern and peripheral regions. If this turns out to be the case, there will be additional negative knock-on effects on the labour markets more generally within these regions. In the light of past experience, as presented here, and taking into account the prospects of the predicted large-scale public sector employment cuts falling unevenly across the country, it seems likely that the South East and London regions will rebound faster and further from the recent economic crisis than other regions.

4. Discussion and conclusions

There has been increasing interest in and invocation of the notion of resilience in the social and environmental sciences over the past few years, and the concept has even entered national, regional and local policy discourse. Yet, the notion is not unproblematic. According to Hanley (1998), for example, the concept of resilience, though highly suggestive, suffers from imprecision of definition and conceptualization, which in turn weakens its purchase as an analytical or explanatory tool. My aim here has been to try to move closer towards a possible conceptualization, with particular reference to how regional economies respond to recessionary shocks. I would not claim for an instant that the explication advanced here constitutes the only possible interpretation of regional economic resilience, nor that as developed here the notion is necessarily applicable in other analytical or empirical contexts (see Walker et al., 2006, for example, for a discussion of how far it may be possible to derive general principles and hypotheses regarding the resilience and adaptability of socio-ecological systems). Indeed, different conceptions of resilience may well be needed for different circumstances. Similarly, even with respect to the specific issue of the impact of recessions on regional growth paths, the idea of resilience requires considerably more elaboration than offered here. The long-run trajectories of regional output and employment, for example, are obviously the complex outcomes of a range of structural and systemic, and external and internal, factors, processes and arrangements, and resilience is but one aspect of a regional economy's growth dynamics. Indeed, how such factors, processes

Table 8. Regional dependence on the public sector

	Public sector share of total regional output growth 1993–2008	Public sector share of total regional employment 2010
Greater London	17.3	23.3
South East	11.4	26.9
Eastern	12.9	26.0
South West	15.7	28.0
East Midlands	18.7	27.3
West Midlands	19.0	27.8
Yorks-Humberside	20.8	29.4
North West	17.6	28.8
North East	22.3	34.4
Wales	28.7	30.6
Scotland	28.4	28.0
Northern Ireland	12.8	32.5

Source: Calculated from data supplied by Cambridge Econometrics.

and arrangements shape the resilience of a regional economy to recessionary and other shocks is a key issue.

But a first stage in any such analysis is to determine whether and in what sense there are discernible and systematic patterns in how regional economies react to and recover from such shocks, and whether the idea of resilience is helpful in this regard. This has been the focus of this article. To this end, I have argued that (at least) four dimensions are needed to capture the idea of regional economic resilience in relation to recessionary shocks, namely: resistance, recovery, renewal and re-orientation (realignment or adaptation). Further, I have suggested that the concept of resilience might usefully be linked to that of hysteresis, which is the notion that economists tend to use to judge the impact of shocks on an economy's growth path. The idea of hysteresis is useful because, in contrast to resilience, as usually defined, it focuses not on the preservation of system functioning and performance in the presence of exogenous change and disturbances, but on how such changes and disturbances can shift system functioning and performance, and whether such a shift is negative or positive in nature and outcome. As Hanley argues, we would not expect an economy's industrial structure, in terms of the distribution of output or employment, to be preserved over time, since structural change occurs more or less continuously. But recessionary shocks can and do cause sudden and intense structural change and re-orientation, and this can result in hysteretic change to a region's growth path. The idea of hysteresis would thus seem to complement that of resilience.

The arguments and analysis contained in this article have been exploratory in nature, but they do suggest that further, more detailed, research would be worthwhile. Three avenues for possible additional investigation are immediately obvious. The first would be to undertake a more rigorous statistical analysis of the reaction and recovery dynamics of regional economies to recessionary shocks, for example using advanced time series techniques. Given that we are interested in identifying regional responses to a series of recessions, that such responses may vary from one recession to another, and

that we wish to test for any hysteretic impacts of those recessions on regional growth paths, the time series models needed for this task are far from straightforward. In addition, allowance should be made for cross-regional interactions, since shocks can be transmitted from one region to another, and this further complicates this type of analysis. However, some preliminary work along these lines for the UK regions (Fingleton et al., 2010), does suggest that the use of formal statistical time series methods can provide a more precise indication of the scale and significance of regional differences in resilience to recessions than the relatively simple procedures used in this article.¹⁵

Secondly, of course, and crucially, if regional economies are found to have different degrees of resilience to recession, then those differences call for an explanation. Why are some local and regional economies more resilient than others? I have not pursued this issue in any depth in this article, beyond some partial discussion of the role of regional economic structures in shaping the sensitivity of regions to recessionary shocks and the extent of their subsequent recovery. A full explanation would need to analyse the reactions and adjustments of both firms and workers at the local level, as well as the reactions of local institutions and policy actors. Regional and local economies are composite entities, made up of numerous heterogeneous firms and workers. Individual firms and workers differ with respect to the ease with which they can adjust to and weather recessionary shocks, their ability to switch into other activities, the range of local constraints they face, the resources available to them and their economic preferences. Aggregate regional reactions to recession are the outcome of the discrete adjustments and responses of these heterogeneous economic agents. Further, when we disaggregate a regional economy, we may well discover that the degree of resilience and adaptability differ as between firms and workers. Firms may act to survive a major recessionary downturn by cutting jobs, but then operate with a smaller workforce even when recovery comes. Unless the workers made redundant find other jobs in the locality, the brunt of the recessionary shock will be borne by the local labour market. A region's firms may well prove to be resilient, but whether its labour market recovers may be a different issue, and will depend on the balance of different adjustments mechanisms, including unemployment, inactivity and outmigration. A regional economy may be resilient in certain respects but not others. Interestingly, current economic research into hysteresis has begun to direct explicit attention to such heterogeneity of response and adjustment, and to the micro-foundations of hysteretic dynamics (for example, see Cross et al., 2009).

Thirdly, the empirical findings presented here indicate that regional resilience to recession can vary and change over time, not only because of differences in the causes and nature of individual recessionary shocks, but because the factors and mechanisms that shape economic resilience may themselves evolve and change. Resilience is not a static feature of an economy, but a dynamic process, influenced both by the impact of major shocks and by the ongoing restlessness of structural economic change and adaptation. An evolutionary approach to regional economic resilience is thus called for, which would permit such notions as variety, selection, path dependence and

15 Statistically identifying structural breaks and shifts in trended time series is a complex issue (see, for example, Altissimo and Corradi, 2003; White and Granger, 2011). Fingleton et al. (2010) use a variety of time series models with dummy variables and error correction components to test formally for hysteretic shifts and breaks in regional growth paths following recessions.

self-organization, as well as purposive adaptation by economic agents and policy-makers, to play an explanatory role. Indeed, the notion of resilience should itself be central to any conceptual framework for studying the evolution of the economic landscape. In this article, I have focused on the idea of resilience in relation to the impact of recessionary shocks, but regional and local economies are, of course, also prone to various other shocks and disturbances, sometimes of a general macro-economic nature, sometimes of a regionally specific and idiosyncratic nature. Technological disruptions, major shifts in competition, local plant closures, major changes in government policy or regulatory arrangements may all test a region's economic resilience and the capacity of its firms and workers to recover and adapt. Regional economic evolution is not simply a steady incremental process, but is also shaped by periodic, often unexpected shocks. Potentially, the notions of resilience and hysteresis can aid our understanding of how regional economies respond to such disruptions. The conceptual framework developed in this article provides one possible, albeit limited, basis for further theoretical development and empirical exploration of this intriguing research agenda.

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References

- Altissimo, F., Corradi, V. (2003) Strong rules for detecting the number of structural breaks in a time series. *Journal of Econometrics*, 111: 207–244.
- Baddeley, M., Martin, R. L., Tyler, P. (1998) Cyclical shocks and structural shifts in British regional unemployment since the early-1980s. *Applied Economics*, 30: 19–30.
- Blanchard, O. T., Katz, L. F. (1992) Regional evolutions. *Brookings Papers on Economic Activity*, 1: 1–75.
- Boschma, R., Martin, R. L. (2007) Constructing an evolutionary economic geography. *Journal of Economic Geography*, 7: 537–548.
- Boschma, R., Martin, R. L. (eds) (2010) *The Handbook of Evolutionary Economic Geography*. Cheltenham: Edward Elgar.
- Caballero, R., Hammour, M. (1994) The cleansing effect of recession. *American Economic Review*, 84: 1350–1368.
- Carpenter, S., Walker, B. et al. (2001) From metaphor to measurement: resilience of What to What? *Ecosystems*, 4: 765–781.
- Carpenter, S. R., Westley, F. et al. (2005) Surrogates for resilience of social-ecological systems. *Ecosystems*, 8: 941–944.
- Cerra, V., Panizza, U., Saxena, S. C. (2009) International evidence on recovery from recessions. Working Paper WP/09/183, International Monetary Fund.
- Cerra, V., Saxena, S. C. (2008) Growth dynamics: the myth of economic recovery. *American Economic Review*, 98: 439–457.
- Christopherson, S., Michie, J., Tyler, P. (2010) Regional resilience: theoretical and empirical perspectives. *Cambridge Journal of Regions, Economy and Society*, 3: 3–10.
- Conroy, M. (1975) *Regional Economic Diversification*. New York: Praeger.
- Cross, R. (1993) On the foundations of hysteresis in economic systems. *Economics and Philosophy*, 9: 53–74.

- Cross, R., Allan, A. (1988) On the history of hysteresis. In R. Cross (ed.) *Unemployment, Hysteresis and the Natural Rate Hypothesis*. Oxford: Blackwell.
- Cross, R., Grinfield, M., Lamba, H. (2009) Hysteresis and economics. *Control Systems Magazine, IEEE*, 29: 30–43.
- Cross, R., Mcnamara, H., Pokrovskii, A. (2010) Memory of recessions. Working Paper 10-09, Department of Economics, University of Strathclyde.
- Dissart, J. C. (2003) Regional economic diversity and regional economic stability: research results and agenda. *International Regional Science Review*, 26: 193–204.
- Domazlicky, B. (1980) Regional business cycles: a survey. *Regional Science Perspectives*, 10: 15–34.
- Elster (1976) A note on hysteresis in the social sciences. *Synthese*, 33: 371–391.
- Fingleton, B., Garretsen, H., Martin, R. L. (2010) *Recessionary shocks and regional employment: evidence on the resilience of UK Regions*. Paper presented at the Institute of Housing and Urban Studies Conference on Urban Development: Patterns, Causes and Consequences, Erasmus University, Rotterdam, December. Forthcoming in *Journal of Regional Science*.
- Florida, R. (2009) How the crash will reshape America. *The Atlantic Monthly*, Available online at: <http://www.theatlantic.com/doc/200903/meltdown-geography> [Accessed 16 August 2010].
- Foster, K. A. (2007) A case study approach to understanding regional resilience. Working Paper 2007–08, Institute of Urban and Regional Development, Berkeley.
- Franz, W. (1990) Hysteresis in economic relationships: an overview. *Empirical Economics*, 15: 109–25.
- Friedman, M. (1993) The plucking model of business fluctuations revisited. *Economic Enquiry*, 31: 171–177.
- Gali, J., Hammour, M. (1993) *Long-run effects of business cycles*. Unpublished manuscript. New York: Columbia University, Graduate School of Business, New York.
- Georgescu-Roegen, N. (1967) *Analytical Economics: Issues and Problems*. Cambridge, MA: Harvard University Press.
- Glaeser, E. (2005) Reinventing Boston: 1630–2003. *Journal of Economic Geography*, 5: 119–153.
- Göcke, M. (2002) Various concepts of hysteresis applied in economics. *Journal of Economic Surveys*, 16: 167–188.
- Goodwin, T. H. (1993) Business cycle analysis with a Markovian switching model. *Journal of Business and Economic Statistics*, 11: 331–339.
- Hanley, N. (1998) Resilience in social and economic systems: a concept that fails the cost-benefit test? *Environment and Development Economics*, 3: 244–249.
- Hassink, R. (2010) Regional resilience: a promising concept to explain differences in regional economic adaptability? *Cambridge Journal of Regions, Economy and Society*, 3: 45–58.
- Harris, D. J. (2005) Robinson on ‘History versus Equilibrium’. In B. Gibson (ed.) *Joan Robinson’s Economics: A Centennial Celebration*, pp. 81–108. Cheltenham: Edward Elgar.
- Hill, E. W., Wial, H., Wolman, H. (2008) Exploring regional economic resilience. Working Paper 2008–04, Institute of Urban and Regional Development, Berkeley.
- Holling, C. S. (1973) Resilience and stability of ecological systems. *Annual Review of Ecology and Systematics*, 4: 1–23.
- Holling, C. S. (1996) Engineering resilience versus ecological resilience. In P. Schulze (ed.) *Engineering within Ecological Constraints*, pp. 31–44. Washington, DC: National Academy Press.
- Holling, C. S. (2001) Understanding the complexity of economic, ecological and social systems. *Ecosystems*, 4: 390–405.
- Hudson, R. (2010) Resilient regions in an uncertain world: wishful thinking or practical reality? *Cambridge Journal of Regions, Economy and Society*, 3: 11–26.
- Jackman, R., Savouri, S. (1999) Has Britain solved the regional problem? In P. Gregg, J. Wadsworth (eds) *The State of Working Britain*, pp 29–46. Manchester: Manchester University Press.
- Jackson, R. W. (1984) An evaluation of alternative measures of regional industrial diversification. *Regional Studies*, 18: 103–112.
- Kim, C.-J., Nelson, C. R. (1999) Friedman’s plucking model of business fluctuations: tests and estimates of permanent and transitory components. *Journal of Money, Credit, and Banking*, 33: 317–334.

- Kim, C.-J., Piger, J. (2002) Common stochastic trends, common cycles, and asymmetry in economic fluctuations. *Journal of Monetary Economics*, 49: 1189–1211.
- Lang, D., Setterfield, M. (2006) History versus equilibrium? On the possibility and realist basis of a general critique of traditional equilibrium analysis. *Journal of Post-Keynesian Economics*, 29: 191–209.
- McGlade, J., Murray, R., Baldwin, J., Ridgway, K., Winder, B. (2006) Industrial resilience and decline: a co-evolutionary framework. In E. Garnsey, J. McGlade (eds) *Complexity and Co-Evolution: Continuity and Change in Socio-economic Systems*, pp. 147–176. Cheltenham: Edward Elgar.
- Markusen, A. (1999) Fuzzy concepts, scanty evidence, policy distance: the case for rigour and policy relevance in critical regional studies. *Regional Studies*, 33: 869–884.
- Martin, R. L. (1992) Has the British economy been transformed? Critical reflections on the policies of the Thatcher era. In P. Cloke (ed.) *Policy and Change in Thatcher's Britain*, pp. 123–158. Oxford: Pergamon Press.
- Martin, R. L. (1997) Regional unemployment disparities and their dynamics. *Regional Studies*, 31: 35–50.
- Martin, R. L. (2010a) The Roepke lecture in economic geography – rethinking regional path dependence: beyond lock-in to evolution. *Economic Geography*, 86: 1–27.
- Martin, R. L. (2010b) Uneven regional growth: the geographies of boom and bust under new labour. In N. Coeand, A. Jones (eds) *The Economic Geography of the UK*, pp. 29–46. London: Sage, pp.
- Martin, R. L., Rowthorn, R. E. (eds) (1986) *The Geography of Deindustrialisation*. London: Macmillan.
- Martin, R. L., Sunley, P. J. (2007) Complexity thinking and evolutionary economic geography. *Journal of Economic Geography*, 7: 16–45.
- Ormerod, P. (2008) Resilience after local shocks. *Applied Economic Letters*. Available online at: <http://dx.doi.org/10.1080/13504850801964331> [Accessed 23 November 2010].
- Pendall, R., Foster, K. A., Cowell, M. (2010) Resilience and regions: building understanding of the metaphor. Berkeley, Institute of urban and regional development. *Cambridge Journal of Regions, Economy and Society*, 3: 71–84.
- Pike, A., Dawley, S., Tomaney, J. (2010) Resilience, adaptation and adaptability. *Cambridge Journal of Regions, Economy and Society*, 3: 59–70.
- Pimm, S. L. (1984) The complexity and stability of economic systems. *Nature*, 307: 321–326.
- Raj, K. (2008) Measuring economic diversification. *Mimeo*, Research and Economic Analysis Division, Department of Business, Economic Development and Tourism, State of Hawaii.
- Reggiani, A. de, Graff, T., Nijkamp, P. (2002) Resilience: an evolutionary approach to spatial economic systems. *Networks and Spatial Economics*, 2: 211–229.
- Romer, R. (2001) *Advanced Macroeconomics*. New York: McGraw Hill.
- Rose, A., Liao, S.-Y. (2005) Modelling regional economic resilience to disasters: a computable general equilibrium model of water service disruptions. *Journal of Regional Science*, 45: 75–112.
- Setterfield, M. (1997) Should economists dispense with the notion of equilibrium? *Journal of Post-Keynesian Economics*, 20: 47–76.
- Setterfield, M. (1998b) History versus equilibrium: Nicholas Kaldor on historical time and economic theory. *Cambridge Journal of Economics*, 22: 521–537.
- Setterfield, M. (2010) Hysteresis. Working Paper 10-04, Department of Economics, Trinity College, Hartford, Connecticut.
- Sherwood-Call, C. (1990) Assessing regional economic stability: a portfolio approach. *Federal Reserve Bank of San Francisco Economic Review*, 1: 17–26.
- Siegel, P. B., Alwang, J., Johnson, T. G. (1994) Toward an improved portfolio variance measure of regional economic stability. *Review of Regional Studies*, 24: 71–86.
- Siegel, P. B., Alwang, J., Johnson, T. G. (1995) A structural decomposition of regional economic stability: a conceptual framework. *Journal of Regional Science*, 35: 457–470.
- Siegel, P. B., Johnson, T. G., Alwang, J. (1995) Regional economic diversity and diversification. *Growth and Change*, 26: 261–284.
- Simmie, J., Martin, R. L. (2010) The economic resilience of regions: towards an evolutionary approach. *Cambridge Journal of Regions, Economy and Society*, 3: 27–44.

- Sinclair, T. M. (2010) Asymmetry in the business cycle: Friedman's plucking model with at correlated innovations. *Studies in Nonlinear Dynamics and Econometrics*, 14. Available online at: <http://www.bepress.com/snede/vol14/iss1/art3> [Accessed 24 November 2010].
- Stehr (2006) The political economy of urban disaster assistance. *Urban Affairs Review*, 41: 492–500.
- Swanstrom, T. (2008) *Regional resilience: a critical examination of the ecological framework. Urban Affairs Association Annual Meeting*. Baltimore, MD: Institute of Urban and Regional Development, Berkeley.
- Vale, L. J., Campanella, T. J. (eds) (2005) *The Resilient City*. New York: Oxford University Press.
- Walker, B., Gunderson, L., Kinzig, A., Folke, C., Carpenter, S., Schultz, L. (2006) A handful of heuristics and some propositions for understanding resilience in socio-ecological systems. *Ecology and Society*, 11. Available online at: <http://www.ecologyandsociety.org/vol11/iss1/art13/> [Accessed 1 December 2010].
- White, H., Granger, C. W. J. (2011) Consideration of trends in time series. *Journal of Time Series Econometrics*, 3: Article 2.
- Wilkerson, C. R. (2009) Recession and recovery across the nation: lessons from history. *Federal Reserve Bank of Kansas Economic Review, Second Quarter*, 5–24.