

On the Notion of Regional Economic Resilience: Conceptualisation and Explanation

Ron Martin* and Peter Sunley**

*Department of Geography, University of Cambridge, UK
(rlm1@cam.ac.uk)

**School of Geography, Southampton University, UK
(P.J.Sunley@soton.ac.uk)

Original Version October 2013
Revised Version March 2014

Submitted to *Journal of Economic Geography*

Abstract

Over the past few years a new buzzword has entered academic, political and public discourse: the notion of *resilience*, a term invoked to describe how an entity or system responds to shocks and disturbances. Although the concept has been used for some time in ecology and psychology, it is now invoked in diverse contexts, both as a perceived (and typically positive) attribute of an object, entity or system and, more normatively, as a desired feature that should somehow be promoted or fostered. As part of this development, the notion of resilience is rapidly becoming part of the conceptual and analytical lexicon of regional and local economic studies: there is increasing interest in the resilience of regional, local and urban economies. Further, resilience is rapidly emerging as an idea ‘whose time has come’ in policy debates: a new imperative of ‘constructing’ or ‘building’ regional and urban economic resilience is gaining currency. However, this rush to use the idea of regional and local economic resilience in policy circles has arguably run somewhat ahead of our understanding of the concept. There is still considerable ambiguity about what, precisely, is meant by the notion of regional economic resilience, about how it should be conceptualized and measured, what its determinants are, and how it links to patterns of long-run regional growth. The aim of this paper is to address these and related questions on the meaning and explanation of regional economic resilience and thereby to outline the directions of a research agenda.

Keywords: Shocks Resilience Robustness Adaptability Regional economies

JEL classification R10 R11 B52

Acknowledgments

The research for this paper forms part of a larger project on *How Regions React to Recession: Resilience, Hysteresis and Long Run Impacts*, funded by the UK Economic and Social Research Council (Grant ES/1035811/1), whose support is gratefully acknowledged. An earlier version of the paper was presented at the Path Dependence Seminar Series, Faculty of Economics and Business, Free University of Berlin, 25-26 June, 2013; at the Annual Conference of the Royal Geographical Society-Institute of British Geographers, London, 28-30 August, 2013; and at the Urban and Regional Economics Studies Group Workshop on ‘What Constitutes a Regional Economy?’, Cardiff, 25-26 September, 2013. The various comments made on those occasions, together with those of three anonymous referees, proved most useful in shaping the final version of the paper.

1. Introduction

Over the past few years a new buzzword has entered academic, political and public discourse: the notion of *resilience*. Although the concept has been used for some time in psychology and ecology, it is now invoked in diverse contexts, both as a perceived (and typically positive) attribute of an object, entity or system and, more normatively, as a desired feature that should somehow be promoted or fostered. Students of emergency response and environmental management use the concept in connection with how far local communities cope with extreme natural events, such as floods, droughts and earthquakes (Parsons, 2010; Lee, Vargo and Seville, 2013). Engineers, transport specialists, and architects harness the notion to discuss the durability, sustainability and adaptability of urban infrastructures in the face of continued population growth and the threats of climate change and peak oil. Organisational scientists and business scholars use the idea in discussions of the strategies firms, companies and other organizations need to adopt if they are to survive and prosper in an increasingly changeable global market place (Hamel and Välikangas, 2003; Starr, et al, 2003; Tompkins, 2007). Behavioural psychologists invoke the notion to describe how far individuals are able to deal with and recover from personal traumas and adversity (Kaplan, 1999; Luthar and Becker, 2000; Denhardt and Denhardt, 2010; O'Dougherty Wright, et al, 2013). We live, we are told, in an increasingly uncertain, volatile, and risk-prone world, one that is subject to seemingly ever more pronounced disruptions and disturbances, and the success with which we negotiate and traverse this unpredictable and rugged terrain will depend on how *resilient* we are (Zolli and Healey, 2012).

Given this rise and spread of 'resilience talk', it is not surprising that the notion should have found its way into economic geography and regional studies. Economies have always been prone to major perturbations and shocks: recessions, major policy changes, currency crises, technological breakthroughs, and the like, can all disrupt and destabilize the path and pattern of economic growth. It is within regional, urban and local economies and communities that such shocks and disturbances work out their effects and consequences. Nationally- or globally-originating shocks are rarely spatially neutral or equitable in their impact or implications. In addition to national or global disturbances, locally-originating and locally-specific disruptions are also far from infrequent, such as the closure or relocation of a major employer or even the local shut-down of a whole industry. Thus it would seem logical enough to assume that the notion of resilience is highly pertinent for analyzing how regions and localities react to and recover from shocks, and thence for understanding the role such shocks might play in shaping the spatial dynamics of economic growth and development over time. Major research

programmes on regional and urban economic resilience are underway, there have been major conference sessions on the subject, special issues of journals and collections of papers have been devoted to the topic (see, for example, *Cambridge Journal of Regions, Economy and Society*, 2010), and even research institutes and lobby organizations established (such as the Resilience Alliance, and the Annual Global Forum on Urban Resilience and Adaptation). The notion of resilience is rapidly becoming part of the conceptual and analytical lexicon of regional economic studies.

Further, as is often the case with new ideas (others that come to mind are ‘competitiveness’ and ‘clusters’), the notion of regional and local economic ‘resilience’ is already finding currency among those interested in policy. Resilience is emerging as an imperative ‘whose time has come’ in policy debates around localities, cities and regions, propelling a new discourse of ‘constructing’ or ‘building’ regional and urban economic resilience. This new discourse has found a ready reception across a variety of policy bodies and scales, from the OECD and the European Commission, to national governments, city authorities, and regional and local economic development agencies. Indices of local and regional resilience have been compiled, akin to those for competitiveness, and even league tables of resilient cities have been proposed, all with the intention of comparing one locality or city with another and thereby fuelling the policy pursuit of ‘building’ greater resilience.

But this eagerness to use the idea of regional (and urban) economic resilience as a policy tool or objective is arguably in danger of running somewhat ahead of our understanding of the concept. If we are to put the idea of resilience meaningfully to work in regional policy agendas and practices, then we need to have a clear definition, conceptualization and understanding of precisely what it is that we are trying to foster. We are not in that position at the moment. For one thing, there is *no universally agreed definition* of regional or local economic resilience: different authors employ different definitions and descriptions, sometimes even invoking the term without giving any precise interpretation. Certainly, as yet there is *no generally accepted methodology* for how the concept should be operationalised and measured empirically: is there some absolute measure of regional economic resilience, or is it a case of more or less resilient, and if so relative to what? Similarly, there is as yet *no theory* of regional economic resilience as such, and relatively little discussion of how the notion relates to other concepts such as uneven regional development, regional competitiveness, regional path dependence, and the like (Bristow, 2010; Hassink, 2010). And then there is the issue of *what determines* the resilience of a regional or local economy: what is it that makes a local economy more or less resilient? Given these and other concerns, some economic geographers have *questioned the applicability and relevance* of the concept in regional and urban settings, and

queried whether it adds anything new to our existing theoretical and explanatory schemas. These are all issues that need discussion and resolution before we can talk meaningfully about ‘building’ local and regional resilience. Our paper is intended to move that discussion forward.

2. Resilience and Robustness: Clarifying Concepts

A survey of the uses of the term ‘resilience’ across various disciplines suggests three main interpretations or definitions of the concept (Table 1). The first, and most restrictive, follows closely the etymology of the word - which derives from the Latin *resilire*, to leap back, to recover form and position elastically following a disturbance of some kind – and construes resilience as ‘bounce back’ of a system following a shock to its pre-existing state or path, which in many applications is assumed to be a stable or ‘equilibrium’ state or path. The focus is on the system’s speed of recovery or return to its pre-shock position. This definition of resilience was termed ‘engineering resilience’ by the ecologist Holling (1973) in his seminal paper on the subject, on the grounds that it is the interpretation found in many physical and engineering sciences. He defined it as *how fast a system that has been displaced from equilibrium by a disturbance or shock returns to that equilibrium*. This definition thus emphasises efficiency, constancy and predictability – all attributes at the core of engineers’ desire for ‘fail-safe’ design. While the ‘engineering’ label has stuck, this interpretation of resilience is not confined to the physical sciences, however, and is used by some ecologists in their discussions of the capacity of ecosystems and socio-ecosystems to maintain or regain stability when subjected to externally or internally originating perturbations and disturbances (see O’Neill, et al, 1986; Pimm, 1984). Further, as Holling himself commented, this idea of resilience as ‘bounce back’ bears a close affinity with the idea of ‘self-restoring equilibrium dynamics’ found in mainstream economics, where the assumption is that the normal condition of an economy is one of equilibrium (a steady state or a balanced growth path), and if the economy is pushed away from this assumed position or path by a shock – say a major recession or financial crisis – automatic, ‘self-correcting’ market mechanisms are activated which operate to restore the *ex ante* equilibrium. Under this mainstream economics scenario, resilience would imply the ‘free operation of market forces’, so that a lack of resilience (slowness or failure to restore the *ex ante* equilibrium following a shock) would be interpreted as a sign of, indeed as caused by, ‘market failures’ or ‘frictions’.

A second definition of resilience, found especially in the ecological literature, is a system’s ‘ability to absorb’ a shock without changing its structure, identity and function. Holling (1973) called this notion ‘ecological resilience’, which he argued was more appropriate for ecosystems. Subsequent work in ecology published since the late-1980s has developed this definition somewhat into the concept of ‘extended

ecological resilience’ (Holling, 1986; 1996; Gunderson and Holling, 2002; Gunderson and Pritchard, 2002; Walker et al, 2002, 2004), defined as “*the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks*” (Walker et al, 2006, p.2). However, this definition is not without ambiguity, since it remains unclear just how much ‘reorganisation’ and ‘change’ is permitted for the system to be regarded as still having ‘essentially the same structure, identity and feedbacks’, or deemed to have assumed a different state: the reorganization of a system will almost invariably involve some degree of change in structure, function and hence identity.

Table 1: The Three Main Types/Definitions of Resilience

Definition/Type	Interpretation	Main Fields of Use
Resilience as ‘bounce back’ from shocks	System returns, ‘rebounds’, to pre-shock state or path: emphasizes speed and extent of recovery.	So-called ‘engineering resilience’, found in physical sciences, some versions of ecology; akin to ‘self-restoring equilibrium dynamics’ in mainstream economics?
Resilience as ‘ability to absorb’ shocks	Emphasises stability of system structure, function and identity in the face of shocks. The size of shock that can be tolerated before system moved to new state/form	So-called ‘extended ecological resilience’, found in ecology and social ecology; akin to multiple equilibrium economics?
Resilience as ‘positive adaptability’ in anticipation of, or in response to, shocks	Capacity of a system to maintain core performances despite shocks by adapting its structure, functions and organization. Idea of ‘bounce forward’.	Found in psychological sciences and organizational theory; akin to ‘robustness’ in complex systems theory; can be linked with evolutionary economics?

Implicit, if not explicit, in this conception of resilience is the assumption that if a shock to a system exceeds that system’s absorptive resilience, or ‘ability to bounce back’, then the system will be pushed into some other alternative (equilibrium) state or form, which is typically assumed to be less favourable than the system’s pre-shock state. There has been debate within ecology as to what these ‘alternative states’ might be, whether they can be specified *a priori*, what the limits to stability are, and indeed around the relationships and distinctions between this notion of resilience and other concepts of stability found in ecological studies (see, for example, Grimm and Vissel, 1997; Justus, 2008). There are, again, parallels to be found in economics where, in recent years, the idea of multiple equilibria has attracted increasing attention. It is now accepted that if a ‘shock’ to an economy is too severe, it can so change economic structures, behaviours and expectations that the economy does not return to its pre-shock state or path, but is pushed to a new equilibrium state or path: the effect of the shock is permanent, not transitory - there is ‘memory’ of the shock (‘remanence’), and ‘hysteresis’ is said to have occurred (Cross, 1993; Setterfield, 2010). But, as in

ecology, there is debate around what these other equilibrium positions or paths are, and whether they can exist latently and conditionally ‘in the data’ of the economy. In much of economics, multiple equilibria are simply a feature of the very *a priori* assumptions and structural specification of the theoretical models used (as is the case in the new economic geography, as found for example in Fujita, Krugman and Venables, 1999; Fujita and Thisse, 2002; Baldwin et al, 2003), rather than an empirical possibility revealed by the actual unfolding historical dynamics of the economy. Indeed, economists of an evolutionary inclination would argue that precisely because the economy is an historical and contingent process, it is impossible to pre-specify multiple equilibria, and that the issue of whether multiple equilibria exist at all can only be an *ex-post* empirical issue (Metcalf, Foster and Ramlogan, 2006).

This links to a third interpretation of resilience to be found in certain literatures, namely that of ‘adaptive resilience’. Notions of ‘positive adaptive resilience’ are found in behavioural psychology to describe the adaptive coping skills that influence the capacity of individuals to maintain or quickly regain psychopathological wellbeing following personal stress, trauma or crisis of some sort: resilient individuals demonstrate dynamic self-renewal and adjustment, whereas less adaptively resilient individuals find themselves worn down and negatively impacted by life stressors (Masten et al, 1990; Kaplan, 1999; Luthar and Becker, 2000; O’Doherty Wright et al, 2013). The idea of ‘adaptive adjustment’ is often implicit if not explicit in the definitions and use of the notion of resilience in a variety of other applications. Thus in ecological economics, resilience is defined as “*the ability of the system to withstand either market or environmental shocks without losing the capacity to allocate resources efficiently*” (Perrings, 2006, p.418), which presumably also includes the possibility of resource *re*-allocation, and thus structural and qualitative change; and in organizational studies resilience has been defined as “*the ability of organizations to maintain their core functions in the face of disturbance by anticipating key events from emerging trends and constantly adapting to change and rapidly bouncing back from disaster*” (Marcos and Macaulay, 2008, p.1). This idea of resilience as involving structural and operational adaptation in response to shocks has led some authors to refer to it as ‘evolutionary resilience’, defined in terms of ‘bounce forward’ rather than ‘bounce back’ (Simmie and Martin, 2010; Davidou and Porter, 2012).

Indeed, this conception of resilience as the capacity to adapt in response to shocks resonates with ideas in complex adaptive systems theory (CAS) and evolutionary theory more generally. Both of these bodies of theory are concerned with the interplay between continuity and change in self-organising systems subject to internal or external perturbations, and the capacity of such systems to absorb and

adapt to such pressures. While CAS theorists do not use the terminology of resilience, they do focus on the notion of ‘robustness’, a feature that is held to be a fundamental characteristic of a wide range of systems, from biological organisms to social systems to sophisticated engineering systems (Jen, 2003; Kitano, 2004). Traditionally, robustness has been interpreted as meaning that the characteristics of a system are unaffected by perturbations: there is a consistency (stability) of structure and function (see Whitacre, 2012). But more recently the term has been reconceptualised to refer to the ability of a system to resist external and internal disturbances and disruptions *if necessary by undergoing plastic change in some aspects of its structure and components in order to maintain or restore certain core performances or functionalities*. It is important to recognize that under this new interpretation, robustness is concerned with maintaining some key functions or performances of a system rather than system states or structures, and that maintaining (or regaining) performance and functionality may actually involve – even require – changes in a system’s structural components and mode of operation:

Robustness is often misunderstood to mean staying unchanged regardless of stimuli or mutations, so that the structure and components of the system, and therefore the mode of operation, is unaffected. In fact, robustness is the maintenance of specific functionalities of the system against perturbations, and it often requires the system to change its mode of operation in a flexible way. In other words, *robustness allows changes in the structure and components of the system owing to perturbations...* (Kitano, 2004, p. 827, emphasis added).

The robustness of a system can manifest itself in different ways. For example, ‘robust adaptation’ is said to have occur when a system undergoes various structural and organisational changes in order to restore its pre-shock functionality and performance path – ie ‘bounce back’ involving structural change. Where shock-induced structural and organizational changes lead to a move to a new form of functionality or performance path, ‘robust transition’ is said to take place. Further, ‘robust transition’ is typically construed as a positive response in that it enhances the system’s ability to withstand and cope with future shocks: in this sense it is akin to the idea of ‘bounce forward’. Thus whereas in the ‘extended ecological’ definition, resilience is about the *stability and persistence* of structures and function in the face of shocks, in CAS theory a ‘robustness’ interpretation of resilience would be about the capacity to undergo *successful change* in structures, functions and behaviour. In a socio-economic context, such change may be deliberately undertaken by individual or collective agents in anticipation of or in preparedness for certain types of shock - one thinks here, for example, of how past experience of a major shock or disturbance (say a financial crisis, or a major local flood) leads to measures (such as the introduction of a new financial regulatory architecture, or the installation of a flood protection scheme) to minimize the impact of any future reoccurrence of such a shock.

The idea of robustness is clearly very close to, and indeed could be argued to be integral to, that of resilience. In addition, the study of robustness within a CAS framework directs attention to certain other possibly relevant concepts, such as ‘modularity’ and ‘redundancy’. *Modularity* refers to a system structure in which different component subsystems or elements are only partially or weakly connected or linked, so that if one such subsystem or element is affected by a shock, the effect remains relatively contained and its diffusion throughout the whole system is minimized. This implies that while one module (subsystem or set of elements) of a system may lack resilience, the system as a whole may nevertheless display robustness in the face of shocks. Robustness can also be enhanced if there are multiple means to achieve a specific function or overall system performance because the failure of one module can be compensated by others. This idea encompasses the concept of *redundancy*. This notion generally refers to a situation in which there are identical or similar components or subsystems (modules) which can replace each other when one fails. However, having multiple identical components as alternatives is rare. A more common mechanism which provides redundancy is that of diversity of components with overlapping, complementary or related functions, whereby a specific system-level function or performance can be attained by different means available in the heterogeneous population of elements of which the system is composed. Thus in an economic context, different combinations of industries might all be capable of yielding full employment or a given growth rate. The presence of modularity and redundancy will depend on the system concerned and the notions might appear more relevant for certain types of system, such as biological or engineering systems, than others, such as social and economic systems. Nevertheless, even in the case of the latter, these concepts do at least direct attention to issues such as structural diversity, relational networks, related variety, supply chains, and the like, and the role these might play in shaping the robustness and resilience of such systems.

While these three main definitions/interpretations of resilience are in some senses quite distinct, they are not mutually exclusive. Indeed, the idea of adaptive resilience (or robustness) subsumes aspects of, but is more expansive than, the other two definitions, since it allows a system - such as a regional economy - to absorb and rebound from a shock, that is, recover or even improve its ‘core performance’ - such as its rate of economic growth, or the full employment of its workforce - by undergoing structural, functional and organizational change. Such structural and functional adaptation may be integral to the way that a regional economy achieves resilience in the face of major shocks. But before we move on to discuss and develop the idea of regional economic resilience in more detail, we need to confront the doubt that some have voiced about the very notion.

3. The Idea of Regional Economic Resilience: A Problematic Notion?

As in other fields of application, the rise of resilience thinking in economic geography has not been without its dissenters and discontents. Even in ecology, where the notion has become most established, there have been complaints about its fuzziness, caused in part by the very diffusion of the concept from that field into other disciplines. For example, Brand and Jax (2007) view the generalization of the resilience idea as having blurred the original descriptive use of the notion in ecological work with broader heuristic, metaphorical and normative dimensions, to the point that:

both conceptual clarity and practical relevance are critically in danger. The original descriptive and ecological meaning of resilience is diluted as the term is used ambiguously and in a very wide extension. This is due to the blending of descriptive aspects, i.e., specifications of what is, and normative aspects, i.e. prescriptions of ought to be the case or is desirable as such. As a result, difficulties to operationalise and apply the concept of resilience within ecological science prevail. This in turn impedes progress and maturity of resilience theory... The success of the concept in stimulating research across disciplines on the one side, and the dilution of the descriptive core on the other, raises the fundamental question what conceptual structure we want resilience to have (2007, pp. 1-2).

We wholeheartedly agree there is a need for conceptual clarity in using the notion of resilience, in economic geography studies no less than in ecological or other contexts. But we would demur from the view that the application and possible reconceptualisation of the idea in settings other than the ecological somehow ‘dilutes’ the notion or ‘hinders progress and maturity in resilience theory’. To the contrary, not only may the notion require different specific conceptualizations in different disciplinary fields, this process may itself enrich resilience theory. This is not to deny, however, that applying the notion in regional and local economic settings raises issues (Table 2).

One such concern is the problem of analogy. It is argued by some that because social and economic systems differ in fundamental ways from ecological and physical systems, resilience ideas borrowed from these disciplines are not appropriate. The use of analogies borrowed from other disciplines – whether the transfer of ideas about resilience developed in ecology, developmental biology, or complexity science, to the study of how regional and local economies react to shocks – must always be exercised with caution: as Alfred Marshall once quipped, “Analogies may help us into the saddle, but are encumbrances on a long journey” (1898, p. 14). But this does not mean that the notion of resilience is irrelevant or inappropriate to the study of how economic and social systems - including local, regional and city economies - react to and recover from disruptions (Table 2). Rather, analogies can be used as the valuable

starting points for appropriate re-specification into constructs that have a closer ontological ‘fit’ with the entity and context under study. Analogies and metaphors may bring a new perspective into play: arguably that is the case with the idea of resilience.

Allied to this criticism, others have raised objections to the application of resilience notions to the study of economic and social dynamics on the grounds that, given its origins in the natural and physical sciences, the concept lacks a conception of human agency, and is depoliticized, even post-political (see Davoudi and Porter, 2012). The charge is that it hides politics and conflict. Yet others are suspicious that the concept is inherently loaded with normative values, that resilience is always seen as desirable, a ‘good thing’, and that it neglects the possibility that resilience may lock a system into a dysfunctional, or inefficient state, one that is not in fact desirable or sustainable, and adherence to which may prevent a much-needed re-orientation in the goals and mode of operation of the economic or social system concerned.

Table 2: Some Concerns Relating to the Use of Resilience Ideas in Spatial Socio-Economic Contexts

Nature of Concern
1. Social and economic systems differ in fundamental ways from ecological and physical systems, so that resilience ideas borrowed from latter are not appropriate
2. Concept of resilience in ecological and complexity sciences ignores human agency and is depoliticized; in the socio-economic realm, conflict and debate over responses to shocks may be crucial
3. Resilience privileges the idea of ‘return to normal’, and is invariably regarded as a ‘good thing’, and often ignores ‘perverse’ resilience – the resistance to change and the preservation of dysfunctional or inefficient structures or systems
4. The idea of resilience as ‘return to normal’ associates the concept with equilibrium, whereas spatial socio-economic systems are rarely, if ever, in equilibrium
5. The concept of resilience is easily captured by neoliberal ideology, to prioritise the status quo, and importance of self-reliance, flexibility and role of ‘self-correcting’ market adjustments
6. Resilience analysis tends to portray systems as responding dichotomously to shocks, either recovering to original state or pushed to a new state, whereas in reality response is complex mix of continuity and change
7. Resilience thinking emphasizes holism and systems ontology, and presupposes systems are easily defined. Regional and local economies are fuzzy and often difficult to demarcate
8. Resilience provides little ‘value-added’ over other concepts used to describe and study regional economic growth and development, such as competitiveness and sustainability

These criticisms point to some potential, but certainly not inevitable, problems. Studies of resilience in socio-ecology, political ecology, and ecological economics, for example, do include examples of maladapted systems, and often deal with the political and social conflicts surrounding the damaging outcomes of human disruptions of environmental systems and the nature of remedial actions that might be undertaken. The discussion of resilience in economic and social settings need not be depoliticized or avoid political issues. Indeed, in the urban planning literature many discussions of resilience are precisely about political influences and the importance of local leadership and agency in forging the recovery of local communities from shocks and disruptions. And, arguably, in any case the task of resilience analysis in economic geography is *first* to identify how regions and localities have been impacted by shocks, and then, *second*, precisely to explain the findings in terms of the various factors and processes involved, and this may well include linking resilience to social, behavioural, institutional, and political issues (Simmie and Martin, 2010; Lang, 2012; Evans and Karecha, 2013). In short, the ultimate goal should be to construct a *political economy of regional resilience* in the full meaning of that term.

Third, some economic geographers have expressed concern that the notion of resilience privileges the idea of a 'return to normal', and thus implies a return to 'successful capitalist functioning', which imbues resilience with harmonious and conservative connotations (Hassink, 2010; MacKinnon and Derickson, 2013). For this reason, some go further and see the idea as essentially neoliberal, as an apologia for the *status quo ex ante* and for the prioritization of 'competitiveness', 'flexibility', 'self-help' and market forces. Such criticisms may possibly have some force in relation to equilibrist or 'engineering' interpretations of the concept, which tend to emphasise the role of 'self-correcting' forces. But, as Martin (2012) points out, the assumption of equilibrium is not in fact necessary even for a 'bounce back' version of the resilience concept. What matters is that regional economies have empirically identifiable long-run, path-dependent developmental trajectories, since this is sufficient to make the study of the ways shocks influence those trajectories a valid topic, for which the idea of resilience may be useful. The fact that economic and social systems are essentially evolutionary disequilibrium systems in no way precludes the potential relevance and use of resilience ideas (see for example, Simmie and Martin, 2010). To the contrary, resilience may play a key role in shaping the process of long-run economic evolution, and is likely itself to evolve as an economy develops. The complaint that resilience necessarily implies a 'return to normal' lacks veracity, since to our minds what constitutes 'normality' is in fact problematised, not simply presumed or imposed, by the concept of resilience.

A further complaint sometimes voiced is that resilience conjures up a stark dichotomy between returning to a pre-existing state after a shock, and transformation to a different post-shock state. The notion of ‘extended ecological resilience’, and that of hysteresis in complex systems theory and some versions of economics, for example, suggest that if a shock to a system is too large, the system will not be able to return to its pre-shock state but will be pushed into a different state or regime. In most economic and social systems, however, the response to a shock is not a stark dichotomy between returning to the system’s pre-shock state and moving to a completely different state: such cataclysmic reconfigurations are rare. Rather, resilience will most likely involve both continuity and change: certain structural features, components and processes may change while others are preserved. The notion of robustness discussed above explicitly allows for varying degrees and types of structural and other change, so as to restore or maintain core functionality and performance: it is not a simple dichotomy between continuity (no change) and (complete) change. In a regional or local economic context, changes in certain structures, features, functions and processes may be necessary in order that regional economic growth paths *are* restored and maintained, and such changes may occur through market-led adjustments by social and economic agents or may be fostered and facilitated by policy interventions. But local economic structures do not change completely overnight, even in response to major shocks. Resilience is not an either/or feature or outcome, but a complex process that admits of many possible combinations of change and continuity.

An additional line of dissent over the use of the notion of resilience to study economic and social phenomena, including in economic geography, is the argument that it elevates the ideas of ‘system’ and ‘holism’. Such a ‘systems ontology’, it is argued, presupposes that regional and local economies can be easily and meaningfully demarcated, and it focuses on the maintenance of overall regional or local economic coherence and functioning. This, it is contended, ignores the heterogeneous nature of local and regional economic systems, the fact that different types of firm and different types of worker may react differently to a given shock, and thus the possibility that all sorts of distributional issues are involved when a local economy is disrupted by, say, a recessionary or similar perturbation. These are all relevant issues, but they are not confined to or peculiar to the study of regional resilience: they have to be considered in any study of (uneven) regional development. However we define ‘regional’ and ‘local’ economies, they are always characterized by a high degree of openness to external events and forces, they invariably consist of a myriad of spatially distributed and often discontinuous networks of interacting heterogeneous economic agents (from firms to workers to institutions), and they typically possess fuzzy boundaries and complicated dynamics, involving emergent and self-organising effects and processes (see Martin and Sunley, 2007). In short, regional and city economies are

complex systems. A complex systems viewpoint on regional or city resilience, while focusing on the dynamics of a regional, local or city economy as a whole, not only acknowledges that those dynamics are determined by the varying behaviors and (re)actions of the micro components making up that economy, but also allows for regional- (or city-) scale emergent effects arising from those micro-behaviours, which effects may in turn exert ‘downward causation’ on those micro-components. Such a view also avoids exaggerating the endogenous determinants of a local economy’s resilience and neglecting the importance of its ‘external’ connectedness, linkages and dependencies. The study of resilience is very much about the dynamics of systems considered as heterogeneous, connected, multi-scalar wholes (Zolli and Healy, 2012).

A final set of doubts focus on what is perceived as a lack of relevance or ‘value-added’ of the concept of resilience for the study of socio-economic systems. Hanley (1998), for example, has not only dismissed the appropriateness of the resilience metaphor for analysing socio-economic systems, but also argued that it contributes little that cannot already be explained by other ideas in economics, such as competitiveness and sustainability (see also Bristow, 2010). He also argues that in any case since economies, unlike say ecosystems, are constantly changing and evolving, they are unlikely to return to the same structure and function following a shock. This latter criticism seems to be leveled at the restrictive interpretation of resilience as simple ‘bounce back’ to the pre-shock state, and is easily countered by the ideas of adaptive resilience and robustness discussed above. But what about the criticism that the idea of resilience adds little to existing notions such as competitiveness? The key contribution of the idea of resilience, in our view, is that it directs attention precisely to the impact of shocks and their role in shaping the trajectories of regional growth and development. Competitiveness (which itself is far from easy to define has to do with the long-run and evolving comparative (and absolute) performance of economies more than with how economies react to shocks (see Martin, 2006; Martin and Sunley, 2012). Now it may well be that the competitiveness of a region’s firms and industries will exert a significant influence on the vulnerability, reaction and recovery of the region’s economy to shocks. Improving the competitiveness of a region’s firms may make them more resistant to shocks. Thus, competitiveness may be a determinant of the resilience of an economy; but it is not the same thing as economic resilience. As Scott (2013) points out, the value of the concept of resilience relative to the notions of competitiveness and sustainability is its explicit emphasis on shocks, disruptions and unknowable perturbations (Tomkins and Adger, 2004), and how such disruptions interact with processes of gradual and incremental change across temporal and spatial scales (Folke, 2006). The value of the idea of resilience is that it encourages us to recognise the potential impact that major shocks can play in the process of uneven regional development, and to explore how regions, localities and cities differ in vulnerability and reaction to shocks.

However, it is certainly the case that defining regional economic resilience is not straightforward, and that its importance as an analytical concept has to be demonstrated rather than simply assumed or asserted. Whatever the field of application, the study of resilience begs a four-part question (see also Carpenter et al, 2001): resilience of what, to what, by what means, and with what outcome? The ‘of what?’ part relates to the delimitation of the critical features or defining characteristics of a region’s economy or economic growth path that are meant to be resilient, how that resilience is to be measured, and the criteria to be used to determine if the region has changed its structure, function or growth path as a result of a shock. In other words, studying resilience requires the specification of a meaningful ‘reference’ state, regime or path against which the impact of a shock can be measured and the extent and nature of recovery from that shock can be judged. The ‘to what?’ part of the question relates to what constitutes a shock or disturbance in response to which regional economic resilience is being measured: what is the nature of the disturbance, its intensity, duration and its effects? Shocks to regional economies can take various forms, and the nature of the shock, and not just its severity, may influence how different regions react and respond to it. A regional economy may be resilient to one form of shock, but not another. The third issue, ‘by what means?’ has to do with the mechanisms and processes by which a regional or local economy reacts and adjusts to a shock, where those mechanisms and processes in turn may be expected to be influenced or determined by a wide range of local structural and micro-level behavioral factors and attributes, which themselves may be changed by the shock. Differences in structural and other attributes and capacities between regions can be expected to shape regional differences in resilience. And, finally, the ‘with what outcome?’ part of the question not only concerns how well the regional economy recovers from a shock, and how long recovery takes, but the nature of that recovery. Does the regional economy eventually return to its pre-shock state or growth path (its ‘reference’ state or path); or to a more favourable post-shock state or path; or has it been so severely impacted that it is left entrapped in a state of relative or even absolute depression and decline? The conceptualisation of regional economic resilience should be capable of addressing all four sets of issues.

4. Defining Regional Economic Resilience

Several different definitions of regional economic resilience can be found in the literature. Hill et al (2008, p. 4), for example, define it 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*”. A region’s growth path is thus the ‘reference standard’ being used to judge resilience to shocks. But of course a region’s pre-shock growth path may not actually be a favourable one, in the sense of

providing full employment and decent and rising real incomes for the region's population: a 'bounce back' to that sort of path would hardly seem to warrant the label 'resilient'. In a socio-economic context, resilience inescapably carries normative meanings. We would therefore suggest a more expansive definition of regional economic resilience as

the capacity of a regional or local economy to withstand or recover from market, competitive and environmental shocks to its developmental growth path, if necessary by undergoing adaptive changes to its economic structures and its social and institutional arrangements, so as to maintain or restore its previous developmental path, or transit to a new sustainable path characterized by a fuller and more productive use of its physical, human and environmental resources.

Further, we would stress that resilience is a *process* that involves several elements (Figure 1): *vulnerability* (the sensitivity or propensity of a region's firms and workers to different types of shock); *shocks* (the origin, nature and incidence of a disturbance, and the scale, nature and duration thereof), *resistance* (the initial impact of the shock on a region's economy); *robustness* (how a region's firms, workers and institutions adjust and adapt to shocks, including the role of external mechanisms, and public interventions and support structures); and *recoverability* (the extent and nature of recovery of the region's economy from shocks, and the nature of the path to which the region recovers). Consideration of all five aspects or dimensions is necessary in order

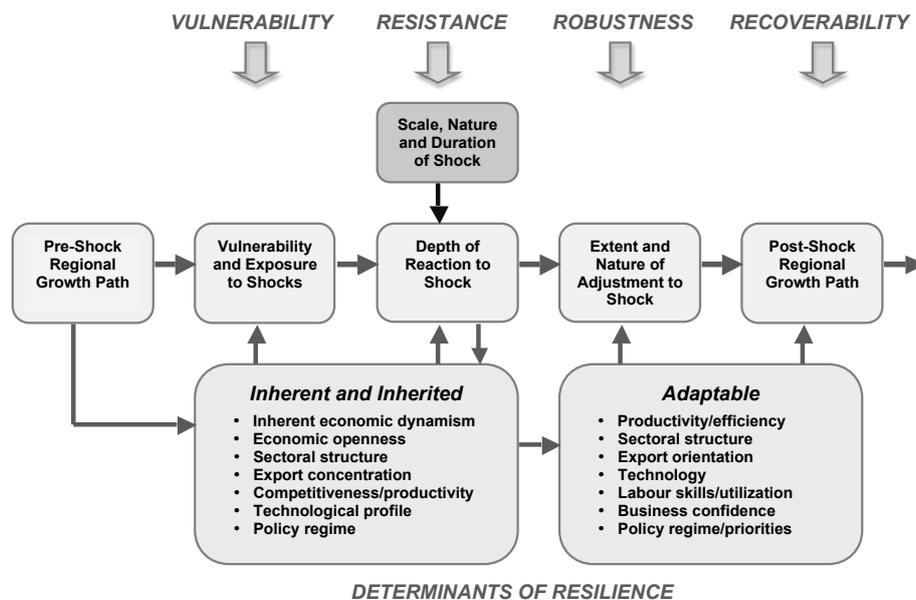


Figure 1: Regional Economic Resilience as a Process

fully to understand the nature of resilience in any specific regional context. Further, it is important to recognize that regional economic resilience is a recursive process, in that a shock and the process of recovery itself may lead to or involve changes in the region's economic structure and functions, and these in turn may influence the region's resistance and robustness to subsequent shocks. Regional economic resilience, in other words, both shapes and is shaped by the reaction of a region's economy to shocks and disturbances: resilience both influences the evolution of regional economies and itself evolves (Simmie and Martin, 2010).

Consider first the issue of *shocks* (Table 3). (Our focus here is on economic shocks, but much of what follows could also apply in the case of perturbations to a local or regional economy caused by natural disasters or environmental disruptions). Economic shocks can take various forms, and are likely to have different effects and hence different implications for resilience. They originate at different spatial scales – from the global to the national to the local. And most shocks – as the very term suggests – are sudden, unexpected and ‘out-of-the-ordinary’ events. National recessions and financial crises are classic examples: these are generally not predictable (though with the benefit of hindsight, they are often claimed to have been only too predictable!). As the deep recessions of the early-1930s, early-1980s, early-1990s and, more recently the ‘Great Recession’ of 2008-2010 have demonstrated, shocks can be highly destabilising, and invariably spatially uneven. Likewise, indigenously-originating regionally- or locally-specific shocks, for example arising from the closure of a dominant company or industry, are also often sudden, unexpected events, and pose particular difficulties for the communities affected (see Ormerod, 2008). But some authors wish to extend the idea of resilience to include how regions, localities and cities react to and cope with ‘slow-burn’ pressures, that is adverse developments that cumulate slowly and incrementally over long periods of time (climate change may be the classic case). The argument seems to be that resilience is about the capacity to react - perhaps adapt is the more appropriate term - more or less continuously in response to such constantly ongoing pressure. We have some sympathy with this view, but also some reservations.

Economies are constantly changing as new firms, new products, new technologies and new markets are added, and old firms, old products, old technologies and old markets disappear: there is a constant wind of ‘competitive selection’ (Metcalf, 1988), and ‘creative destruction’ (Schumpeter, 1942). This slow, cumulative and ongoing process of ‘industrial mutation’ (Schumpeter, op cit) or ‘adaptive growth’ (Metcalf et al, 2006), should, in our view, be distinguished from the specific issue of the impact of sudden major shocks, interruptions or disruptions to that process (akin to Schumpeter's infrequent major ‘gales’ of creative destruction). To be sure, the inherent and inherited features underpinning a region's ongoing

(adaptive) growth path will exert a strong influence on a region's resilience when impacted by a shock (as highlighted in Figure 1); but the specific idea of resilience should be restricted to the analysis of the reaction to and impact of that event itself, and not extended to refer to the slow incremental process of change and adaptation that normally characterizes an economy in the absence of shocks.

Table 3: Key Issues in Regional Economic Resilience

Domain	Key Issue	Focus of analysis
1. Vulnerability to shocks	Why do regions differ in their vulnerability (propensity) to shocks?	To what extent is vulnerability a predictable feature of a region's economy; or is it wholly shock dependent?
2. Disturbance or shock	What is the nature of the shock? What aspect of a region's economy is being disturbed?	Sudden, short-term disturbance (eg economy-wide recession, plant closure, loss of supply-chain), or slow cumulative ('slow-burn') pressure (eg progressive loss of markets to competitors?); intensity and duration of the disturbance.
3. Reference state or reference dynamic	What is the reference state or dynamic of the variable(s) of interest in the absence of a shock?	Pre-shock levels or trend growth paths of output, employment, business stocks, per capita incomes, etc;
4. Resistance to shock	How far has the reference state or dynamic been disturbed by the shock?	Scale of reaction to shock, compared to what might have been expected
5. Robustness	What are the mechanisms by which the region's firms, workers and institutions respond and adjust to shocks? The processes of mitigation.	Scope for structural and market reorientation and adaptation; redeployment of region's economic resources
6. Recovery	Recovery to what, and how fast?	Return to pre-shock reference state or dynamic? Or shock-induced movement to new reference state or dynamic, and nature of the latter.
7. Determinants of resilience	Why are some regional economies more resilient than others?	The factors that shape regional economic resilience and how far and in what ways those factors change over time

For if resilience is conflated or equated with on-going slow adaptive change, or the idea of shocks extended to include 'slow burn' processes, the danger is that the notion of resilience loses its distinctive meaning and becomes indistinguishable from ongoing economic change (as implied, for example, in the idea of dynamic

competitiveness). This is not to deny that sudden shocks can be ‘slow in the making’. For example, a region’s industries may be subject to a process of growing cumulative competition from elsewhere, but prove slow or reluctant to modernize or adapt over time in order to resist that competition, perhaps because of substantial historical sunk costs or entrenched business practices and attitudes, perhaps because of a sophisticated horizontal inter-firm division of labour, or some other factor that engenders rigidity and hinders change. If continued, this *adaptive inertia*, or failure to upgrade and modernise, for example by investing in new production methods, improving product design and quality, or expanding into new markets, may eventually reach a point when market shares and profits fall so low that a major wave of firm closures and job losses is triggered and the industries in question then go into decline and all but disappear, with profound effects on the regional economy as a whole. Thus some economic changes may be ‘slow-burn’ in character, growing incrementally over time, but only become disruptive ‘shocks’ when they reach a critical ‘tipping point’ or ‘threshold’. Equally, a lack of ‘anticipatory adaptation’ to competitive and other pressures on the part of a region’s firms or industries in the past can manifest itself as a lack of resilience should a shock suddenly occur. And how those firms and industries react to the shock may well influence the future trajectory and nature of the region’s post-shock developmental path (Figure 1). But essentially the idea of resilience should be distinguished from that of long run adaptive growth, and is best confined to the study of shocks, including any ‘reactive adaptation’ that such shocks may initiate. Otherwise, there is the risk that the concept of resilience takes on a plethora of meanings and interpretations and loses its analytical purchase. Put another way, we should not confuse the continually evolving *determinants* of regional economic resilience, which may well include slowly-unfolding structural changes and adaptation, such as the product, technological and market reorientation of existing activities, the emergence of new dynamic sectors, upgrading of the local skill base, and the like, with the *actual reaction or resilience* of the region’s economy if and when a shock or disruption occurs. An evolutionary approach to resilience would be concerned precisely with whether, how far and in what ways the structural, organizational and behavioural characteristics that make for the resilience of a region’s or city’s economy develop over time, and how the region’s or city’s resilience to any shocks that occur then feeds back to reinforce or change the evolution of those characteristics. But the basic point still applies, namely that it is only when a shock occurs that we can ascertain whether, and to what extent, the evolutionary development (ongoing adaptation) of a region’s economy has imbued it with resilience.

5. The Anatomy of Regional Resilience: Measuring Resistance and Recovery

The depiction in Figure 1 suggests there are several aspects to what we might call the ‘anatomy’ of regional resilience, and hence to its measurement. How do we gauge a region’s actual resistance to and recovery from an economic shock, and the degree and nature of structural and organizational change (adaptation) involved? There are several possible ways of measuring the degree and ‘shape’ of a region’s resilience to an economic shock, and different methodological approaches to this issue can be found in the literature, ranging from descriptive, interpretative case studies, to sophisticated statistical and econometrics models, using impulse functions and the like, to measure speeds of regional recovery and other such features of the sort illustrated in Figure 2 (see Table 4). Each has its specific uses, merits and limitations, and in principle there is no reason why different methods could not be combined. For example, statistical and quantitative methods could be used to measure and compare resilience to a particular system-wide shock across different regions, localities or cities, but the explanation of those differences may well require detailed case-study analysis, which could be partly or wholly qualitative in nature.

Table 4: Some Alternative Approaches to Measuring Regional Economic Resilience

Method	Focus	Examples
1. Case study based	Mainly narrative based, may involve simple descriptive data and interviews with key actors, interrogation of policies	Munich (Evans and Karecha, 2013); Cambridge and Swansea (Simmie and Martin, 2010); Buffalo and Cleveland (Cowell, 2013)
2. Resilience indices	Singular or composite, comparative, measures of (relative) resistance and recovery, using key system variables of interest	UK regions (Martin, 2012); US cities and counties (Augustine et al, 2012; Hans and Goetz, 2013)
3. Statistical time series models	Impulse response models; error correction models. These estimate how long it takes for impact of shock to dissipate (how much of the impact is subsequently eliminated per unit time period)	US regions (Blanchard and Katz, 1992); UK regions (Fingleton, Garretsen and Martin, 2012)
4. Causal structural models	Embedding resilience in regional economic models to generate counterfactual positions of where system would have been in the absence of shock	US metropolitan areas (Doran and Fingleton, 2013)

The fact remains that there is no single agreed approach to measuring the ‘anatomy’ of regional (or local or city) resilience. Defining resistance and recovery is in fact far from straightforward. There are no agreed metrics or methods for assessing these two key aspects of resilience. But some measure is needed, otherwise how can we tell whether a particular regional or local economy is resilient, and how could we tell whether one region or locality is more or less resilient than another? The problem is that several different measures might be proposed.

To illustrate this, consider Figure 2, which shows the actual employment path of the South East region in the UK, a path that has been disrupted by four major recessionary shocks over the past forty years. Recessions are of course only one type of shock to a region’s or city’s economy (others include the collapse of a local major employer, the impact of a major natural disaster, a general or localized financial crisis, and so on), but they are illustrative of many of the general issues involved. The recessionary shock of 1990-92 is used in Figure 2 to focus the discussion. In terms of resistance, should the impact of this shock on the South East region be measured by the actual (absolute or proportionate) drop in employment due to a shock (say *ab* in Figure 2), or the duration of the contraction (*bc*)? Or should the impact of the shock be gauged by comparing the actual level of employment at the bottom of the trough (*c*) with some counterfactual level that would have been expected had the shock not occurred at all? Figure 2 shows two such counterfactuals. The first draws on the ideas

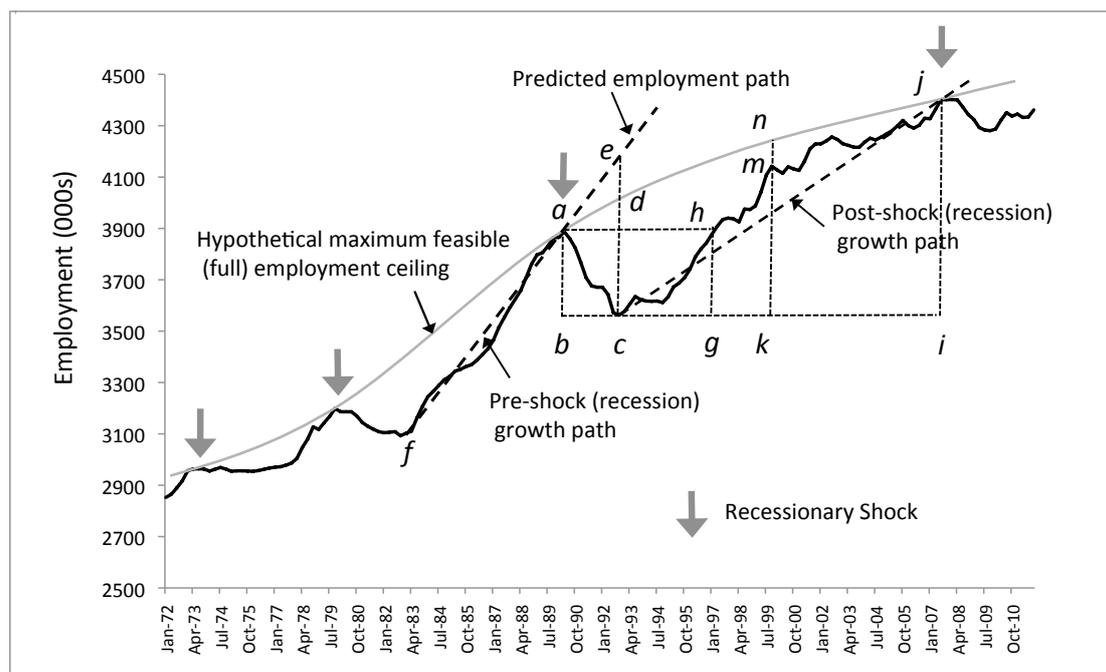


Figure 2: The Anatomy of Resilience: Illustrated by a Recessionary Shock to Employment in the South East Region, UK

of Friedman (1988) who, on the basis of his study of shocks to business activity in the post-war US economy, likens an economy's output (and presumably also its employment) path to a string attached to the underside of a board, which defines that economy's 'maximum feasible' output (or full employment ceiling). Shocks occasionally 'pluck' the string (actual output or employment) down from the board (the maximum feasible growth path):

Output is viewed as bumping along the ceiling of maximum feasible output except that every now and then it is plucked down by a cyclical contraction. Given institutional rigidity in prices, the contraction takes in considerable measure the form of a decline in output. Since there is no physical limit to the decline short of zero output, the size in the decline in output can vary widely. When subsequent recovery sets in, it tends to return output to the ceiling: it cannot go beyond, so there is an upper limit to output and the amplitude of the expansion tends to be correlated with the amplitude of the contraction (Friedman, 1988, p. 3).

Furthermore, shocks and their recoveries are viewed as typically symmetrically V-shaped:

The cycles are symmetrical about their troughs: each contraction is of the same amplitude as the succeeding expansion [recovery]. But there is no necessary connection between the amplitude of an expansion [recovery] and the amplitude of the succeeding contraction... Expansions [recoveries] would be uncorrelated with succeeding contractions, but contractions would be correlated with succeeding expansions [recoveries]... to complete the analogy, we can suppose the board to be tilted to allow for trend.. (op cit, p. 3).

Friedman suggests that the hypothetical 'maximum feasible' growth path can be approximated (ex post) by that line or curve joining successive cyclical peaks. If we assume that an economy can be viewed as also having a long run 'maximum feasible or full employment ceiling' of the sort fitted in Figure 2, the resistance to a (recessionary) shock might be measured by the difference between the actual level of employment at the trough of the shock-induced contraction (*c*) and the level given by the estimated 'maximum feasible' or full employment ceiling at that point, (*d*), that is that level that might have been expected had the shock not occurred and the region's economy had continued to grow along its full employment ceiling. An alternative approach to constructing a counterfactual position would be to project or forecast the pre-shock growth path (say *fa*) forward on some basis (for example using an autoregressive time series model, or perhaps an appropriate structural model of the regional economy) to give an expected employment level (*e*) against which to compare the actual, shock-reduced level (*c*).

Similarly different measures can be devised for assessing the recoverability of a regional economy from a shock. Interest might focus on the time taken to return to the pre-shock state of the region's economy; that is, in terms of Figure 2, back to the

pre-shock employment level, $h=a$. Or we might choose some other specific post-shock point in time, say k in Figure 2, and compare how far actual employment has moved back to what its maximum feasible level would have been at that time, that is the gap mn in Figure 2. Or yet further, recoverability could be measured by either the time taken by a regional economy to return to its long-run maximum feasible growth path, point j in Figure 2. This might be the time since the onset of the shock (bi) or from the bottom of the shock-induced contraction (ci).

However, the problem with using such estimated counterfactual positions is the obvious one, namely that measures of resistance and recoverability based on this approach are crucially dependent on the validity of the counterfactuals themselves. Furthermore, interest will often be focused on how different regions (or localities or cities) are affected by a common (say nation-wide) shock. A recession or financial crisis are possible examples. This suggests the need for some comparative or relative measure of resilience, of resistance and recoverability. In this instance a particular type of counterfactual suggests itself, namely the resistance and recovery of the national economy as a whole. Thus, for example, regions that experience a larger proportionate fall in employment (or output) than the national economy to which they belong would be deemed as having relatively low resistance to the shock; and regions in which the proportionate fall in employment is less than that nationally would thereby be deemed to be relatively resistant. Likewise, following the shock, regions in which employment undergoes a greater proportionate expansion than employment nationally could be considered as having greater relative recoverability; and vice versa for regions in which employment expansion is less than that nationally (see Martin, Sunley, Gardiner and Tyler, 2014, for an example of this approach).

Just as there is no consensus over resilience metrics, so there has not yet been much systematic effort devoted to exploring how far and in what way regional economies adapt structurally and organizationally to shocks. As mentioned above, structural change, mutation and transformation occurs more or less continuously in an economy, so a key question is whether such processes are accelerated by shocks, and if so whether this acceleration occurs more in the contraction ('destructive') phase of a shock or during the recovery ('creative') phase. That is to say, how do shocks influence the process of economic evolution? If structure is changing, the first place to look is at the patterns of the employment and output shares and the changes they evince over time. In proportional growth, these shares are constant, which is only possible if all industries grow at the same rate and if all rates of productivity growth are the same. In the absence of any structural change, the employment share structure in a given base year will exactly predict the employment share structure in all subsequent years, and similarly for the output shares. So changes in these share structures relative to the pattern in the base year can be used to gain some insight into

whether shocks disrupt or lead to particularly rapid changes in a region's economic structure. So-called Salter (1960) graphs can be constructed which show the correlation of sectoral employment (or output) shares between successive years over the course of the contractionary and recovery phases of a shock and the shares in the chosen pre-shock base year (see Metcalfe, et al, 2006) for an application of this method). With proportional growth, the shares would remain constant over time, and the correlation coefficients would correspondingly remain constant at unity. Or, alternatively, a Manhattan norm or similar such index, which sums the absolute differences between a region's sectoral shares in any shock (or recovery) year with those in a specified pre-shock year, could be used. Significant changes in the correlations or index during and following a shock would thus provide some evidence of shock-induced structural change. Yet another approach would be to use a dynamic version of the shift-share technique to isolate the cumulative contribution of industrial structure versus regional competitiveness effects to the reaction of a region's economy to a shock and its growth path during recovery (see Martin, Sunley, Gardiner and Tyler, 2014). Of course, how far it is possible to detect shock-induced structural change will depend on the level of sectoral disaggregation that is possible, and the methods referred to above will not reveal changes that occur within sectors (however fine the disaggregation), nor within individual firms. Ultimately, determining the extent and nature of regional economic adaptation in response to shocks requires in-depth study of individual industries, firms, and workers, of the type that may only be revealed by regional or locality case study analysis.

6. Resilience and Long-Run Regional Development Patterns

The question of whether shocks set in train (positive) structural changes in a region's economy, and hence contribute to the region's recovery, raises the more general and intriguing issue of how resilience interacts with long-run regional growth patterns. A considerable effort has been directed in recent years into the study of long run patterns of regional growth, with a particular interest in - and debate over - the extent of convergence (or divergence) in regional levels of GDP per capita over time (the literature on this topic is vast: for selected examples, see Martin and Sunley, 1998; Michener and McLean, 1999; Arbia and Paelink, 2003; Rey and Janikas, 2005; Neven and Gouymte, 2008). Little reference has been made in such studies to the impact that major shocks might have on those long run patterns. It is as if long run growth paths – whether convergent, or possibly divergent - are driven solely by slowly-moving changes in technology and productive forces, and that shocks, if they occur, have no lasting effect on those growth paths. Yet, as the discussion above suggests, the differential resilience of regions to shocks opens up the possibility that long-run growth paths are shaped by, even composed of, successive major shocks and

recoveries. The impact of shocks - and these of course can themselves be technological in nature - on long-run growth is thus more deserving of study than has traditionally been recognised, a neglect partly acknowledged by Krugman when he complains that:

Even now, many economists still think of recessions as a minor issue, their study as a faintly disreputable subject; the trendy work has all been concerned with technological progress and long-run growth. These are fine, important questions, and in the long run they are what really matter - but as Keynes pointed out, in the long run we are all dead (1999, p.156).

One might go further, and argue that a distinction between the study of the effects of 'short-run' events like recessionary and related shocks, on the one hand, and growth over the 'long run' on the other, is in fact misplaced. A region's resistance to and recovery from shocks may depend on the underlying dynamism of its economy, that is on the growth path itself, while how the region reacts and recovers may well have a bearing on that long-run growth path. Thus regional differences in resilience may contribute to patterns of long-run regional convergence or divergence in employment, output and incomes.

The Friedman type model referred to above assumes (as does most economic theory, and most impulse response models of economic dynamics) that the effects of shocks are transitory and have no lasting impact on an economy's basic structures and fundamentals. But a recessionary or other shock may be so pronounced that it causes significant structural and functional change, leading to a permanent shift in a region's 'maximum feasible growth ceiling' and thence its actual growth path. For example, a deep recession may result in the closure of so many local firms and loss of so many local jobs that a region's productive base shrinks substantially and its full capacity growth ceiling is shifted downwards. The same might occur if a locality's major employer closes, leading to the subsequent failure of local supplier and supporting firms. There are essentially two possibilities (see Martin, 2012). In the first, the region's growth path is pushed downwards, but it returns to its pre-shock growth rate. In the second, both the region's growth path and its post-shock growth rate are lowered. Either way, the region has not been able to fully absorb the shock, and emerges from it on a new growth path that is inferior - in terms of output growth, employment and incomes - compared to its pre-shock path. These conditions may then militate against the formation of new firms and new jobs, and generally suppress the local business climate and business confidence, so that the downward shift in the region's full capacity growth ceiling becomes firmly established and stabilized. In this case of what is essentially *negative hysteresis*, the region's new growth path is hardly a favourable one (unless of course its pre-shock growth path was in fact unsustainable and itself based on dubious fundamentals). Thus, contrary to Friedman's model, in a

regional or local setting it could well happen that a deep contraction is not followed by a rapid recovery, but leaves a region or locality with a smaller economy and possibly also slower rates of growth of output, jobs and incomes: in short, in a state of relative or even absolute economic depression. Such a region would seem to lack resilience on several fronts. Studies of US states, by Blanchard and Katz (1992) and Krugman (1993), for example, provide ample evidence that if shocks are severe enough, they can have permanent effects on a region's long-run growth path. These authors find that while wages do decline somewhat in states that suffer severe adverse shocks there is no discernible tendency for states to recover lost jobs. Instead, workers migrate out until the unemployment rate falls back to its pre-shock level: in effect such states experience a downward shift in their maximum feasible output and employment 'ceilings'.

A quite opposite scenario is not inconceivable, however. A sharp shock to a region's economy may act to remove what were unproductive firms and practices, and release resources and workers that can be re-employed in more productive firms and jobs. This might produce not just a one-off sharp increase in productivity, but trigger a whole new wave of business enterprise and growth that becomes self-reinforcing. This is the more likely to occur if there are some sectors of activity present in the region which are able to take particular advantage of the general nature of the post-shock recovery, or are particularly well placed to benefit from any national governmental economic expansion policies. And it might be that that region's industrial structure is such that firms can easily switch into alternative or complementary activities and specialisms. In any case, if sustained, the region's strong recovery could also attract resources - labour and capital inflows - from other regions, with the result that recovery itself improves yet further and expands the region's resource base, and thereby shifts its maximum feasible output or employment 'ceiling' and its actual growth path upwards. Again two cases are possible, one where growth on this upward-shifted growth path resumes its pre-shock rate, and one where the growth rate is also raised (again, see Martin, 2012). In these instances of *positive hysteresis*, the region's economy has absorbed the shock by reorganizing around a new mode of growth that is in fact more favourable than that which existed before the shock. In this sense, the region exhibits a high degree of robustness and resilience.

In this way, differences in resilience across regions can contribute to inter-regional patterns of long run growth. In an international context, some studies suggest that countries that experience particularly severe shocks, or several shocks in quick succession, tend to have slower rates of growth over the long term than countries not so affected (Cerra and Saxena, 2008; Cerra et al, 2009). A similar effect may well operate at the regional scale. Consider the example shown in Figure 3. Here two regions are impacted by a common shock (say a major recession), but the

outcomes are quite different. Region 1 is much more severely hit (is much less resistant) than region 2, to the extent that its economy does not return back to its pre-shock growth path, but emerges from the shock on a lower and less favourable growth trajectory: its economic base has been so badly effected that its maximum feasible output or employment growth ceiling has been lowered, and its actual trend growth rate correspondingly reduced. In region 2, however, the shock has the effect of propelling the region on a recovery trajectory that is much more favourable than the region's pre-shock growth trend: its economic base emerges from the shock with a higher growth potential. The result is that the two regions begin to diverge in growth terms. Various other outcomes are obviously possible; but the key point is that differences in resilience across regions can contribute to the process of uneven regional development. In fact, we need to allow for possible interaction between regions as a result of their differential resilience to shocks (see Fingleton, Garretsen and Martin, 2012). In effect, shock-induced flows of labour and/or capital from regions hard hit by (less resistant to) shocks into regions more resistant to such shocks may serve to put downward hysteretic pressure on the growth paths of the former, while helping to raise the growth paths of the latter. This is an example of the sort of inter-regional interdependence discussed by Holland (1976) in his model of combined and uneven regional development. In his exposition, an autonomous

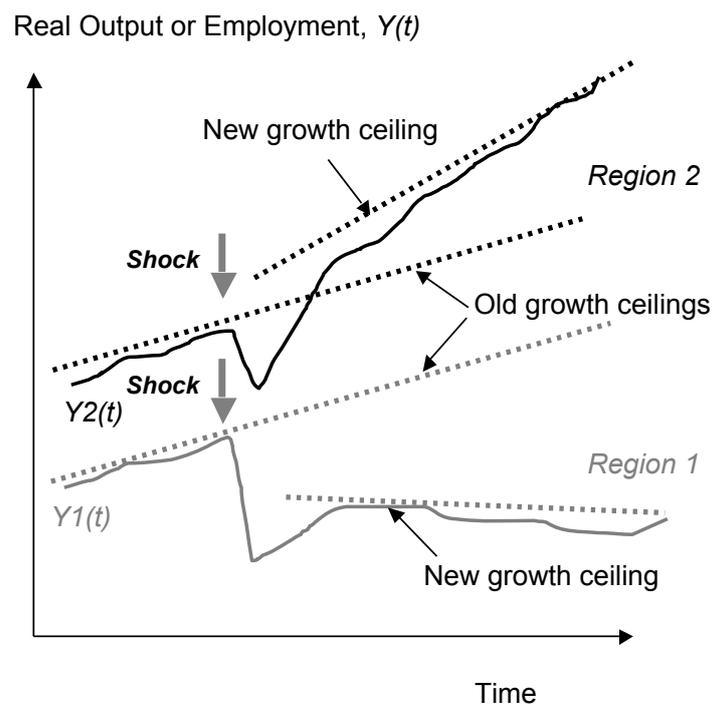


Figure 3: How Differential Resilience and Hysteretic Responses can influence Regional Economic Growth Paths

increase in investment in one region raises that region's maximum feasible (or full capacity) growth path, allowing it to gain a growth advantage over other regions. This attracts labour and capital into the advantaged region, which raises its growth ceiling, and hence its actual growth rate still further, while lowering the growth ceilings, and hence growth rates of other regions. The scene is thus set for regional divergence. Adverse shocks may have the same effect and outcome. And if it is those regions that are already the more dynamic that are also the more resilient, then shocks could well lead to a process of divergent regional long-run growth. In this way, shocks and recoveries are not events that take place 'around' a region's 'autonomous' growth path, they are constitutive of that path. Hence determining the relative contribution of shock-induced contractions and corresponding recoveries to regional patterns of convergence or divergence becomes an important research question.

This possibility reinforces the need to integrate the concept of resilience into the study of regional development more generally, and to explore the relationship between the two. The problem here is that different theories of regional development would assign different roles to shocks and different interpretations to the idea of resilience (see Table 5). In New Economic Geography theory, for example, shocks - such as a major change in the terms of trade, or in transport infrastructure - play the role of potentially shifting the spatial distribution of economic activity from one equilibrium configuration to another. This would seem to imply that resilience is about the stability of the economic landscape in the face of such shocks. Somewhat differently, in Schumpeterian perspectives, shocks might equate with the occasional historic shifts in technological regime that set off 'gales of creative destruction' across the economic landscape. How regional and city economies react and respond to such 'shocks' will depend on their adaptability to the new technologies and the industrial transformations these shocks generate.

Yet again, how would the idea of resilience link to a path dependence perspective on regional development? Standard path dependence theory posits a tendency for regional development paths to become 'locked in' via various self-reinforcing processes (Martin and Sunley, 2006, 2010). One possibility is that during what Martin and Sunley (2006) call the phase of 'positive path dependence', when self-reinforcing processes and mechanisms propel a particular regional path growth, resilience to shock and perturbations is high. But if and when this virtuous path-dependent growth begins to slow, because of the 'lock-in' of emergent rigidities, of increasingly outmoded technologies, institutional inertia and the like, and turns into 'negative path dependence', then a region's potential economic resilience may weaken, and the region becomes much more vulnerable to and less able to absorb major

shocks. This idea is akin to the ‘adaptive cycle’ model found in socio-ecological studies (Peterson, 2000; Gunderson and Holling, 2002). Such systems are assumed to develop through a sort of life-cycle of emergence, growth, and consolidation (conservation or maturity). As a system develops through these stages or phases so its resources become progressively locked into a particular structure, the internal connectedness of the system increases, its flexibility and adaptability declines, and its potential resilience is correspondingly reduced. If then a major shock occurs, resources are released and the system may then either reorganize itself and develop afresh on a new cycle of development, or become maladapted in some sense (Carpenter and Brock, 2008; for an elaboration of this model for spatial business clusters, see Martin and Sunley, 2011).

Table 5: Embedding Resilience in Regional Development Theory? Three Possibilities

Theory	Role of Shock/Implied Interpretation of Resilience
NEG theory	‘Resilience’ as stability of an equilibrium spatial pattern of economic activity in the face of shocks. A shock above critical threshold induces shifts to new spatial equilibrium pattern.
Evolutionary-Schumpeterian theory	Shocks as ‘gales’ of creative destruction and ‘competitive selection’. ‘Resilience’ as regional economic ‘fitness’, and ‘positive re-orientation’ of a region’s industrial-technological system.
Path dependence theories	Shocks ‘de-lock’ regional development paths. Is ‘resilience’ resistance to ‘de-locking’ or positive path dependent adaptation/ability to create new paths?

A number of authors have posited the idea of regional development and growth as driven by the life cycles of their constituent industries and technologies, which are assumed to move through a sequence of emergence, youth, growth and maturity (see Audretsch et al, 2008). The assumption is often made that as industries mature, in terms of either technology or markets, so they lose their dynamism and competitiveness, and as a result become less flexible: in short, their potential resilience, and hence that of the regional economy in which they are located, declines. Both the industries and the region then become particularly vulnerable to, and less able to resist and absorb, major shocks. Under this model, much then depends on the capacity of the region to move into new industries and technologies. Successful regions will be those that are able to restructure and reorient their human and capital resources in this way - in effect to branch into related or entirely new paths of

development – and hence to renew their resilience. Unsuccessful ones will be those unable to reorganize or restructure on the scale necessary to renew their growth path, and which may even become subject to a downward or negative hysteretic shift in their long run growth ‘ceiling’. They may even rigidify into a state with ‘perverse’ high resilience but little development. In effect, this perspective envisages major shocks as bringing one phase of path-dependent regional development to a close and initiating a new phase: a sort of punctuated equilibrium form of regional economic evolution. But the ‘lock-in’ model is only one type of path-dependent development (Martin and Sunley, 2007; Martin, 2010). Regional evolutionary dynamics can in fact take various forms (Martin and Sunley, 2011), and, in reality, many regional economies do not become rigidly ‘locked-in’: path dependence can, and often does, involve more or less continuous adaptation and structural change (Martin, 2010, 2012, 2013), so that a region’s resilience need not trace out any simple cyclical or phase-like pattern over time. How resilience relates to path dependence is an important issue that requires much more research.

7. Why do Regions Differ in Resilience?

If, then, resilience is potentially significant in shaping the evolution of the economic landscape, the central question arises as to why resilience might vary from region to region, city to city, locality to locality. Empirical studies are accumulating that testify to such variations, and the search is on for explanations of these differences. Just as different theories of regional development focus on different explanatory factors, so they imply particular explanations for what makes for regional economic resilience. Thus NEG theory would emphasise the importance of local productivity and the role of local externalities and labour and capital mobility. Evolutionary economic geography accounts would stress the importance of sectoral variety, innovation capacity and institutional arrangements. In fact, regional resilience is the outcome of a complex of factors, some of a general nature, but which vary from region to region and from city to city, and others that are locally specific. Further, a region’s economic resilience will be shaped by wider conditions and forces, for example national policies and circumstances, and even international influences. National policies, for example, intended to promote economic recovery out of a major recession, may end up having different impacts on different regions, assisting the recoverability in some regions and perhaps hindering it in others. Other central government policies, on the other hand, may be intentionally spatially targeted at those regions or localities particularly severely hit by a system-wide shock, and specific forms of support might be used to help a locality hit by a locally-specific disruption, such as a major firm closure. And to complicate things further, ultimately of course, the ‘overall’ resilience of a region’s or city’s economy is but the aggregation

of the reactions and interactions of a myriad of heterogeneous economic agents (firms, workers, institutions). Some agents might be much more resilient to shocks than others. Nevertheless, and at the risk of simplification, regional resilience can be thought of as determined by the dynamics of four main economic, interacting subsystems: the structural and business subsystem; the labour market subsystem; the financial subsystem; and the governance subsystem (Figure 4).

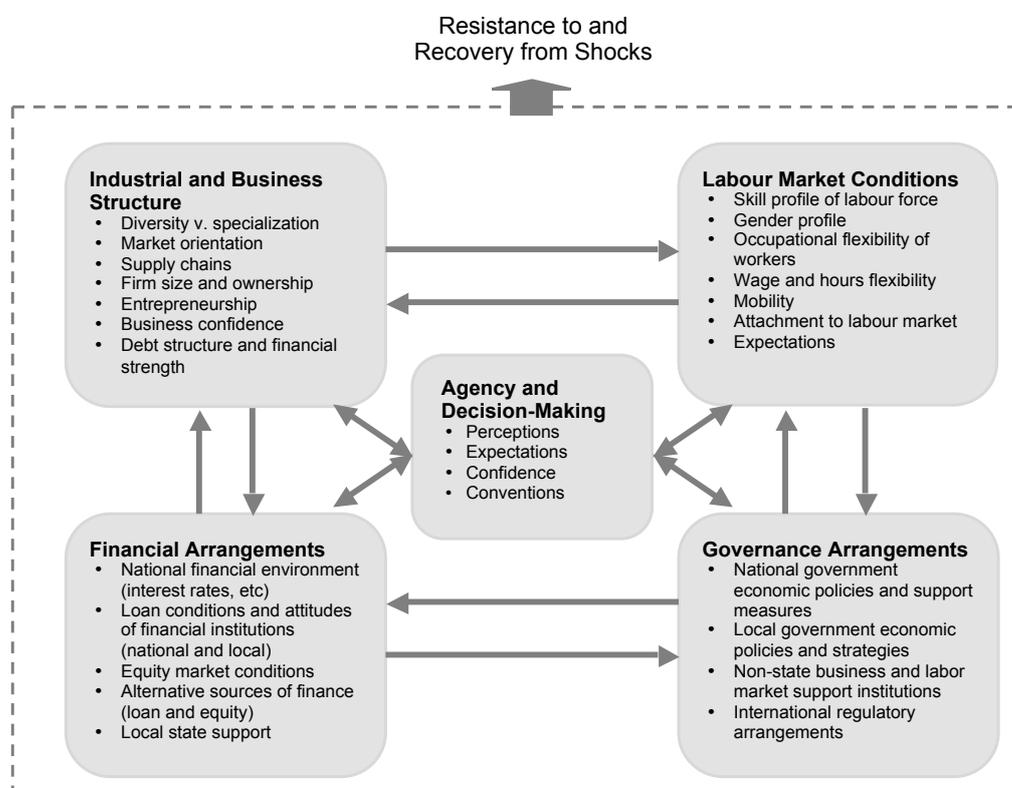


Figure 4: Some Determinants of Regional Economic Resilience

The most obvious, and most discussed, sub-system has to do with various aspects of a region's, city's or locality's economic and business structure. Given the recurring debate within economic geography around the role of industrial structure in regional development, it is not surprising that industrial and firm composition has figured prominently in discussions of regional economic resilience. There is a direct parallel here with many studies of resilience in ecological research, where the role of structural or species diversity is frequently emphasised. Similarly, in biological systems theory, structural heterogeneity or diversity is argued to play a key role in influencing developmental robustness. In economic geography, there has long been an interest in how a region's sectoral structure – the range, types and degree of inter-relatedness of its industries – shapes its economic development. One area of debate,

for example, has been over whether sectoral specialization or diversification is the more conducive to (export-led) regional growth and stability (for example, Conroy, 1975; Siegel et al, 1995; Dissart, 2003). Another has been on whether and to what extent a diversified structure shields a region from cyclical fluctuations in demand and from idiosyncratic industry-specific shocks. In yet another, the focus has been on whether a region's innovative capacity, and hence its adaptive capacity, is enhanced by sectoral specialisation or diversity - the so-called, and still unresolved, Marshall-Arrow-Romer versus Jacobs debate. And, more recently still, the ideas of 'related variety' (refs) and 'diversified specialisation' (Farhauer and Kröll, 2011) have been proposed as more appropriate characterisations of the importance of economic structure in determining regional economic success. These same discussions and debates carry over to the issue of regional resilience. In fact several hypotheses or contentions can be advanced (Table 4). According to Davies and Tonts (2010), for example, the more diverse a region's economy the more resilient it will be:

The general contention is that those places with diverse economies are more resilient in socio-economic terms than those with a narrow economic base (p. 232).

Since different types of industry have different elasticities of demand, different export orientations, different labour and capital intensities, and different exposures to external competition, so, the argument goes, a diverse economic structure should not only reduce the vulnerability of a region to shocks (a 'portfolio effect'), but also enable a more rapid recovery if a shock occurs (an innovation and market opportunity effect). The implication is that a region with a narrow economic base, that is one specialised in a limited range of activities, will not only be more susceptible to idiosyncratic sector-specific shocks, but will have fewer opportunities to re-orientate its economy, and hence fewer alternative routes to recovery. In practice, what is likely to matter is the *specific* specialism(s) on which a regional economy depends, since specialization in, say, computer software or biotechnology is likely to have vastly different implications for a region's economic resilience, than specialization in, say, steel production or heavy engineering.

Just as a region's economic structure may influence its exposure and vulnerability to various kinds of shock, so too it may shape a region's robustness. The modularity condition implies that a region's economy will be more robust, and hence more resilient, if its different industries are not closely inter-linked locally, or only weakly coupled, in terms of similar competences, input-output relations or supply chain connections. So what matters is perhaps not just economic variety, but the

Table 6: Economic Structure and Regional Resilience

Structural Dimension	Hypothesised Effect on Resilience
1. Structural Diversity	Regional economic diversity is generally considered to enhance robustness, and the scope for adaptive reorganization, whereas sectoral specialization reduces robustness by increasing vulnerability and limiting scope for recovery. Role of 'related variety' is ambiguous.
2. Modularity	Modularity – the degree to which different sectoral or organizational components of a region's economy and functions are separable, or only weakly interlinked – can be an effective mechanism for containing shocks locally, minimizing the effects on the whole regional economy, and hence increasing its robustness
3. Structural Redundancy	A region's robustness will be influenced both by the extent to which certain sectors or firms can substitute for one another if some fail, and by the extent to which a region's resources can be put to related or alternative uses
4. 'Rivet Effect'	The more a region's economic structure is dominated by and dependent on a particular sector or major firm, then the failure or decline of that sector or firm in response to a shock could lead to widespread collapse or decline of the region's economy as a whole. Conversely, high-growth 'new economy' sectors may act as drivers of resilience
5. 'Related Variety'	The idea that complementarities among subsets of sectors (for example similar knowledge or material inputs) enhances (long-run) adaptability of local economy by facilitating the transferability of resources from one subset to another and promoting innovation in the process. However, the implications for resilience are ambiguous, since 'relatedness' can reduce modularity, and increase the spread of a shock across (related) subsets of sectors.
6. 'Diversified Specialisation'	By specialising in a number of sectors, rather than just one or two, 'diversified specialisation' supposedly combines the higher productivity and innovation advantages of MAR-type narrow specialization with the spreading of risk associated with a Jacobs-type diversified structure. The latter affords resistance to shocks, while the former supposedly promotes rapid and sustained recovery from them.

extent to which that variety confers modularity and redundancy, the former limiting the spread of a shock across a region's economic structure, and the latter increasing the scope for a re-orientation of that structure towards the more resilient and robust sectors. Yet herein lies a potential tension or tradeoff. Recently, economic geographers have put increasing stress on the importance of so-called 'related variety' for the health of a regional economy (Boschma and Frenken, 2006). The claim is that the greater the 'relatedness' between a region's industries, particularly cognitive, knowledge and skill relatedness, the more adaptable that economy will be over time, since it will be easier for workers and capital to transfer to, and be absorbed by, other

types of economic activity if a particular activity goes into decline or sudden contraction. So on the one hand related variety would seem to run counter to modularity, since it suggests that related activities will be similarly affected by shocks, while on the other hand it is supposed to increase the potential for compensating, adaptive shifts of resources between activities. How related variety actually shapes regional resilience is an area where much more clarity of concepts and empirical evidence are required: related variety – depending on the form it actually takes – may assist regional structural adaptation and evolution over the long run, but how it impacts on regional economic resilience and robustness in response to sudden shocks is less clear. Likewise, the idea of ‘diversified specialisation’ (Farhauer and Kröll, 2012), in which specialisation in a ‘number’ of activities supposedly combines the innovative advantages of narrow specialization with the externalities associated with a diversified economic structure, may or may not enhance a region’s resilience: again much depends on the specialisms concerned.

In addition to modularity and redundancy, in ecological studies of reliance a further aspect of structural diversity is sometimes stressed, namely what is called the ‘rivet effect’. This refers to the idea that an ecosystem may contain certain components (or species) that occupy a crucial pivotal role or position within the functioning of the system as a whole, so that their collapse or removal can cause sudden and catastrophic failure of the entire system. A parallel situation may also hold for a local or regional economy. Imagine a region whose economic structure is essentially of a ‘hub and spoke’ form, in which a particular firm or sector lies at the heart of the productive and employment base, served by a network of diverse supplier and subcontractor activities dependent on that core activity. If, then, that major ‘rivet’ firm or sector is hit by a shock – say a major collapse of demand – and either closes or undergoes drastic retrenchment, this could lead to the failure and decline of much of the remainder of the region’s economy, unless suppliers are able to find alternative customers elsewhere (in other regions or even overseas).

A more positive version of a ‘rivet’ hypothesis highlights the key role of knowledge and technology-led sectors in the functioning of contemporary regional economies. This view points to the importance of specialization in ‘new economy’ or innovative and high-wage industries – such as high-technology manufacturing, creative, media, digital, financial and other business services – as a means to resilience. There are several bases to this argument. First, firms in these sectors are found to be more innovative and adaptable, that is, they have greater dynamic capabilities so that they can better reconfigure, renew and recreate their resources and assets in response to adverse circumstances. They may be better and faster at ensuring the reproduction of distinctive competitive assets in a regional or urban economy. Second, a key dimension of these dynamic capabilities is the high

absorptive capacity of such sectors which enables them to assimilate, exploit and transform new strategies and ideas. ‘New economy’ sectors may both generate and absorb new innovations at a faster rate than other sectors and may act to diffuse these innovations into a regional economy, thereby raising the productivity and recovery of other linked industries. Third, these sectors attract highly skilled and cognitively skilled human capital (Storper and Scott, 2009) and the presence of such human capital in a region is likely to be crucial to resilience to any form of shock. The agglomeration of skilled and highly qualified employees tends to raise entrepreneurialism, and thereby helps regions to renew their economic base after a recession through firm births. Fourth, many of these new economy sectors are also high-wage sectors and the consequent local and regional multipliers stimulate the growth of many service and cultural (such as entertainment and amenity) industries (*ibid*). Again the vitality of ‘new economy’ sectors may thus raise resilience through income effects. In this view, contemporary regional economic resilience is driven by the specialization in those sectors that are undergoing a structural wave of expansion and growth. Of course, this structural change may come to an end at some point, and new technology and knowledge-intensive have themselves repeatedly generated downturns and recessions, but, according to this view, the key determinant of resilience and recovery in any period, is to specialise in, and embed, those industries that are riding and leading the current wave of long-term structural change. Given the path and place dependence of such sectors, however, this is far from easy for many regions and localities to achieve.

The relative importance of specialization in growth-leading sectors, versus diversity as an insurance against risk, is difficult to measure and establish empirically (see Duranton and Puga, 1999, for a survey of the various ways of measuring diversity/specialization). Conventional measures of industrial classification are typically outdated and do not measure the regional presence of new economy and knowledge intensive sectors with much accuracy. While such measures often capture historical manufacturing categories at a fine level, they tend to misrepresent and lump many new economy and technology-based sectors into broader classifications. In addition, of course, patent-based innovation statistics are poor at capturing many forms of organisational, creative, service and process innovations so that even the identification of some innovative ‘new economy’ sectors is difficult. To complicate matters further, leading sectors rely on different types of knowledge and combine analytical, symbolic and synthetic knowledges in different ways so that ‘knowledge-intensive’ means different things in different industries. For all these reasons it is difficult, but not impossible, to assess the importance of regional specialization in ‘new economy’ cognitive-based sectors for economic resilience. In fact, a diversity of specialized clusters - ‘clustered diversity’ – (not the same thing as ‘diversified specialisation’) may represent the ideal situation, and in many of the world’s fastest

growing cities and regions this is precisely what we find. Despite the emphasis in the literature on the importance of diversity to resilience, in the field of regional economic structure the debate between specialization and diversity is far from settled. Martin et al (2013) find that economic structure has played a minor role in accounting for differences in resilience across UK regions. In contrast, Evans and Karecha (2013) suggest that Munich's economic resilience is in large part the outcome of a diverse industrial base, and Doran and Fingleton (2013) similarly find that the resilience of US metropolitan areas to the recent deep recession is positively related to the structural diversity of their economies.

But a region's sectoral mix is not the only possible structural influence on its reactions to shocks and its recovery from them. A region's business 'demographics' may also be important. Thus small firms may be less able than large companies to ride out a major and prolonged economic contraction (for example, they may have smaller financial reserves to draw upon). Ownership patterns may also be influential, though the direction of influence is again ambiguous. Foreign owned plants and establishments may be the first to close locally in a deep contraction, as the parent company pulls ('reshores') activity back to home, or seeks out a cheaper offshore location elsewhere. On the other hand, a large foreign owned firm may be more resilient than local small ones. At the same time, the reliability of local firms' supply chains, and the scope for switching to alternative (perhaps cheaper or more stable) suppliers, whether locally or elsewhere, may be crucial to their resilience. And an area's inherent or inherited entrepreneurial culture will have a bearing on its resilience: a culture of vigorous new firm formation will, other things being equal, improve a locality's recoverability from shocks.

In a recession firms face a dilemma as they need both to reduce short-term costs and expenditure as well as maintain their productive capacity in order to be able to respond to recovery and take up any new opportunities created by the bankruptcy and exit of competitors. The ways in which they resolve this dilemma are crucial to economic resilience. Recent research has identified two major types of firm response to recession (Smallbone et al, 2012; Latham, 2009). Firstly, many firms will be forced to adopt cost and asset reduction strategies that seek to maintain their profitability by reducing costs or by selling off some of their assets including products and facilities. Secondly, firms also engage in revenue generation strategies that aim to increase their markets and sell more to existing customers. These include new marketing initiatives, the identification of market niches and investments in new equipment and staff (*ibid*). The balance between these two types of strategy is likely to determine whether firms survive a recession and also how well they are positioned to respond to recovery. A robust regional economy would certainly show examples of both types of approach

but it is the precise focus and effectiveness of these types of response that determines firm resilience rather than a straightforward choice of one or the other.

To date, there has been very little analysis of how regional contexts influence the prevalence of these types of strategy, and in turn how their adoption shapes the environment for other firms in the region. Those firms who have benefitted from better-developed and stronger markets during a boom period are likely, of course, to have accumulated profits that buffer against the effects of a downturn and allow more strategic choice (Knudsen, 2011). The financial position of firms is a key factor in shaping their ability to survive recessions. A region dominated by cost reduction strategies may provide a much harsher competitive environment through negative supply chain and multiplier effects. At the same time, an excessive reliance on revenue generation would lead to a high firm mortality rate and could also reinforce and amplify an initial downturn. Certainly, as we have argued above, we should not exaggerate the homogeneity of regional economies so that firm responses in a region are bound to differ by industry sector and by type of firm (size, ownership, etc). Nevertheless, the mix of firm strategies may well vary between different regions due to the ways in which local economic contexts enable or constrain particular responses. For instance, a region with a local financial system that provides long-term funding for smaller firms may well allow more sustained attempts to develop revenue generation approaches, whereas a system that has encouraged high firm indebtedness will tend to intensify the effects of an adverse economic shock, particularly if there is a ‘flight to quality’ in terms of new lending during the downturn. The innovation capabilities of a regional economy may also be significant here. The performance of innovative and non-innovative firms within the same industries has been found to diverge during recessions so that firms who have a track record of innovation and change prove to be more flexible and adaptive (Geroski and Machin, 1992). In this view, the process of innovation transforms the internal capabilities of firms and affects their ability to sustain growth. Thus those regions with a stronger ensemble of innovation-related externalities and fundamentals may thus benefit from a greater prevalence of adaptive firms. The degree to which regions have developed strong entrepreneurial systems is also an additional influence on robustness. Major economic shocks are inevitably marked by a release of resources and human capital and those regions with stronger entrepreneurial cultures and supportive institutions will be better equipped to translate this release into new firm formation.

To a large degree, regional economic recovery from shocks depends on the interactions between firm strategies and labour market characteristics, that is between the industrial-business subsystem and the local labour market subsystem. It is in the local labour market that the major impacts of contractionary shocks are felt.

The degree to which regional employment falls as a result of a major shock is a complex product of firm mortality, firm cost reduction, real wage flexibility and the extent to which employers decide to retain labour. Different types of firm will have different types of workforce strategy: for example, some may resort to layoffs, redundancies or cuts in hours worked; others may impose wage reductions (perhaps instead of reducing employment); while still others may seek to redeploy workers in different roles, with implications for skills and perhaps wages. But those strategies will also be influenced by the state of the local labour market itself. In those regional labour markets that have been tight (on the labour supply side) for a long period of growth we might well expect a larger proportion of firms to decide to keep hold of ('hoard') their existing labour force as, in their experience, hiring will have been difficult and expensive. It is also likely that firms with a higher skilled labour force will be more inclined to retention while those with a predominantly unskilled labour force will be marked by greater employment reduction. So geographical variations in levels of human capital and skills may yield variations in regional patterns of adjustment. Retention and reduced hours of work may restrain rises in unemployment, but they will lead to lower productivity (as has been the case in the recent recession in the UK) and are not in themselves necessarily a route to strong resilience.

How labour markets respond to a reduction in employment is a further key determinant of longer run resilience. Where adjustment mechanisms such as retraining and job and geographical mobility are overwhelmed by rapid job loss, economic resilience is limited and undermined by the detachment of the unemployed and the consolidation of a group of long-term unemployed who may ultimately give up seeking work locally and become permanently dependent on welfare and social support measures. It is well known that areas with high unemployment rates also tend to have high rates of long-term unemployment and high rates of labour force inactivity. Where possibilities exist, some unemployed may be able to find jobs in neighbouring labour markets, so that out-commuting or outmigration help to minimise the unemployment impact of a shock. These effects may be such that a locality moves to a new, lower level of full employment. This raises a question over whether and in what sense such a response can be called resilient: the region may return to a state of low unemployment, but its post shock employment base is now smaller, and the shock has resulted in a permanent loss of jobs (this is what happened, for example, in Massachusetts in the late-1980s - see Krugman, 1993). Regional outmigration by the unemployed is clearly a mechanism by which regional economies may restore employment rates, but this adjustment mechanism may lead to a longer-term negative hysteretic effect, especially if it involves outmigration by the young and the more highly skilled. In some equilibrist accounts of economic resilience, falling real wages due to a negative demand shock are seen as a

mechanism for ensuring resilience and a way to restore pre-shock growth rates. However, this view makes strong and questionable assumptions about the demand for workers, and in many circumstances reduced real wages may lead to a permanently reduced rate of growth. Furthermore, given that we have argued that economic resilience should take into account distributional criteria (resilience for whom?), it is unconvincing to describe an economy in which workers are forced to trade employment security for falling real wages as resilient: this would not be a case where a regional economy is maintaining the standard of living of its population (as required in our definition of resilience in Section 4). As Glaeser's (2005) research on Boston's reaction to successive shocks over a 250-year period shows, a region's ability to attract and retain skilled and creative labour over the long run is probably one of the key determinants of regional resilience and growth.

In discussing the scope for old industrial regions to recover and bounce back from shocks, Krugman (2005) argues that the existence of finance capital and the quality and orientation of local economic governance arrangements may be just as important as the types of business organization, skilled labour, entrepreneurial culture and other features that have been built up directly as a result of a locality's previous development path. The availability of finance – and on suitable terms – may prove crucial in enabling firms to ride out a deep economic depression in demand or other types of negative shock. Large firms may have capital reserves to draw upon; but small firms may have limited resources and may soon go into debt, and thence into liquidation. The attitude of financial institutions towards providing loan finance or deferring loan repayments to firms severely affected by an economic shock will have a formative influence on their ability to recover. The supply of loan finance to small and medium sized firms is a subject that has attracted considerable attention and debate in several countries (see for example, Alessandrini, Fratiani and Zazzaro, 2009). While much depends on the national system of finance and its institutional organization, and on national policies relating to bank lending, interest rates and so on, even in this age of advanced information technologies, firms' access to loan finance still seems to vary from locality to locality. Copious evidence exists to indicate that lending practices by banks and other institutions can be spatially discriminatory, such that firms in economically depressed regions and localities can find themselves viewed by financial institutions as high risk and as a consequence denied finance, especially in difficult times. This can occur even in those countries with local, as against centralised banking systems. And alternative circuits of finance, such as venture capital, are themselves typically concentrated in just a few locations, usually the most prosperous and dynamic, and tend to concentrate their activities in precisely those same regions. The more general debate over whether there is a case for local capital markets in order to help overcome spatially uneven development (see Klagge and Martin, 2007) carries over to the issue of local disparities in resilience

Local economic governance arrangements can likewise policy can exercise considerable influence over regional resilience to shocks. For example, a region with an activist policy authority committed to constantly enhancing and fostering local economic investment, entrepreneurship, technological innovation, the attraction of skilled labour, and infrastructural improvement, is not only likely to contribute to that region's long-run growth rate but also to its resource base and capability to recover from unexpected shocks and perturbations to its economy. Similarly, the existence of local business associations, labour training institutions, and other such components of a region's economic governance architecture may also be expected to shape its resilience. The ability of local policy and governance institutions to develop a collective and forward-looking strategic position on their economy may be critical to its ability to weather disruptive shocks. How far a local public authority can intervene and support the recoverability of its local economy will of course depend on the financial resources at its disposal (which in turn will reflect how local authorities themselves are funded), and on the leadership of key local public officials. And then there is the impact of central government policies, for example with respect to spending on infrastructure, technology, skills, business promotion, and public services. How these work out across regions and localities can shape not only geographical patterns of long-run growth, but also regional differences in economic resistance to and recoverability from shocks. Historically, public sector employment itself has imbued an element of stability to local economies, since public services have to be maintained. But with the new politics of fiscal austerity and public expenditure sector cuts that has taken hold in many countries in the wake of the recent financial crisis, especially in the USA, UK and certain other European countries, this is no longer the case.

A key point about most of the determinants of regional economic resilience is that they are product of history and path dependence: they reflect a region's or city's previous pattern and mode of economic growth and development, and will influence local attitudes, perceptions and expectations as to the underlying strength (or weakness) of a region's economy and its prospects for recovery from shocks. The role of expectations and confidence – essentially psychological factors – in shaping how local economic agents react to economic shocks is a relatively unexplored one, and worth consideration as a separate explanatory factor in its own right. A slow-growing region may not be able to resist a negative shock, such as a recession, as well as a strongly-growing region. In a region that has a sluggish growth record, and in which business confidence was already relatively depressed prior to a shock, expectations and confidence in a strong and fast recovery from the shock will be low, which will dampen decisions over new investment and job creation, all of which will serve to compound the initial effect of the shock, which might then lower expectations and

confidences still further. On the other hand, in a region that previously had a well established record of sustained buoyant economic growth, business expectations may be such that even if the region is disrupted by a deep shock, confidence that the underlying strengths and fundamentals of the economy have not been adversely affected may encourage businesses to retain workers and maintain investment, thereby contributing to the region's recovery, and reinforcing the original expectation and confidence. However, expectations need not necessarily confirm an established direction of change. Although expectations often are the product of previous circumstances – and hence themselves an important source of path dependence – they may be more influenced by current conditions than past experience, and can be substantially changed by shocks, leading to a post-shock shift in business behaviour and even an hysteretic change in a region's growth path, of a positive or even negative nature. An unusually long recession may depress entrepreneurs' 'animal spirits' and undermine normal recovery processes (Ormerod, 2010). We know surprisingly little about the role of market psychology and decision-making in shaping agents' behaviour following a major economic disruption, nor about how such behaviour and decision-making interact with local context. Yet, arguably, expectations, confidence and attitudes may prove to be critical factors, and possibly highly place-specific. Ultimately, it is both individual and collective agency, originating and operating at different spatial scales, that shapes how regional and local economies rebound from shocks.

8. Conclusions

There is little doubt that the idea of resilience is one of those concepts that has become 'of the moment': an idea that appears to have the capacity to travel across disciplinary boundaries with almost effortless ease. According to Zoli and Healy (2012), for example,

it often feels as if disruption itself has become 'the new normal'. In this time of turbulence, many people – scientists, economists, social innovators, civic leaders and citizens alike – are asking the same basic questions: What causes one system to break down and another to rebound? ... in the face of constant disruption, can we build better shock absorbers – for ourselves, our communities, our economies, and for the planet as a whole?

The new field of enquiry focused on 'resilience' is intended to provide answers to these questions. Local and regional economies are no less susceptible to unexpected and unforeseen shocks and disruptions than other types of system. The resilience of regional and local economies – or the geographies of economic resilience - is thus a valid topic for academic enquiry, not only in its own right, but also because of its potential importance for informing policy-making. The underlying motivation for

this paper has been that while the current spread of ‘resilience thinking’ into regional and urban economic analysis and policy arenas is welcome, there is still work to be done to understand the notion before it can form the basis of policy action. This paper has argued that we need to treat resilience critically, but constructively, in order to avoid some of the conceptual slippages seen in other fields, and to understand the concept as a set of multi-scale processes that need to be explained, rather than being a singular explanatory characteristic.

As we have seen, a fundamental problem is how we define and measure regional economic resilience. A difficulty here is that while economists are certainly interested in the effects of shocks, thus far they have not much used or explored the explicit idea of resilience in their work. And from a geographical perspective, there is an additional issue: if the notion of regional resilience is necessarily context- and place-dependent, how far is it possible to develop some general principles concerning the definition, measurement and explanation of regional resilience? General principles are not only useful for conducting comparative studies of resilience across space and time, but also for guiding case-studies of specific regions, cities or localities, of the sort that are becoming increasingly common in the literature. Whether the analysis of regional resilience is of a comparative cross-region or an individual case-study kind, the central question to be addressed is: resilience of what to what? What aspects of a region’s economy are being disturbed, and how is recovery to be defined? Without some agreed and meaningful concepts we have no way of assessing whether and to what extent regional economies are resilient, nor of comparing one region with another. A general definition of resilience has been proposed here, one that implies a focus on a region’s long-run growth and developmental path, and the employment, output, welfare and income trends associated with it. But measuring such paths, and the movements from them caused by adverse shocks is not unproblematic. Further, of course, different aspects of a region’s economy may differ in their resistance and reaction to adverse shocks and in their recovery from them. Regional economies are composite complex systems, composed of numerous heterogeneous firms, workers and institutions, each with complex connections and links to the ‘external environment’, and all of which differ with respect to the ease with which they can absorb and adjust to adverse shocks, in their ability to re-orientate their activities, in the range of local constraints they face, and in the resources available to them. Regional and city level reactions to shocks are the outcome of the discrete responses and adjustments of these heterogeneous economic agents and institutions. This heterogeneity raises the possibility that resilience and adaptability will differ not only between firms and workers, but also as between different types of firms and different types of worker. A regional economy may be resilient in one sense but not in another. How we build such heterogeneity and complexity into our definitions and measurements of regional economic resilience is one area requiring further research.

Secondly, there is the question of what makes for a resilient regional economy? Are there certain basic factors or mechanisms that are always at work everywhere, but which operate in different ways in different places, depending on local context and how particular places are connected to the wider economic and political environment? We have suggested several groups of possible determining factors. But how these play out is likely to vary from one locality or region to another, and from one shock to another. For example, in one particular spatio-temporal setting, economic specialisation might be source of dynamism and optimism, and hence resilience; but in another, it might prove to be a highly destabilizing feature if a region is subjected to a shock. Much depends on the type and degree of specialization. Or is a diversified local economic base the best guarantee of resilience? It may even be that local leadership is the catalytic factor. Further, regional economic resilience will often be shaped by conditions and constraints outside the region itself. Local and regional economies do not exist in isolation and we need to resist the temptation to simplify resilience as inherent and indigenous. There is increasing political interest in and promotion of 'economic localism', the belief that the main responsibility for local economic growth and vitality rests with local people themselves, not with central governments. Yet, if local businesses, workers and institutions lack the necessary resources and capabilities, full recovery from a major disruption may not occur without external support, including from central government. Local and regional resilience is not just about how well local communities 'fend for themselves': local resistance and recoverability may depend crucially on a region's or locality's dependence on the wider economic and political system of which it is a part.

Thirdly, and importantly, there is the need to think about resilience as an historical evolutionary process, and one moreover that is inextricably bound up with (although not synonymous with) the process of regionally or geographically uneven development more generally. To begin with, we have suggested that resilience itself should be thought of as a dynamic composed of four interrelated dimensions – vulnerability, resistance, robustness, and recoverability. But further, these attributes are themselves shaped by the mode and path of a region's economic development, which is itself in part a product of those same attributes. The relationship is a recursive one: the features and structures built up by a region's past development influence its resilience, and its resilience to shocks will impact back on that development path, either reinforcing it or promoting change. As we have seen, shocks can result in hysteretic shifts in regional growth paths. It may be that a shock alone does not dramatically change a region's economic trajectory – although that is entirely possible - but that it can open up (or close down) opportunities to re-orientate that trajectory around new activities that can take advantage of changed circumstances: shocks are moments of opportunity as well as times of threat. Shocks can change

expectations and confidences and lead to changes in agents' behaviour, and thus local business strategies and commitments. Major shocks and disruptions can serve as mechanisms of 'creative destruction' that can clear a path for new arrangements and priorities – in economic structures, institutions, infrastructures, and regulatory architectures. To some degree, therefore, patterns of long-run uneven regional growth and development reflect regional differences in how regions and localities react and adjust to shocks. Or put another way, resilience is part of the process of geographically uneven economic evolution and development, and should be theorized and analysed as such. That remains the principal challenge. In this paper we have endeavoured to set out some, but by no means all, of the fronts on which that task might be conducted.

References

- Adger, W.N. (2000) Social and Ecological Resilience: Are they Related? *Progress in Human Geography* 24, 3, pp. 347-364.
- Alessandrini, P., Fratiani, M. and Zazzaro, A. (Eds) (2009) *The Changing Geography of Banking and Finance*, Dordrecht: Springer.
- Arbia, G. and Paelink, J.H.P. (2003) Economic Convergence or Divergence? Modeling the Regional Dynamics of EU Regions, *Journal of Geographical Systems*, 5, pp. 291-314.
- Audretsch, D., Falck, O., Feldman, M. and Heblich, S. (2008) *The Lifecycle of Regions*, CEPR Discussion Paper 6757.
- Augustine, N., Wolman, H., Wial, H. and McMillen, M. (2013) *Regional Economic Capacity, Economic Shocks and Economic Resilience*, MacArthur Foundation Network on Building Resilient Regions, Working Paper May.
- Baldwin, R., Forslid, R., Martin, P., Ottaviano, G., Robert-Nicoud, F. (2003) *Economic Geography and Public Policy*. Princeton: Princeton University Press.
- Blanchard, O. and Katz, L. (1992) Regional Evolutions, *Brookings Papers on Economic Activity* 92, 1, pp. 1-75.
- Boschma, R. and Frenken, K., (2006) Why is Economic Geography not an Evolutionary Science? Towards an Evolutionary Economic Geography, *Journal of Economic Geography* 6, 3, pp. 273-302.
- Brand, F., and Jax, K. (2007) Focusing the Meaning(s) of Resilience: Resilience as a Descriptive Concept and a Boundary Object. *Ecology and Society* 12, 1: 23. URL: <http://www.ecologyandsociety.org/vol12/iss1/art23/>
- Briguglio, L. (2004) Economic Vulnerability and Resilience: Concepts and Measurements, in L. Briguglio, L. and Kisanga, R.E.J. (Eds), *Economic Vulnerability and Resilience of Small States*. Malta: Islands and Small States Institute.
- Briguglio, L., Cordina, G, Farrugia, N. and Vella, S. (2009) Economic Vulnerability and Resilience: Concepts and Measurements, *Oxford Development Studies* 37, 3, pp. 229-247.
- Bristow, G. (2010) Resilient Regions: Re-place-ing Regional Competitiveness, *Cambridge Journal of Regions, Economy and Society*, 3, 1, pp. 153-167.
- Cambridge Journal of Regions, Economy and Society*, (2010) The Resilient Region, 3, 1.
- Carpenter, S., Walker, B., Anderies, J. and Abel, N. (2001) From Metaphor to Measurement: Resilience of What to What? *Ecosystems* 4, 8, pp. 765-781.
- Carpenter S. and Brock, W., (2008) Adaptive Capacity and Traps, *Ecology and Society* 13, 3, art40.

- Cellini and Torrìsi, G. (2014) Regional Resilience in Italy: A Long Run Analysis, *Regional Studies*, DOI: 10.1080/00343404.2013.861058.
- Cerra, V. and Saxena, S., (2008) Growth Dynamics: The Myth of Recovery, *American Economic Review* 98, 1, pp. 439-457.
- Cerra, V., Panizza, U. and Saxena, S. (2009) *International Evidence on Recovery from Recessions*, IMF Working Paper 09/183.
- Conroy, M. (1975) *Regional Economic Diversification*, New York: Praeger.
- Cowell, M. (2013) Bounce back or move on: regional resilience and economic development planning, *Cities*, 30, pp.212-222.
- Cross, R. (1993) On the Foundations of Hysteresis in Economic Systems, *Economics and Philosophy* 9, 1, pp. 53-74.
- Davies, A. and Tonts, M., (2010) Economic Diversity and Regional Socio-Economic Performance, *Geographical Research* 48, pp. 223-234.
- Davoudi, S. and Porter, L. (2012) Resilience: A Bridging Concept or a Dead End? *Planning Theory and Practice* 13, 2.
- Denhardt, J., and Denhardt, R. (2010) Building Organisational Resilience and Adaptive Management, in Reich, J. W. Reich, Zautra, A. J. and Hall, J. S. (Eds.), *The Handbook of Adult Resilience*, New York: The Guilford Press.
- Dissart, J. C. (2003) Regional Economic Diversity and Regional economic Stability: Research Results and Agenda, *International Regional Science Review*, 26, pp. 193-204.
- Doran, J. and Fingleton, B.(2013) US Metropolitan Area Resilience: Insights from Dynamic Spatial Panel Estimation, Paper presented at the Annual Conference of the Regional Science Association International (British and Irish Section), University of Cambridge, August 22.
- Duranton, G. and Puga, D. (1999) Diversity and Specialisation in Cities: Why, Where and When Does it Matter? *Research Papers in Environmental and Spatial Analysis No. 56*, Department of Geography and Environment, London School of economics.
- Evans, R. and Karecha, J. (2013) Staying on Top: Why is Munich so Resilient and Successful? *European Planning Studies*, DOI:10.1080/09654313.2013.778958
- Fingleton, B., Garretsen, H. and Martin, R. (2012) Recessionary Shocks and Regional Employment, *Journal of Regional Science* 52, 1, pp. 109-133.
- Folke, C. (2006) Resilience: The Emergence of a Perspective for Socio-Ecological Systems Analysis, *Global Environmental Change*, 16, pp. 253-267.
- Farhauer, O. and Kröll, A. (2012) Diversified Specialisation – Going one Step Beyond Regional Economics’ specialization-Diversification Concept, *Jahrbuch für Regionalwissenschaft*, 32, pp. 63-84.

- Friedman, M. (1988) *The 'Plucking Model' of Business Fluctuations Revisited*, Hoover Institution, Stanford University, WP in Economics E 88-48.
- Fujita, M., Krugman, P., and Venables, A. (1999) *The Spatial Economy: Cities, Regions and International Trade*, MIT Press: Cambridge MA.
- Fujita M. and Thisse, J-F., (2002) *Economics of Agglomeration: Cities, Industrial Location and Regional Growth*, CUP: Cambridge.
- Gardiner, B., Martin, R. L., Tyler, P. and Sunley (2012)
- Geroski, P. and Machin, S. (1992) Do Innovating Firms Outperform Non-Innovators? *Business Strategy Review* 3, 7 pp. 79-90.
- Glaeser, E. (2005) Reinventing Boston, 1630-2003, *Journal of Economic Geography* 5, 2, pp. 119-153.
- Grimm, V. and Vissel, C. (1997) Babel, or the Ecological Stability Discussions: An Inventory of Terminology and a Guide for Avoiding Confusion, *Oecologica*, 109, pp. 323-334.
- Gunderson, L. and Holling, B. (2002)(Eds.) *Panarchy: Understanding Transformations in Human and Natural Systems*, Island Press; Washington DC.
- Gunderson, L. and Pritchard, L. (2002) (Eds.) *Resilience and the Behaviour of Large Scale Systems*, Island Press: Washington DC.
- Hamel, G., & Välikangas, L. (2003) The Quest for Resilience, *Harvard Business Review*, September 1, pp. 1-15.
- Hanley, N. (1998) Resilience in Social and Economic Systems: A Concept that Fails the Cost-Benefit Test? *Environment and Development Economics* 2, pp. 221-262.
- Harvey, D. (2006) *Spaces of Global Capitalism*, Verso: London.
- Hassink, R. (2010) Regional Resilience: A Promising Concept to Explain Differences in Regional Economic Adaptability? *Cambridge Journal of Regions, Economy and Society*, 3, 1, pp. 45-58.
- Hill, E., Wial, H. and Wolman, H. (2008) *Exploring Regional Economic Resilience*, Working Paper 2008, 4, Institute Urban and Regional Development, UC Berkeley.
- Holland, S. (1976) *Capital Versus the Regions*, Macmillan: London.
- Holling, C.S. (1973) Resilience and Stability of Ecological Systems, *Annual Review of Ecology and Systematics* 4, 1-23.
- Holling, C.S. (1986) The Resilience of Terrestrial Ecosystems; Local Surprise and Global Change, 292-317 in W.C. Clark and R.E. Munn, eds. *Sustainable Development of the Biosphere*. Cambridge University Press, Cambridge, UK.
- Holling, C.S. (1973) Resilience and Stability of Ecological Systems, *Annual Review of Ecology and Systematics* 4, 1-23.

- Holling, C.S. (1996) Engineering versus Ecological Resilience, In P. Schulze (Ed.) *Engineering Within Ecological Constraints*, National Academy Press: Washington DC, pp. 31-44.
- Janssen, M. and Anderies, J.M. (2007) Robustness of Socio-Ecological Systems to Spatial and Temporal Variability, *Society and Natural Resources*, 20, pp. 1-6.
- Jen, E. (2003) Stable or Robust? What is the Difference? *Complexity*, 8, pp. 12-18.
- Justus, J. (2008) Ecological and Lyapunov Stability, *Journal of the Philosophy of Science* 75, 4, pp. 421-436.
- Kaplan HB. (1999) Toward an Understanding of Resilience: A Critical Review of Definitions and Models, in Glantz M.D. and Johnson J. R. (Eds) *Resilience and Development: Positive Life Adaptations*, Plenum: New York, pp. 17-83.
- Kitano, H. (2004) Biological Robustness, *Nature Reviews – Genetics* 5, pp 826-837.
- Knudsen, E.S. (2011) *Shadow of Trouble: The Effects of Pre-Recession Characteristics on the Severity of Recession Impact*, Institute for Research in Economics and Business Administration Bergen, Working Paper 19/11.
- Krugman, P. (1993), The Lessons of Massachusetts for EMU, 241-266 in F.Torres and F. Giavazzi (Eds.) *Adjustment and Growth in the European Monetary Union*, Cambridge University Press: Cambridge.
- Krugman, P.(1999) *The Return of Depression Economics*, W.W.Norton: New York.
- Krugman, P. (2005) Second Winds for Industrial Regions, pp. 35-47 in Coyle, D., Alexander, W. and Ashcroft, B. (Eds.) *New Wealth for Old Nations: Scotland's Economic Prospects*, Princeton UP: Princeton.
- Lang, T. (2012) How do Cities and Regions adapt to Socio-economic Crisis? *Raumforsch Raumordn* 70, pp. 285-291.
- Latham, S. (2009) Contrasting Strategic Responses to Economic Recessions in Start-Up versus Established Software Firms, *Journal of Small Business Management* 47, 2, pp. 180-201.
- Lee, A V., Vargo, J, Seville, E. (2013) Developing a Tool to Measure and Compare Organisations' Resilience, *Natural Hazards Review*, 14, pp. 29-41.
- Luthar, S. and Becker, B. (2000) The Construct of Resilience: A Critical Evaluation and Guidelines for Future Work, *Child Development*, 7, pp. 543-562.
- MacKinnon, D. and Derickson, K. (2013) From Resilience to Resourcefulness: A Critique of Resilience Policy and Activism, *Progress in Human Geography* 37, 2, pp. 253-270.
- Marcos, J. and Macaulay, S.,(2008) *Organisational Resilience: The Key to Anticipation, Adaptation and Recovery*, Paper, Cranfield School of Management, Cranfield University..
- Marshall A. (1898) *Principles of Economics, Volume 1*, Macmillan: London.

- Martin, R.L. (2006) Economic geography and the New Discourse of Regional Competitiveness, Ch 13 in Bagshi-Sen, S. and Lawton-Smith, H. (eds) *Economic Geography: Past, Present and Future*, London: Routledge, pp. 159-172.
- Martin, R.L. (2010) Roepke Lecture in Economic Geography – Rethinking Regional Path Dependence: Beyond Lock-in to Evolution, *Economic Geography* 86, 1, pp. 1-27.
- Martin, R.L. (2012) Regional Economic Resilience, Hysteresis and Recessionary Shocks, *Journal of Economic Geography* 12, 1, pp. 1-32.
- Martin, R.L. (2013) Path Dependence and the Spatial Economy: A Key Concept in Retrospect and Prospect, Ch 34 in Fischer, M. and Nijkamp, P. (eds) *Handbook of Regional Science*, Heidelberg: Springer Verlag, pp. 609-629.
- Martin, R.L., Gardiner, B. Tyler, P. and Sunley, P. (2013) *Resilience and Local Growth Paths*, Paper presented at the Cambridge Political Economy-Cambridge Centre for Geographical Economic Research Conference on Local Economic Growth: Recession, Resilience and Recovery, St Catharine's College, Cambridge, 11-12 July.
- Martin, R.L. and Sunley, P.J. (1998) Slow Convergence? The New Endogenous Growth Theory and Regional Development, *Economic Geography* , 74, 3, pp. 201-227.
- Martin, R.L. and Sunley,P. (2006) Path Dependence and Regional Economic Evolution, *Journal of Economic Geography* 6, 4, pp. 395-437.
- Martin, R.L and Sunley, P. (2007) Complexity Thinking and Evolutionary Economic Geography, *Journal of Economic Geography* 7, 4, pp. 573-601.
- Martin, R. L. and Sunley, P.J. (2010) The Place of Path Dependence in an Evolutionary Perspective on the Economic Landscape, in Boschma, R. and Martin, R. L. (Eds) *Handbook of Evolutionary Economic Geography*, Cheltenham, Edward Elgar, pp. 62-92.
- Martin, R.L . and Sunley,P.J. (2011) Regional Competitiveness: Clusters or Dynamic Comparative Advantage? Chapter 12 in Huggins, R. and Izushi, H. (Eds) *Competition, Competitive Advantage and Clusters: The Ideas of Michael Porter*, Oxford: Oxford University Press, pp. 211-238.
- Martin, R.L. and Sunley, P. (2011) Conceptualizing Cluster Evolution: Beyond the Life Cycle Model, *Regional Studies* 7, 5, pp. 1299-1318.
- Masten, A., Best, K. and Garmezy, N. (1990) Resilience and Development: Contributions from the study of children who overcame adversity, *Development and Pyschopathology* 2, 4, pp. 425-44.
- Metcalf, J.S., Foster, J. and Ramlogan, R. (2006) Adaptive Economic Growth, *Cambridge Journal of Economics* 30, 1, pp. 7-32.
- Michener, K. J. and McLean, I.W. (1999) *US Regional Growth and Convergence*, *Journal of Economic History*, 59, pp. 1016-1042.

- Neven, D. and Gouymte, C. (2008) Regional Convergence in the European Community, *Journal of Common Market Studies*, 33, pp. 47-65.
- O'Dougherty Wright, M., Masten, A. S. and Narayan, A. J. (2013) Resilience Processes in Development: Four Waves of Research on Positive Adaptation on the context of Adversity, in Goldstein, S. and Brooks, R. B. (Eds) *Handbook of Resilience of Children*, pp.15- 37.
- O'Neill, R., DeAngelis, D., Waide, J. and Allen, T. 1986. *A Hierarchical Concept of Ecosystems*. Princeton University Press, Princeton, New Jersey.
- Ormerod, P. (2008) Resilience after Local Economic Shocks, *Applied Economic Letters* 17, 5, pp. 503-507.
- Ormerod, P. (2010) Risk, Recession and the Resilience of the Capitalist Economies, *Risk Management* 12, pp. 83-99.
- Parsons, D. (2010) Organisational resilience, *The Australian Journal of Emergency Management* 25(2), pp. 18-20.
- Perrings, C. (2006) Resilience and Sustainable Development, *Environment and Development Economics* 4, pp. 417-427.
- Peterson, G. (2000) Political Ecology and Ecological Resilience: An Integration of Human and Ecological Dynamics, *Ecological Economics* 35, 3, pp. 323-336.
- Pimm, S. (1984) The complexity and stability of ecosystems, *Nature* 307, pp. 321-326
- Rey, S. J. and Janikas, M. V. (2005) Regional Convergence, Inequality and Space, *Journal of Economic Geography*, 5, pp. 155-176.
- Robb, D. (2000) Building Resilient Organizations, *OD Practitioner*, 32 (3) pp. 27-32.
- Salter, W. E. G. (1960) *Productivity and Technical Change*, Cambridge, Cambridge University Press
- Scott, M. (2013) Resilience: A Concept for Rural Studies? *Geography Compass*, 7/9, pp. 597-610.
- Schumpeter, J. (1942) *Capitalism, Socialism and Democracy*, London: Rputledge.
- Setterfield, M. (2010) *Hysteresis*, Trinity College Dublin, Economics Working paper 1004.
- Seville, E. (2009) Resilience: Great Concept... But What Does it Mean for Organisations? New Zealand Government, Wellington, New Zealand.
- Siegel, P.B., Johnson, T.G. and Alwang, J. (1995) Regional Economic Diversity and Diversification, *Growth and Change*, 26, pp. 261-284.
- Simmie J. and Martin, R. (2010) The Economic Resilience of Regions: Towards an Evolutionary Approach, *Cambridge Journal of Regions, Economy and Society* 3, 1, pp. 27-43.
- Smallbone, D., Deakin, D., Battisti, M. and Kitching, J. (2012) Small Business

- Responses to a Major Economic Downturn: Empirical Perspectives from New Zealand and the United Kingdom, *International Small Business Journal* 30, 7, pp. 754-777.
- Starr, R., Newfrock, J., and Delurey, M. (2003) Enterprise Resilience: Managing Risk in the Networked Economy, *Strategy Business*, 30, pp. 2–10.
- Storper, M. and Scott, A., (2009) Rethinking Human Capital, Creativity and Urban Growth, *Journal of Economic Geography* 9, 2, pp. 147-167.
- Tompkins, J. A. (2007). Four Steps to Business Resilience, *Industrial Management*, 49, 4, pp. 14- 18.
- Tompkins, E. L. and Adger, W.N. (2004) Does Adaptive Management of Natural Resources Enhance Resilience to Climate Change? *Ecology and Society*, 9, <http://www.ecologyandsociety.org/vol9/iss2/art10>
- Walker, B. H., Carpenter, S., Anderies, J., Abel, N., Cumming, G., Janssen, M., Lebel, L., Norberg, J., Peterson, G. and R. Pritchard. R. (2002) Resilience management in social-ecological systems: a working hypothesis for a participatory approach. *Conservation Ecology* 6, 1, pp. 14-
- Walker, B. H., Gunderson, L., Kinzig, A., Folke, C., Carpenter, S. and Schultz, L. (2006) A handful of heuristics and some propositions for understanding resilience in social-ecological systems. *Ecology and Society* 11, 1. [URL:http://www.ecologyandsociety.org/vol11/iss1/art13](http://www.ecologyandsociety.org/vol11/iss1/art13)
- Walker, B. H., Holling, C., Carpenter, S. and Kinzig, A., (2004) Resilience, adaptability, and transformability. *Ecology and Society* 9, 2. URL: <http://www.ecologyandsociety.org/vol9/iss2/art5>.
- Whitacre, J.M. (2012) Biological robustness: Paradigms, Mechanisms and Systems Principles, *Frontiers in Genetics*, 3, Article 67, pp. 1-3.
- Zolli, A. and Healy, A. M. (2012) *Resilience: Why Things Bounce Back*, London: Headline Publishing Group.