THE SEARCH FOR EUROPE

Contrasting Approaches

BBVA

PHILIP COOKE is professor at the Center of Innovation in Bergen University College, Norway. Between 1991-2014 he was university research professor of Regional Development, director of the Centre for Advanced Studies at University of Wales and professor of the Oxford Institute for Sustainable Development. Formerly, he was an adjunct professor of the School of Development Studies in Aalborg University, Denmark, and of LEREPS (Studies and Research laboratory in Economics, Policies and social systems) at the University of Toulouse, and editor of *European Planning Studies.*

This paper reviews some key conceptual and practical barriers that have hampered territorial economic development prospects. Conceptual and comparative empirical studies show that regional knowledge and innovation flows were no longer vertical, linear and cumulative but horizontal, variegated and combinative. This evolutionary economic geography discovery will be supported with insights from resilience and complexity theory and demonstrated by reference to three exemplars of transversality, which is the name for innovation and knowledge flows policy that overcomes the cognitive and policy lock-ins.

TRANSVERSALITY AND TERRITORY: ON THE FUTURE DYNAMICS OF REGIONAL KNOWLEDGE, INNOVATION & GROWTH

"By its nature, the metropolis provides what otherwise could be given only by travelling; namely, the strange" (Jane Jacobs, 1961, 238)

Introduction

This paper plants the idea that territorial knowledge flows, whether at urban, regional, national or international scale, have been changed by knowledge economies. It examines questions such as: Does knowledge still flow sectorally in specific industries? Do multinationals still dictate knowledge flows within supply chains? Is policy-makers' attachment to the specialisation of economic development in vertical "knowledge silos" appropriate? Surprisingly, perhaps, the answers to these and related questions, after five years of recent research into Regional Innovation Systems (RIS), were largely negative. However, as innovation

SYSTEMIC INNOVATION HAS CAUSED KNOWLEDGE DYNAMICS TO BECOME LESS VERTICAL, CUMULATIVE AND PATH DEPENDENT AND MORE TRANSVERSAL, COMBINATIVE AND PATH CREATING.

theory shows, every paradigm shift meets initial resistance from the ancien regime. Systemic innovation has caused knowledge dynamics to become less vertical, cumulative and path dependent and more transversal, combinative and path creating. This type of innovation is linked by networks of buyers and suppliers of knowledge, goods and services.

This gives an answer to the question, sometimes asked: What, exactly, is innovation for? The purpose of innovation is growth, measured in terms of productivity, efficiency and effectiveness. It seems that capitalism, which from a Schumpeterian perspective is fueled by innovation,

must grow in order to survive. Growth is implicit in markets, whose inefficiencies stimulate innovative efforts to create profits by seeking better alignments between value and price[1], whether of commodities, companies or currencies. Desiring that more citizens have access to the quality of life of the typical middle-class household in an advanced economy is not a morally indefensible position, especially given the massive inequalities that arise from the neoliberal dogma settled in many of these countries—not to mention the inequalities between them and the developing world.

THE HIGHER THE AVERAGE LEVEL OF HUMAN CAPITAL, THE MORE RAPID THE DIFFUSION OF KNOWLEDGE, THEREFORE THE HIGHER THE LEVEL OF REGIONAL PRODUCTIVITY

Growth is increasingly sought and found by firms and relevant support organisations which explore "relatedness" within and beyond regional boundaries. Relatedness describes firms that understand each other's business models, skillsets and technologies, even though they belong to different industries. These firms, although hidden in different sectors, may nevertheless offer innovative learning opportunities if they can be identified. This perspective is supported by at least three new territorial models. The first is New Economic Geography (NEG), which encourages systemic regional innovation in terms of labour pooling behaviour. Firms and workers seek out regional markets and financial spillover effects, co-locating or agglomerating when they find a region where industry has a lead due to innovation (Felsenstein 2011; Krugman 1991). Some modelling deficiencies persist in this perspective since it continues to produce misleadingly over-specialised and over-concentrated spatial results[2].

1 An anonymous referee queries this distinction. It is hoped that the following illustration is helpful. The price for a plumber to fix a burst pipe at a customer's home may be €5 for travel, €2.50 for materials and €10 for an hour's labour. However, the value of the service to the customer, who may have water leaking all over his house, is far greater than that, so the plumber typically estimates the price the customer will pay at €100. Investment bankers arbitrage such value to price differences for profit in the financial services industry.

2 Krugman (1991) displays the centrality of innovation in his theory of city agglomeration while admitting it is simplistic: "There are assumed to be two technologies for producing manufactured goods: a 'traditional' technique that produces goods under constant returns at a unit cost c1, and a 'modern' technique with a marginal cost lower than c1,

An alternative that does not fall into the trap of over-emphasising a single type of knowledge determinant of regional growth is New Growth Theory (NGT), which offers better insights into endogenous (i.e., local or regional) technological growth. Here, by analysing regional knowledge externalities and spillovers, the approach estimates the way in which human and physical capital, labour mobility and innovation impact regional productivity and growth (Martin and Sunley 2006). According to the NEG model, the increasing returns theory also supports the deduction that the higher the average level of human capital, the more rapid the diffusion of knowledge and, therefore, the higher the level of regional productivity, including earnings (Felsenstein 2011). Thus, NGT incorporates different kinds of regional knowledge and innovation into the innovation-productivity analysis. However, while human and physical capital combine positively to affect regional productivity, the model's results are weakened by a regional innovation effect.

A third approach, Evolutionary Economic Geography (EEG), receives some degree of support from this inconsistency. This perspective considers institutions, organisations and cultural practices as critical to the creation of regional growth. Cultural and institutional proximity are as important as spatial proximity, and the region represents an active innovation agent. This phenomenon has recently been termed Territorial Embeddedness Innovation (TEI), to be distinguished from Scientific and Technological Innovation (STI), and Doing, Using and Interacting (DUI) innovation (Nunes and Lopes 2015; Jensen et al. 2007).

Accordingly, this contribution summarises new arguments and findings concerning territorial knowledge dynamics, which pose problems for the prevailing understanding of innovation and knowledge theory. This paper is constructed around answers to four such problems raised by the testing of an EEG-informed theory and supported by wide-ranging and structured evidence. Our approach is marked by two sub-sections: one theoretical and the other empirical.

The first of the theoretical questions is: Does the interactive model of innovation that replaced the prevailing linear model now require

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but that involves a fixed cost F per production site[...] If manufacturing is dispersed, an optimally located modern plant will be a distance of 1/4 from its average consumer, and will thus incur transport costs tx/4. On the other hand, if all manufacturing were concentrated at z=0.5, an urban plant located at the same point could serve a fraction Ⓟ of consumers at zero transport cost, and incur transport costs of only (l—Ⓟ) tx/4[...] This story bears an obvious resemblance to the Big Push story of Rosenstein-Rodan (1943)."

re-engineering? The linear model that proposed innovation followed a path from research and development (R&D) to prototyping and testing and then to commercial innovation on the market. This interactive model provided feedback among suppliers in value chains.

The second theoretical question, deriving from the Schumpeterian heritage, is: What counts as radical innovation? Does it only occur once every sixty years? Or does the process occur more frequently? Long wave theory proposes that the mechanisation of railways during the nineteenth century was radically overhauled by electrification and automatisation in motor vehicles in the 1900s and informatisation in computers in the late twentieth and early twenty-first centuries. Additionally, does the associated regulatory regime resistance, which is sometimes a stimulus for innovation, last for lifetimes? Does this mean there needs to be swifter paradigm and regime change, through economic drivers and government regulation, in the industries or industry platforms that display relatedness?

The next, more practical, question is: Are innovators also entrepreneurs? Or do the complexities of distributed knowledge dynamics mean there is a diversity of global actors helping to translate knowledge into commercial products and services? Does new knowledge dynamics thinking make path dependence—historical industrial development trajectories—redundant? Or, is that knowledge used for "branching" and new path creation when transversal, or crossover, knowledge dynamics are exploited? These issues will be addressed, and their resolutions illuminated by reference to EEG research findings (Frenken 2006).[3]

Evolutionary Economic Geography Theory

This section will say little about NEG or NGT but much more about EEG (Boschma and Martin 2010). Evolutionary Economic Geography

3 An anonymous reviewer holds that EEG after the Dutch approach should be cautioned against because it suffers from ergodicity, in which all future states of the model must be in the model at the beginning. A priori, this seems unlikely for any kind of economic geographer given that, in Boltzman's initial formulation, the term refers to a "...dynamical system which, broadly speaking, has the same behaviour averaged over time as averaged over space." Moreover, EEG research shows that relatedness, which equates very much to eurodite thinking on territorial knowledge dynamics (TKDs), includes revealed related variety as well as unpredictable ex ante but rather only understandable *ex post*.

theory exemplifies the evolutionary biological concept of exaptation (Vrba and Gould 1982). The late evolutionary biologist Stephen Jay Gould held that a new word was needed to account for the biological process whereby an obsolescent organ evolves a new use over time and possibly even in a different species. Examples include human inner ear bones, which were once the jawbone joints of an extinct fish species, and fish with buoyancy bladders, which have exapted the lung functions of earlier amphibious species, so the word proved useful. Evo-

THE CO-EVOLUTION OF INSTITUTIONAL REGIMES AND RELATED PARADIGMS IS AN EXTREMELY FRUITFUL WAY TO CONCEIVE OF REGIONALLY ADAPTIVE SYSTEMS OF INNOVATION

lutionary economic geography is a new discipline which has exapted concepts as old as nineteenth century classical economics, the forebear of the neoclassical perspective. "Cumulative change" Veblen"s (1898) precursor of Myrdal"s (1957) "circular cumulative causation" (CCC) was an early species of "increasing returns" (Krugman, 1995). New neoclassicals created NEG by relaxing neoclassical assumptions including "constant returns", "perfect information" and "equilibrium outcomes". Evolutionists are as interested in increasing returns, appropriated by "new neoclassicals" like Krugman, for understanding basic spatial growth processes as neoclassicals are. But that interest is far less mechanistic and reductionist, emphasising much more the institutional, co-evolutionary and path dependent (historical) aspects of change (Martin & Sunley, 2010). EEG also favours disequilibrium rather than equilibrium or even partial-equilibrium explanations for the crisis-ridden "progress" of capitalism. It does not assume economic balance and stability are normal but rather the reverse, namely that they are unusual and economic crisis conditions reflect such general conditions of instability.

The co-evolution of regional institutional regimes and related regional paradigms, including economic mixes of industries, is an extremely fruitful way to conceive regionally adaptive, or changeable, systems of innovation. To explain innovation and growth, it is as equally inadequate to privilege external shocks as it is to privilege endogeneity—that is, internally-generated growth impulses. If we think of regional regimes as varying combinations of organisational or governance structures

that interface with institutional conventions, we immediately have a conceptual grasp of regional variety.

This combination of formal governance, or regulatory rules, and informal practices, of business associations, for example, indicates an important source of regionally distinctive outcomes. We can think of these in terms of hierarchical, adaptive system interactions. Thus, economy, politics and culture are different everywhere because regions and nations vary within systems with multi-level governance, as for example, the system involving the EU, its member-states and regions.

THE NOVELTY OF INNOVATION LIES IN ITS RECOMBINATIONS RATHER THAN ITS INGREDIENTS, WHICH WERE ALWAYS THERE AWAITING DISCOVERY

If, furthermore, we add the notion of regional paradigms as related varieties of path dependent, socio-technical systems—that is, industry mixes that comprise a regional or national economy—(Geels 2007), the interaction of these knowledge flows produces innovation. Arthur (2009) calls this combinative, or combinatorial, evolution in his book on the nature of technology and innovation. For Martin (2010), this constitutes path interdependence, a far more dynamic concept than path dependence because it is in recombinant knowledge collisions that all innovation lies (Schumpeter 1934). So, we move from a vertical, linear and sectoral view of knowledge flows to one that recognises horizontal, interactive and inter-sectoral knowledge flows for innovation.

These are bold claims that require further elaboration. Put simply, Arthur's most recent statement about the ubiquity of bricolage, or recombination, as the midwife of all innovation may, from some perspectives, underestimate the role of truly novel knowledge. However, for engineering, which was Arthur's first calling and from which he gets much exemplification, including the complex path dependence of jet engine technology, it is probably a more reasonable assertion than for, say, biotechnology, which he also declaims. Even some keystone biotechnology knowledge, like DNA, nevertheless betrays a "ghost in the machine"[4]—a

4 The expression "ghost in the machine" is an allusion to the critique made by philosopher Gilbert Ryle, in 1949, about Descartes' dualism, according to which both mind and soul are heterogeneous substances. In this context, the expression could point to the occasion when concepts from certain disciplines are used in a different science.

metaphor exapted from elsewhere—, like the physicist Schrödinger's idea that DNA might resemble a non-repeating crystal.

So what constitutes truly novel knowledge? Briefly, two examples must suffice. The first was the 2000 Nobel Prize-winning research by Heeger, MacDiarmid and Shirakawa (1978), which revealed that the prevailing scientific consensus that polymers could only insulate electricity, not conduct it, was wrong. That research is now the basis for Samsung's Active Matrix Organic Light Emitting Diode (AMOLED) technology, which replaced liquid crystal in the screens of its Android 4G LTE smartphones.

The other example is the nanotechnology research of Maria Strømme and her team at Uppsala University (Nystrom et al. 2009) on the filtering properties of special paper. When their filter paper was tested in a lake suffering eutrophication (algal blooms and de-oxygenation), it produced electrolytic effects from its interaction with specific algae. A method of utilising algae to store electricity in a battery was thus discovered from a completely unknown source. The battery can be recharged much faster than a lithium battery.

The cellulose that Strømme and her colleagues used comes from a polluting type of algae whose cell walls contain cellulose with a distinctive nanostructure, giving it 100 times the normal surface area. The researchers coat paper made from this cellulose with a conducting polymer and then sandwich a filter paper soaked in a salt solution between the paper electrodes. It charges in a few seconds, and it is flexible, sustainable and non-toxic. Hence, though the battery application utilises the conducting polymer, the discovery represents novel knowledge about the electrical storage capabilities of algae, and possibly presents a solution to the age-old problem of storing electricity at scale and over long periods of time.

So, we conclude this "nothing new under the sun" debate by asserting that the novelty of innovation lies in its recombinations rather than its ingredients, which were always there in atomic, molecular or memetic forms, awaiting discovery. For example, it should be noted that algae contain many previously undiscovered yet potential commercial opportunities, including the synthesis of Omega-3 nutrients from rapeseed oil.

In complexity theory, these knowledge and innovation processes would be referred to as exploration of the adjacent possible, in the first case, and preadaptation, rather than the more biological exaptation, in the second. The adjacent possible is a search process that seeks

novel solutions, many of which are incremental innovations that begin relatively close to the existing problem. Such novelty becomes radical innovation when the knowledge recombination search swiftly reveals numerous related innovation possibilities and potentials. In the case of paper batteries, the adjacent possible was the application of old knowledge (conductive polymers) to new knowledge (electrolytic algae) to create an eco-innovation.

Preadaptation, which is a more common innovation process, starts with already existing innovation, which is then preadapted to a new setting, either by some kind of cognitive reversal or by adaptively transferring it from one industry to a wholly different one (Kauffman 2008). Kauffman's exemplar of cognitive reversal preadaptation concerns the invention of the modern tractor, specifically the early massive engines that continually broke the chassis when mounted. An engineer, noting the scale and rigidity of the engine block, suggested it could form the chassis. The historical innovation was Henry Ford's Fordson Model F, which was completed in 1916 and was the first lightweight, mass produced tractor in the world. Ford engineer Eugene Farkas successfully designed the engine block, transmission and axle housings, which bolted together to form the basic structure of the tractor. By eliminating the need for a heavy, separate chassis, costs were reduced and manufacturing was simplified.

We could also point to the Wright brothers' innovation of the aeroplane, which combined bicycle, boat, kite and automotive technologies in the form of wheels, chains, propellers and motors from different industries to fulfil the purpose of creating a flying machine.

Today, preadaptation is consciously practised by the regional cross-cluster and sectoral knowledge transfer agency Bayern Innovativ for its industry members. This process involves large numbers of variably-sized and themed meetings of industry innovators evaluating the preadaptation (or knowledge and innovation transfer) potential of innovations already implemented in other industries, as described by Cooke et al. (2010).

One interesting example of preadaptation, given by Cooke et al. (2010) occurred when BMW exhibited the nanotechnology-refined textile that kept the seats of its new model free from dirt. Nano-filters had been embedded in the seat fabric to produce this effect. Sitting in the audience were representatives of hospitals and medical clinics. They immediately thought that such an innovation could be used to reduce the

amount of bacteria and dirt that stick to medical uniforms if a suitable textile could be produced with the same filtering properties. Over time, that innovation-transfer was achieved, and the new product is now on the market.

So much innovation, in the form of commercialised recombinations, has occurred historically that transversality will typify innovation opportunities in the future. Currently, transfer occurs face-to-face and by word-of-mouth, but it is easy to see how a firm or agency could make such knowledge available as a market offer.

Territorial Knowledge Flows and Innovation Issues

Does the interactive model of innovation that replaced the prevailing linear model now require re-engineering?

The conventional wisdom about innovation is in need of an overhaul. It was noted at the outset of this contribution that transversal knowledge flows not only pose problems for the cumulative model of innovation, but also for the linear (STI) and interactive (DUI) versions of this model, which have dominated the understanding of innovation for decades (Balconi et al 2010; Kline and Rosenberg 1986). Both share verticality: STI from its emphasis on intra-corporate knowledge flows, from R&D laboratories to marketing and sales departments, and DUI from the recognition that supply chains became more clearly emergent with the onset of Japanese modes of lean production.

The older theories focused on innovation without much thought to what it was for or how knowledge acquisition to achieve innovation was related to it. This could mean one of two things. First, it could be that innovation was once linear, cumulative and closed, but that is no longer the case. This seems unlikely from a complexity perspective because Kauffman (2008) stresses that the key feature of complex adaptive socio-economic systems is that:

> The more diverse the economic web, the easier is the creation of still further novelty [...leading to...] a positive correlation between economic diversity and growth (Kauffman 2008, 151-160).

Similarly, as Arthur (2009) sees it:

> When a network consists of thousands of separate interacting parts and the environment changes rapidly, it becomes almost impossible to design top-down in any reliable way. Therefore, increasingly, networks are being designed to "learn" from experience which simple rules of configuration operate best within different environments (Arthur, 2009, 207).

What is more likely is that the framing of these innovation models was wrong. This means that observers misunderstood and over-simplified what they thought they had seen, or perhaps had not seen because most innovation occurs in confidential situations. Contrariwise, what was always present even in portrayals of intra-corporate or intra-supply chain innovation orderliness was a great mixture of purchasing or borrowing of adjacent extramural ideas, possibilities and solutions from related and even unrelated industries. Individual scientists, knowledge entrepreneurs and consultant experts come to mind as innovation contributors in this case. Even Alexander Fleming, who innovated antibiotics, was helped by his housekeeper to notice his discovery of penicillin, which she thought was cheese.

TIME AND VARIETY DISTINGUISH SYSTEMIC FROM ROUTINE INNOVATION, RENDERING THE FIRST EPOCHAL BY USHERING IN A LONG-WAVE TECHNOLOGICAL REGIME

Accordingly, other than describing such bricolage, theorists at the time lacked an interest, or a theoretical discourse, in which to position such messy processes. So, the evolution of knowledge flows around platforms of innovation, integrated by digitisation as facilitators of economic growth, has both shattered the hitherto prevailing narrative of cumulative orderliness and introduced "an image of wholeness, and within that wholeness a 'messy vitality'" (Arthur 2009, 213).

What counts as radical innovation?

If all innovation is bricolage, where one innovation builds on a preceding one, or more, to fill a niche formed by an opportunity created from what has gone before, it seems difficult to find a place for anything other than incremental innovations that explore possibilities of preadaptation or

the adjacent possible. Kauffman (2008) frequently uses the tractor metaphor to marvel at the ingenuity of mankind, but he also notes how, for example, the innovation of the remote TV channel control could simply not have been envisaged in a society without TV, or more particularly, multi-channel TV.

This gives a clue to the reasons why it is important to differentiate between innovation in general, which uses preadaptation and adjacency and is therefore incremental, and radical innovation. Whether that means most innovation occurs in geographic proximity is an open question to which we will return. But, for the moment, research on the history of innovations (e.g., Johnson 2010) suggests most are produced in geographic proximity to where adjacent possible opportunities arise, and most contain unexpected elements, for example, the aforementioned paper research that found electrolytic algae). Even if knowledge flow interactions are inter-continentally relational, innovation is recombined at the spatial point of the innovator, or the team. Johnson (2010) allows only one exception to this rule: the "multiple", when an innovation (e.g., the incandescent light bulb) occurs simultaneously and independently in different regions. Hughes (1983) argues that Edison gained priority for the light bulb because he also innovated a co-evolving electricity generating and lighting system. This is a clue to the difference between long-term radical innovation and short-term incremental innovation: the former swiftly stimulates a variety of related innovations.

Time and variety distinguish systemic from routine innovation, rendering the first epochal by ushering in a long-wave technological regime that envelops, protects and facilitates the exploitation of the new growth-inducing technological paradigm, both classically as well as in our contemporary informational economy. But, within that technological paradigm, many shorter-term, but still radical, innovation episodes occur today, affecting retail, newsprint, recorded music and even taxi transportation firms.

Time is also an important factor in the creation of episodic radical innovation. Change occurs more swiftly in creative design and "cognitive-culturally" inspired industries, like smartphones, than in light bulbs. Here, instant shifts in socio-cultural meaning can be captured through the phenomenon of "circles" in design driven industries, or crowdsourcing and crowdfunding as practised by apps firms in the smartphone industry (Scott 2008; Pisano and Verganti 2008; Page 2007).

So, we conclude that the original idea of radical innovation survives but needs variegation conditional to different temporal innovation frames, whose knowledge turnaround speeds are conditional to their conscious exploitation of the crossover of knowledge or actual innovations among firms or industries—transversality (Cooke 2013). Illustrative material on this phenomenon for the Swedish regions of Skåne and Västra Götaland and the French Midi-Pyrénées is presented below.

Are innovators also entrepreneurs?

This question addresses the complexities of distributed knowledge dynamics, asking if there is a diversity of global actors assisting the translation of knowledge into commercial products and services. This is not the old individualist question about believing innovation to be the product of genius. It is far more important than that and relates to a common misconception that entrepreneurship and innovation are different sides of the same coin, or worse, that they are the same thing. If that was ever true, it seems decreasingly so nowadays. Even Schumpeter (1934) is clear that the key skills were very different: the innovator recombined knowledge while the entrepreneur assembled the financial, legal and human resources to commercialise it.

EEG research has registered the rise of complexity in the intermediation of innovation processes by practitioners of knowledge-intensive business services (KIBS), who are found performing crucial coordinating, advisory and consulting roles in most industries (Strambach 2010). These include management accountants, venture capitalists, patent lawyers and so on. Even knowledge-intensive business services for farming are located in cities where insurance, credit and technical talent is found, rather than in the rural markets for such services. But KIBS are a very large platform of differentiated knowledge, which returns us, momentarily, to the question of geographic proximity.

Clearly, the phenomenon of rural services being supplied from metropolitan locations reveals how the presence of global talent pools, their knowledge spillovers, and relatedness across industry boundaries allows for fluid entrepreneurial activity to be conducted in an urban ecosystem by KIBS of many sizes. Ironically, indicators of such knowledge-intensive entrepreneurial concentrations place cities like Stockholm and London at the peak of the European hierarchy for their disproportionate shares of employment in KIBS and the lesser category

of high-tech manufacturing (Cooke and Schwartz 2008), but they also show London, at least, to underperform UK regions on innovation per capita (Chapain et al. 2010). So, it seems likely that knowledge-intensive entrepreneurs are located in different places than innovators.

THE INNOVATOR RECOMBINES KNOWLEDGE WHILE THE ENTREPRENEUR ASSEMBLES THE FINANCIAL, LEGAL AND HUMAN RESOURCES TO COMMERCIALISE IT

More precisely, most KIBS and high-tech manufacturing workers in cities are clearly neither entrepreneurs nor innovators. Rather, they are clerical, secretarial, retail and administrative workers, which corrects the discourse that emphasises the creativity of large cities, at least regarding the composition of their labour markets. From this research on cities, we conclude that entrepreneurs are increasingly divorced as actors and in geographical terms. This is a source of the difficulty innovators have in launching new start-up businesses, especially in Europe.

Does the new knowledge dynamics paradigm make path dependence redundant?

This is possibly the most interesting question posed by the EEG research. Traditionally, path dependence has been associated with somewhat negative outcomes, like the "lock-in" of older industrial regions to outdated industry and management practices (Grabher 1993). David's (1985) equilibrium perspective over-emphasised such issues. Nowadays, that research is criticised in favour of a more open and innovation-friendly perspective (Martin 2010). A second weakness was Arthur's (1994) reliance on chance or accidental explanations for innovative events that shift path dependence (Martin and Sunley 2010). Building on a more socially constructive conception of path dependence, reflective of Garud and Karnøe's (2001) notion of innovation, which also involved mindful deviation by social agency to affect change, EEG has introduced the notion of path interdependence. Martin and Sunley (2010) thus align this adjusted perspective on path dependence to another key EEG concept, namely proximity. This shift towards a mobilisation explanation for innovation, when linked to the multi-level perspective idea of co-evolving socio-technical systems, allows us to

incorporate the key complexity theory concepts of preadaptation and the adjacent possible in a rather satisfactory explanation of emergent regional knowledge flows and innovation. Allowing for the likelihood of market failure by firms which do not explore regional paradigm relatedness sufficiently, thereby delaying the onset of new path creation, opens up regional regime opportunities for government or governance organisations to introduce firms to both regional and non-regional innovation as a preadaptive form of transversality and to encourage exploration of structural holes or white spaces among regional paradigm elements (Burt 1992; Johnson 2010). Thus, we begin to see more clearly the element of path interdependence that defines key spatial forces underlying and influencing inter-organisational relations.

POLICY MAY BE ACTIVE WHEN MARKET FAILURE MEANS THAT POTENTIALLY COMPLEMENTARY FIRMS OR INDUSTRIES IN GEOGRAPHICAL PROXIMITY NEVER MEET TO DISCUSS POSSIBLE INNOVATIONS

Martin and Sunley (2010) refer largely to the economic geography dimension, including interdependent technological paradigm interaction, which will be explored in more detail under the rubric of relatedness conjoined to transversality. This moves the discourse closer to that of regional regime and paradigm interaction because transversality is the policy correlate of relatedness among industries or firms. Policy—whether created by government, public-private governance, or private governance through intermediary or lead-firm initiative—may be active when market failure means that potentially complementary firms or industries in geographical proximity never meet to discuss possible innovations. If policy is not active, then innovative structural holes (Burt 1992) will remain unidentified, unless and until a firm's search of the selection environment eventuates, possibly due to the rise or entry of new incumbents (see below). High market uncertainty in a context that values innovation as the highest virtue of the accomplished firm and region, owing to its overwhelming contribution to productivity and growth, means regional regimes or governance systems increasingly assist such searches for structural holes by inducing speed-up in the process.

Empirical Tests of the Foregoing: Brief Comparative Case Analysis

The Skåne Region

EEG and other research shows the strength of this region in Sweden to be clustered in agro-food production and services, including functional food based on biotechnology applications, like health drinks, and organic food offered in farms, public canteens and restaurants, as well as conventional mass production using industrialised productivist chemicals, pesticides, fungicides, herbicides and other conventional control technologies. A once strong but now fading path dependence was seen in the region's historical industry trajectory of shipbuilding in Malmö, but the closure of the Kockums yard in the 1980s led to redundancy and migration of shipyard workers—some to wind-turbine engineering in Jutland, Denmark.

By early 2010, the western harbour area had been reinvented as a centre of cognitive-cultural activity by the media. Activity promoted by the regional development agency also included mobile telephone companies (Mobile Heights), new media (Media Evolution), and the Skåne film industry, which included computer gaming. An emergent clean-tech industry and a systems resilience initiative were also beginning to be visible. This area prioritised regional paradigm resilience while the next regional account, also from Sweden, emphasised regional regime resilience aspects.

Mobile Heights[5]

During the 2000s, Mobile Heights' territory was invaded by rapidly expanding Asian producers, including Samsung from South Korea and Huawei from China. This resilience shock (Gunderson and Holling 2002; Folke 2006) led Sony Ericsson to reduce shipments of hardware and refocus on managing global services, such as selling network services to mobile telephone suppliers, including Telenord and Telia. To the latter, they also sold the extra service of managing the network, leaving the client to simply manage billing and cash flow. Accordingly,

5 Mobile Heights is a non profit organization whose mission is strengthening the Scania Region as a hotspot for mobile innovation. Members include companies, industries, associations, academic institutions and public organizations

Telia began cutting employment in the mid-2000s and has not filed more patents. ST Ericsson, the telephony infrastructure arm of the Ericsson Group, seemed unlikely to survive as a stand-alone company, and Sony Ericsson, the Ericsson mobile telephone joint venture, was dissolved. Nokia, Finland's flagship with a telecoms presence, also nosedived at that time.

The main competition for key Mobile Heights' member Sony Ericsson was Huawei, which had an office in Lund, Mobile Heights' home base, for the development of basic components of mobile phones. This augmented their offices at Kista Science Park in Stockholm, and Gothenburg, to employ 250 engineers. Huawei took advantage of cutbacks by Ericsson in Lund, which had made hundreds of qualified engineers available. The range of Huawei manufactures increased from base stations to mobile Internet modems and its own telephone handsets.

Resilience theory from EEG promises a response to resilience shock, so what was the regional and firm response to these perturbations? On the regional level, an emergent clean-tech industry (Sustainable Hub) and a systems resilience initiative (Training Regions) began to become visible around 2010. Both related to an EU Europe 2020 Grand Challenge shared with the Västra Götaland region to contribute Swedish expertise to the construction of sustainable cities (see fig. 1 below). On the firm level, Sony Ericsson rather fruitlessly began evolving "open innovation" relationships with innovative start-ups. Even S.T. Ericsson, which was a classic "closed innovation" firm, began to buy from external suppliers while actively seeking to contract or acquire them.

There were quality entrepreneurial firms in Skåne; for example, the near bankrupt Canadian mobile telephony firm RIM, which produces BlackBerry, acquired user-interface maker The Astonishing Tribe (TAT) in 2010. Moreover, Polar Rose, a Malmö startup which built a facial recognition programme that linked to Facebook photos, was bought by Apple for $29 million, also in late 2010. Other open innovation connections involved Mobile Heights' start-ups that joined AstraZeneca in the Life Sciences platform for remote diagnostics telephones and biosensors. Lateral linkages were also in position with the Media Evolution (Nordic Game) cluster member.

Media Evolution

This Skåne regional cluster concentrated on convergent media, or new media. It promoted the emergence and growth of start-ups in relevant fields. Most such new firms had entrepreneurial leaders with at least two to three years of experience in larger companies, while a minority came from Lund or Malmö University. Polar Rose, for example, grew out of computer vision research—the analysis of digital images and

AN EMERGENT CLEAN-TECH INDUSTRY ('SUSTAINABLE HUB') AND A SYSTEMS RESILIENCE INITIATIVE ('TRAINING REGIONS') WERE BEGINNING TO BE VISIBLE AROUND 2010

video—at the Universities of Lund and Malmö. Polar Rose entered the Teknopol Mobile Heights Business Centre in 2004. Teknopol was a tailored business advice agency specialising in start-up activity for the Mobile Heights Business Centre, Sustainable Hub and Life Sciences Business Centre, each of which related to the Skåne region's white spaces, or cluster-platform programmes. Polar Rose was given an initial loan of €30,000, as a Sony Ericsson spin-out, to develop academically originated face-recognition software.

TAT, purchased in 2010 by Research in Motion, was started in 2002. TAT was to fit its user experience-user interface (UX-UI) applications into BlackBerry's PlayBook and smartphone platform. This was a pioneer user of novel social media forms like crowdsourcing (Shirky 2010) and crowdfunding of anything from film projects to start-ups. Accordingly, crowdsourcing was another open innovation response to global, corporate competitive forces impinging on large Swedish ICT incumbents.

Another cross-sector media-ICT innovation link included Qubulus, a system platform for indoor positioning on which location based services could be developed by Qubulus or by an application developer community through a shared application programming interface. The platform aggregates positioning input from proprietary web services and mobile apps to hardware installations. By using the best technology to fit the usage and purpose of the customer case, Qubulus can meet user demand and solve the problem of indoor positioning. Crowdsourced positioning activities are a focus in designing space syntax for people flows, shopper movements in retail malls and product finder smartphone applications.

The Västra Götaland Region: "Iconic Projects" Innovation Platform Management

Transversal policies were, at this time, also the characteristic approach taken in the Västra Götaland region, in Gothenburg. A strategic decision was taken to concentrate initially on meeting the Europe 2020 Grand Challenges of Climate Change and Healthcare. In 2003, the region had been one of the first in the world to publish a climate change response strategy report, Gothenburg 2005, involving policies for "smart energy". This report then evolved into a strategic target for the Västra Götaland region to be totally free of fossil fuels by 2030, in what became known as the Gothenburg Model of the Lisbon Strategy. However, working out the region's position on that Grand Challenge in advance gave scope for the new environmental strategy to be down-to-earth and practical. This meant focusing on iconic projects committed to innovation, learning and collaborative platform management laboratories (see fig. 1).

Thus, the particularisation of the Climate Change Grand Challenge involved translating it into a sustainable cities initiative triggered by a large infrastructure commitment to a new tunnel, which brought together numerous regional clusters involved in renewable automotive fuels, forest plastics, petroleum and health. At a more detailed level, these assembled pilot projects mixed expertise in cluster firm logistics, public transport, visioning (computer graphics and imaging) and green accounting.

They also linked with Chalmers University and specialist firms like Asta AB. A comparable iconic project approach was taken in healthcare, and the project in question involved a new health complex centred on a Medical Health Imaging Facility at the University Medical School. This connected transversally to digital signals processing (data compression) and medical diagnostics engineering expertise at Chalmers University and one of its spinout firms, Medfield Diagnostics.

Midi-Pyrénées

The interest here is in an economically strong but over-specialised region that has a narrow path dependence paradigm composed of agro-food, aerospace and healthcare with biotechnology inputs, but a strong regional regime that emphasises transversality as a policy model. In

the French Pôles de Compétitivité contest, the region was successful in accessing national cluster-building funding to complement abundant regional and European resources. Remarkably, the regional government practises a policy, which it calls transversalité, to populate its narrow regional paradigm with greater path interdependence. Chart 2 represents a process diagram of the regime methodology for inducing transversality from the regional paradigm in a strong way. The steps involved in this process first prioritise the formation of a large, consolidated pool of financial resources derived from the Midi-Pyrénées region, the French government and the EU.

The next step was to build a methodology for determining how new and greater innovation could be extracted from the region's leading industries by emphasising transversality among them. This led to two parallel exercises. The first, CAVALA, was a statistical review of the

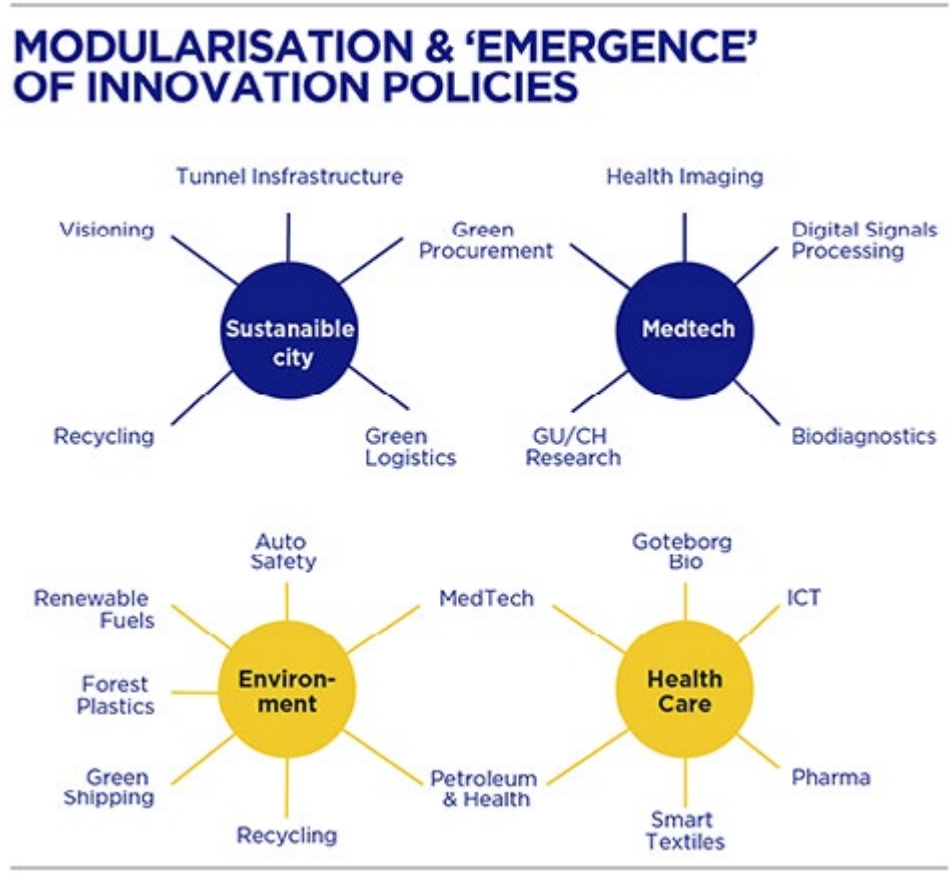

Chart 1. Västra Götaland's Iconic Projects Cluster-Platform Approach.
Source: Center of Innovation, Bergen University College.

strengths and weaknesses of the main clusters and leading firms with respect to innovation and innovation potential. This led to recognition that, in effect, only two types of existing and established firms were likely to be good innovation candidates: lead firms, like EADS and Thales in aerospace, and hub firms or firmes pivots, which are important systems integrators or aggregator firms in supply chains. To these were added innovative spin-out or start-up businesses.

Leading candidates from agro-food, aerospace and bio-healthcare were then put in a transversality group to consider methodologies, incentives and conventions by which they might proceed to talk across sector and cluster boundaries, known to be an especially difficult task where tacit knowledge is concerned (Janowicz-Panjaitan and Noorderhaven 2009). In these group discussions, the key focus was on technology, its known properties and cross-pollination potentialities, barriers to innovation from cognitive research or resources and, as noted, methodologies by which firms might find each other, despite their apparent un-relatedness, in order to generate regional innovation through the exploitation of relatedness. This is a new, French, top-down model that

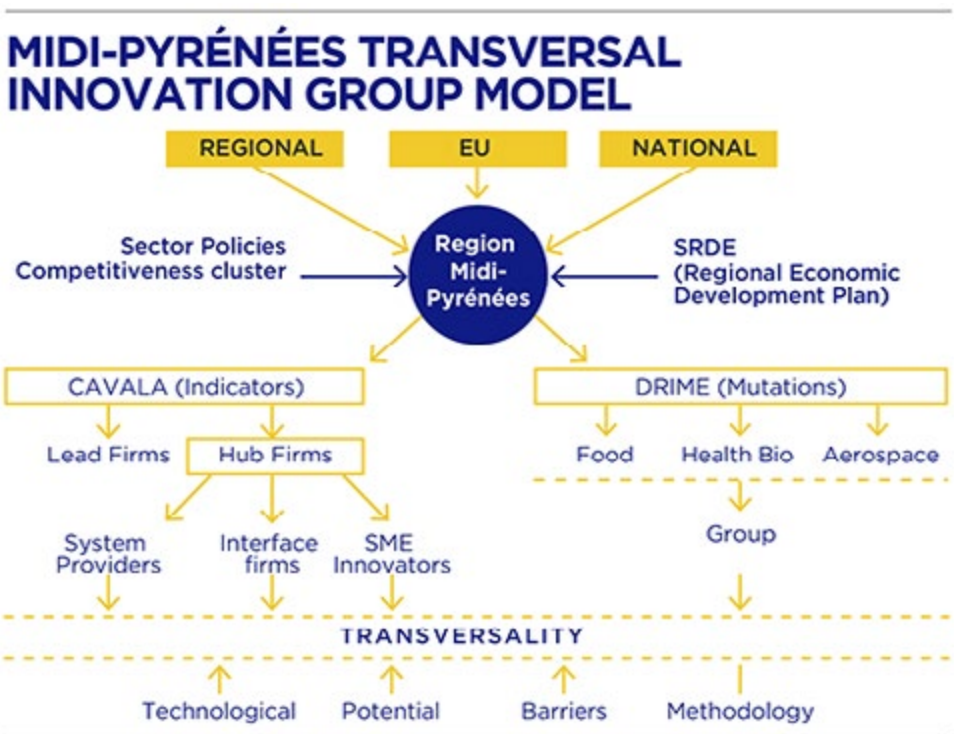

Chart 2. Path Inter-dependences and Transversality

seeks to induce innovation by a formal imposition of the conventions of transversality on regional firms.

Confusion and Contradiction in EU Innovation and Growth Policy

Between March 2013 and June 2015, we researched innovation in Portugal at both national and regional levels (Algarve, Centro and Norte regions). The aim of the research was to measure the distance between the transversality theory of innovation outlined above and the new Regional Innovation Strategies 3 (RIS3) methodology promoted by the European Commission under the rubric of "smart specialisation." Specialisation is clearly the opposite of variety or diversification, so we were interested to see how this contradiction worked in practice. Were regions sacrificing valued industries to promote smart specialisation? Was the idea even understood? And how, after the Commission was criticised for its linear, sectoral and specialisationist approach so that it had to propose in footnotes that related variety and DUI-type innovation were also examples of smart specialisation did its regional and national clients manage the resulting confusion (Kroll 2015)?

This proved to be an interesting laboratory for observing multi-level governance tensions, from regional to national to supranational levels of interaction. The context is unique in that a slow-moving, cumbersome and—as many see it—spatially myopic and conceptually chaotic European Commission belatedly sought to induce a new, post-program budget and linear regional economic development model to promote growth while imposing major constraints in the form of austerity policy, budget cuts and draconian debt repayment conditions. At its worst, the austerity strategy has massively impoverished Eurozone member Greece, and while Portugal emerged from the imposed fiscal straitjacket without the same devastating results, the hallmarks of contradictory thinking remain evident about how the EU believes it promotes growth by imposing conditions that ensure the opposite.

In brief, the studied regions and even, to some extent, the state ignored the precepts of specialisation and pursued the common-sense potential of optimising their regional diversity to promote regional innovation (Cooke 2015). This meant Algarve aimed to escape its narrow over-specialisation in "sun and beach" tourism by pushing for DUI applications of renewable energy, marine biology, ICT and creative

industries to diversify their tourism and—with the help of a regional innovation agency—to develop new industries, including some with STI-type innovation from universities and research centres. These could be located outside Algarve if necessary. However, it was a very horizontal set of aspirations.

Centro and Norte already had high related variety scores, as judged by the Portuguese National Research Council (FCT 2013), so they used matrix methods to identify crossover innovation opportunities and projects in biotechnology, flexible manufacturing systems, robotics, renewables and footwear, among other intersecting innovation platforms. In the last two cases, their strategies were accepted by the state, which retained control of project evaluation (dependent on the EU Regional Operational Programmes into which RIS3 allocations fit). But for Algarve, and other regions, the state's innovation ministries and agencies opposed their diversity plans on grounds of lack of critical mass, thus condemning Algarve to remain specialised but not especially smartly so. A better governance model for regional innovation was approved, but it was not a full-blooded regional innovation agency.

THE STUDIED REGIONS AND EVEN, TO SOME EXTENT, THE STATE, IGNORED THE PRECEPTS OF SPECIALISATION AND PURSUED THE COMMON-SENSE POTENTIAL OF OPTIMISING THEIR REGIONAL DIVERSITY TO PROMOTE REGIONAL INNOVATION

So, the adoption of a specialisationist model in the field of ERDF allocations via ROPs to subsidise regional innovation and growth was rejected by Portugal's regions and even in limited ways by the state. In its stead, diverse regions either sought to initiate or, where conditions were more evolved, consolidate growth opportunities and gains by adopting regional diversity through building on the concept of related variety and fashioning transversal innovation policies. That this was given approval in the RIS3 documentation promoting smart specialisation merely underlies the conceptual confusion and spatial myopia of the EU and its Commission. This shows that the EU and even its member-states are slow-moving, backward-thinking policy action entities.

Even weak regional administrations, such as those anatomised above, can respond and, in limited ways, even anticipate needed economic

policy actions more swiftly. However, at the edge of chaos, as understood in EEG and complexity theory, where change is imminent or unavoidable, "fortune favours the prepared mind", as Louis Pasteur saw it. Centro and Norte saw clear advantages in exploiting innovation opportunities arising from past R&D infrastructural investments, and their sense-making, crossover thinking was hard to oppose by the state. Algarve had great difficulty extracting its future innovation profile from the specialised sun and beach frame endowed upon it by its state and fellow regions. The key problem lies in institutional failure by big, slow organisations, like the EU and member states, to leave their neoclassical industrial economic comfort zone and embrace the full meaning of innovation, which is recombinant, interactive and unconfined to a sector or even a cluster. Rather, innovation is geographical, interactive and based on crossover innovation at interfaces.

Conclusions

It is clear that the transversality perspective can be considered successful at path-breaking in three significant dimensions. First, the theoretical sophistication of its approach places its evolutionary economic geography approach in a primary position, from the viewpoint of advanced regional analysis. This utilises evolutionary concepts from economic geography, complexity and resilience theory, such as the multi-level perspective, complex adaptive systems, external shocks and internal perturbances, preadaptation, adjacency, cognitive reversal, relatedness, proximity, path dependence and transversality, in a coherent, innovative and intellectually penetrative way. Much further research is likely to follow into the explanatory validity of this non-reductionist, non-predictive evolutionary framework. Kauffman (2008) presents this perspective as "lawless" in the sense that it is beyond the paradigm exemplar of neoclassicism, which derives mechanistically from physics. Since life forms cannot be predicted, this approach escapes the strictures of that reductionist frame.

The second major contribution of the findings on knowledge flows and innovation for the future concern its critical reflections on numerous inadequately scrutinised aspects of innovation theory. Accordingly, innovation is now better specified as the key element of any evolutionary growth model. Finally, the theoretical and empirical results have shown

how relatedness and transversality are practised in the actualité and may be empirically observed by firms and policy agencies seeking or charged with enhancing business and regional innovation. This strongly suggests the validity of Kurt Lewin's observation that "there is nothing so practical as a good theory".

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Arthur, B. 2009. *The Nature of Technology*. London: Penguin.

Balconi, M., S. Brusoni, and L. Orsenigo. 2010. "In defence of the linear model: an essay." *Research Policy* 39: 1-13.

Boschma, R., and R. Martin, eds. 2010. *The Handbook of Evolutionary Economic Geography.* Cheltenham: Edward Elgar.

Burt, R. 1992. *Structural Holes: The Social Structure of Competition.* Cambridge MA: Harvard University Press.

Chapain, C., P. Cooke, L. De Propris, S. MacNeil, and J. Mateos-Garcia. 2010. *Creative Clusters and Innovation: Putting Creativity on the Map*. London: NESTA.

Chiang, C., M. Druy, S. Gau, A. Heeger, E. Louis, A. MacDiarmid, Y. Park, and H. Shirakawa. 1978. "Synthesis of highly conducting films of derivatives of polyacetylene (CH)x." *Journal of the American Chemical Society* 100: 1013.

Cooke, P., and D. Schwartz. 2008. "Regional knowledge economies: an UK-EU and Israel perspective." *Tijdschrift Voor Economische en Sociale Geografie* 99: 178-192.

Cooke, P., C. De Laurentis, S. MacNeil, and C. Collinge, eds. 2010. *Platforms of Innovation.* Cheltenham: Edward Elgar.

Cooke, P., ed. 2013. *Reframing Regional Development*. London: Routledge.

Cooke, P. forthcoming in 2016. "Four minutes to four years: the advantage of recombinant over specialised innovation—RIS3 versus smartspec." *European Planning Studies.*

David, P. 1985. "Clio and the economics of QWERTY." *American Economic Review* 75: 332-337.

European Commission. 2012. *Guide to Research and Innovation Strategies for Smart Specialisation*. Brussels: European Commission.

FCT. 2013. *An Analysis of the Portuguese Research and Innovation System: Challenges, strengths and weaknesses towards 2020*. Lisbon: Fundação para a Ciência e a Tecnologia/ National Research Council.

Felsenstein, D. 2011. "Human capital and labour mobility determinants of regional innovation." In *The Handbook of Regional Innovation & Growth,* edited by P. Cooke, B. Asheim, R. Boschma, R. Martin, D. Schwartz and F. Tödtling, 119-131. Cheltenham: Edward Elgar.

Folke, C. 2006. "Resilience: the emergence of a perspective for social-ecological systems analysis." *Global Environmental Change* 16: 253-267.

Frenken, K. 2006. *Innovation, Evolution & Complexity Theory*. Cheltenham: Edward Elgar.

Garud, R., and P. Karnøe. 2001. "Path Creation as a Process of Mindful Deviation." In *Path Dependence and Creation,* edited by R. Garud and P. Karnøe, 1-38. London: Lawrence Erlbaum.

Geels, F. 2007. "Analysing the breakthrough of rock 'n' roll (1930-1970): multi-regime interaction and reconfiguration in the multi-level perspective." *Technological Forecasting & Social Change* 74: 1411-1431.

Grabher, G., ed. 1993. The Embedded Firm: on the Socioeconomics of Industrial Networks. London: Routledge.

Gunderson, L., and C. Holling, eds. 2002. *Panarchy: Understanding Transformations in Human and Natural Systems*. Washington DC: Island Press.

Hughes, T. 1977. "Edison's method." In *Technology at the Turning Point*, edited by W. Pickett, 5-22. San Francisco: San Francisco Press Inc.

Jacobs, J. 1961. *The Death & Life of Great American Cities*. New York: Vintage.

Janowicz-Panjaitan, M., and N. Noorderhaven. 2009. "Trust, calculation and interorganizational learning of tacit knowledge: an organizational roles perspective." *Organization Studies* 30: 1021-1044.

Jensen, M., B. Johnson, E. Lorenz, and B. Lundvall. 2007. "Forms of knowledge and modes of innovation." *Research Policy* 36: 680-693.

Johnson, M. 2010. *Seizing the White Space*. Boston: Harvard Business Press.

Johnson, S. 2010. *Where Good Ideas Come From*. New York: Riverhead.

Kauffman, S. 2008. *Reinventing the Sacred*. New York: Basic Books.

Kline, S., and N. Rosenberg. 1986. "An overview of innovation." In *The Positive Sum Strategy*, edited by R. Landau and N. Rosenberg, 275-305. Washington, D.C.: National Academy Press.

Kroll, H. 2015. "Efforts to implement smart specialization in practice—leading unlike horses to the water." *European Planning Studies.* DOI:10.1080/09654313.2014.1003036.

Krugman, P. 1991. "Cities in Space: Three Simple Models." NBER Working Paper 3607. Cambridge: National Bureau of Economic Research.

Krugman, P. 1995. *Development, Geography & Economic Theory*. Cambridge: MIT Press.

Martin, R. 2010. "The Roepke Lecture in Economic Geography—Rethinking regional path dependence: beyond lock-in to evolution." *Economic Geography* 86: 1-27.

Martin, R., and P. Sunley. 2006. "Path dependence and regional economic evolution." *Journal of Economic Geography* 6: 395-438.
Martin, R., and P. Sunley. 2010. "The place of path dependence in an evolutionary perspective on the economic landscape." In *Handbook of Evolutionary Economic Geography*, edited by R. Boschma and R.L. Martin, 62-92. Cheltenham: Edward Elgar.
Myrdal, G. 1957. *Economic Theory and Underdeveloped Regions*. London: Duckworth.
Nunes, S., and R. Lopes. 2015. "Firm performance, innovation modes and territorial embeddedness." *European Planning Studies* 23: 9. DOI: 10.1080/09654313.20 15.1021666.
Nystrom, G., A. Razaq, M. Strømme, L. Nyholm, and A. Mihranya. 2009. "Ultrafast, all-polymer, paper-based batteries." *Nano Letters* 9: 3635-3639.
Page, S. 2007. *The Difference*. Princeton: Princeton University Press.
Pisano, G., and R. Verganti. 2008. "Which kind of collaboration is right for you?" Harvard Business Review 86: 78-86.
Rosenstein-Rodan, P. 1943. "Problems of industrialisation of eastern and south-eastern Europe." *Economic Journal* 53: 202-211.
Schumpeter, J. 1934. *The Theory of Economic Development*. Cambridge: Harvard University Press.
Scott, A. J. 2008. *Social Economy of the Metropolis: Cognitive-Cultural Capitalism and the Global Resurgence of Cities.* Oxford: Oxford University Press.
Shirky, C. 2010. *Here Comes Everybody*. London: Penguin.
Strambach, S. 2010. "Knowledge-intensive business services." In *Platforms of Innovation*, edited by P. Cooke, C. De Laurentis, S. MacNeill, and C. Collinge. Cheltenham: Edward Elgar.
Veblen, T. 1898. "Why is economics not an evolutionary science?" *Quarterly Journal of Economics* 12: 373-397.
Vrba, E., and S. Gould. 1982. "Exaptation—a missing term in the science of form." *Paleobiology* 8:4-15.

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