Arne Isaksen · Roman Martin
Michaela Trippl *Editors*

New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons

Springer

New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons

Arne Isaksen • Roman Martin •
Michaela Trippl
Editors

New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons

Springer

Editors
Arne Isaksen
School of Business and Law
University of Agder
Grimstad, Norway

Roman Martin
School of Business, Economics and Law
University of Gothenburg
Gothenburg, Sweden

Michaela Trippl
Department of Geography and Regional Research
University of Vienna
Vienna, Austria

ISBN 978-3-319-71660-2 ISBN 978-3-319-71661-9 (eBook)
https://doi.org/10.1007/978-3-319-71661-9

Library of Congress Control Number: 2018931068

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Foreword

It is an honour and privilege to write a few words in tribute to my long-time friend and colleague, Professor Bjørn Asheim. We have known one another since the mid-1990s, when his work on industrial districts and learning regions was attracting international attention. We began to interact frequently at international conferences focused on these topics, soon embarking on a long and fruitful working partnership that persisted until I became captive to senior administration and could no longer hold up my end of the bargain.

Over these two decades, I had the pleasure (along with my co-editors Gordon Clark and Maryann Feldman) of commissioning and editing Bjørn's classic chapter on industrial districts for the *Oxford Handbook of Economic Geography* (published in 2000). Five years later, we co-authored a highly cited chapter on 'The geography of innovation' in *The Oxford Handbook of Innovation*, a piece that still continues to enjoy more than a passing interest from our peers in the world of academic publishing. In 2006, I contributed a chapter (with David Wolfe) to a collection published by Routledge on *Clusters and Regional Development*, co-edited by Bjørn, Phil Cooke, and Ron Martin. And 2013 saw the publication of the co-edited *The Creative Class Goes Global* with Bjørn, Charlotta Mellander, and Richard Florida (for Routledge).

Accepting Bjørn's invitation, I served as Professor II in the Centre for Technology, Innovation and Culture (TIK) at the University of Oslo from 2001 to 2006, visiting Oslo twice a year to teach in doctoral courses and contribute to PhD student supervision. Following Bjørn's move to Lund University, I was invited to chair the International Board of the Centre for Innovation, Regions, Clusters and the Learning Economy (CIRCLE), an intellectually vibrant—and remarkably innovative—research centre funded by the Swedish Innovation Agency VINNOVA. Bjørn and I also worked together on several comparative research projects focusing on innovation systems, clusters, creativity, and economic development, including two major collaborative projects funded by Canada's SSHRC (with David Wolfe, 2001–2005 and 2006–2012) and a project funded by the European Science Foundation and Norwegian Research Council (with Arne Isaksen, 2004–2006). Finally, we have each served as external examiners ('opponents' to use the Nordic term) for one another's PhD students on multiple occasions.

I recite this rather lengthy list of past interactions to document the depth and dimensions of this unusual academic partnership. Looking back on this history, I find myself asking the question: what aspects of Bjørn's qualities as a scholar and colleague might explain this long and productive collaboration? These encounters over such an extended period have given me a unique and privileged perspective on the work and ways of one of our field's most important and influential scholars and teachers.

First, the work.

As an economics and management graduate of the Norwegian School of Economics and Business Administration, followed by a PhD under the supervision of Torsten Hägerstrand at Lund, Bjørn's intellectual pedigree is impeccable. His early grounding in both the fundamentals of mainstream economics and heterodox social sciences (known at one time as 'the only Marxist geographer in Norway'),[1] combined with a deep interest in economic behaviour in the real world of business, has blessed him with the inclination and ability to bridge the chasm between theory and practice throughout his scholarly career. He has maintained a keen interest in the institutions of capitalism that shape the ways in which economic actors interact with one another—including competition, cooperation, buyer–supplier relations, localized learning, and collaborative innovation. He has always started from a rigorous theoretical framework, which he has tested against empirical phenomena, revised, and applied once again to the study of economic change in real places. He realized, early on, how much one can learn by making comparisons across different economic regions and nations. He developed an early fascination with social well-being and economic policy aimed at promoting the prosperity of regions and their inhabitants, a theme that has run through his work consistently from the beginning of his career. He and his former students (many of whom are contributors to this volume) have elaborated a conceptual framework for helping us understand how economic knowledge can be classified into different types, each with its own distinctive geography, and how regional advantage is actively constructed rather than passively inherited. These contributions have had a profound impact on the fields of economic geography, innovation systems, industrial economics, and more.

Second, the ways.

Bjørn is a committed, conscientious, and considerate colleague. He is passionate about his work and the broader intellectual mission of which it forms a part. He is committed to building intellectual communities, both locally—he has left a lasting imprint in Oslo and Lund—and globally—he has masterminded and led many research projects that have spanned multiple countries and organizations. He has consistently been a builder, resisting the all-too-common temptation to enhance his reputation by criticizing the work of others. He can always be counted on to deliver, making good on his commitments, even if he has to fly half way around the world to

[1]The quote comes from p. 502 of Haraldsen, T. and Isaksen, A. (2009) Regional resources, global knowledge networks, and innovation policy: special issue in honour of Bjørn Asheim, *European Planning Studies* 17:4, 501–04.

do so. By the same token, he expects others to be equally conscientious and committed, holding them to a very high standard. He has been—and continues to be—a model advisor, successfully shepherding many a PhD student through their studies, co-authoring publications with them to help launch them on their own independent careers, providing advice for years after they have completed their graduate work, and taking pride in their accomplishments—almost as much as he does for those of his own children.

Those who have had the pleasure of Bjørn's company over a meal will also know of his deep interest in food and his encyclopedic knowledge of the grape-based beverages that always accompany it—including their unique histories, their distinctive geographies, and the particular artisanal practices that have produced them. Having been the fortunate recipient of his hospitality on many occasions, I can vouch for his incredible generosity of spirit.

The quality of the contributors assembled here to pay tribute to Bjørn Asheim is itself an eloquent testament to the very high regard in which he is held by his peers around the world. This volume is a fitting tribute to a colleague whose scholarly contributions and intellectual and personal generosity continue to have such a major impact on his field, both in the Nordic countries and well beyond.

University of Toronto
Toronto, ON
Canada

Meric S. Gertler

Contents

New Avenues for Regional Innovation Systems and Policy

Arne Isaksen, Roman Martin, and Michaela Trippl

Abstract

Regional innovation systems (RISs) have received increasing interest from researchers and policy makers over the past three decades. The interest is driven partly by advances in theoretical analyses, partly by empirical studies of well-functioning, successful regional economies, partly by the growing interest in innovation as a source of competitive advantage, and partly by the need for new policies to stimulate job growth and lower regional inequalities. This chapter presents the approach of the book to further improve regional innovation studies. The chapter introduces the content of the three parts of the book; (i) theoretical advances on RIS research, (ii) empirical cases of RIS development, and (iii) discussion of regional innovation policy approaches. The chapter summarises main results from existing work within these three parts and points to how the book explores new avenues for research on RISs and sheds light on issues that have thus far received little attention.

Keywords

Regional innovation systems · Regional development · Regional policy

A. Isaksen (✉)
School of Business and Law, University of Agder, Grimstad, Norway
e-mail: arne.isaksen@uia.no

R. Martin
University of Gothenburg, Gothenburg, Sweden
e-mail: roman.martin@handels.gu.se

M. Trippl
Department of Geography and Regional Research, University of Vienna, Vienna, Austria
e-mail: michaela.trippl@univie.ac.at

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_1

There is a consensus in both academic and policy circles that learning and innovation are pivotal for ensuring competitiveness and prosperity of regional economies. Since its development in the 1990s through the pioneering work by Cooke (1992), Asheim and Isaksen (1997) and Braczyk et al. (1998), the regional innovation system (RIS) approach has received enormous attention from economic geographers, innovation scholars and policy actors alike. The notion shares similarities with other innovation system concepts and territorial innovation models and has become a key approach for explaining the uneven geographical distribution of innovation activities in space. After 25 years of conceptual and empirical research on RIS, the concept is well-established and still figures prominently in academic debates on regional innovation and growth. The RIS approach has also proven to be a powerful concept for informing policy. It has become a widely used framework for designing, implementing and evaluating regional innovation strategies and interventions in many parts of the world. The RIS notion has provided essential foundations for what has become an indisputable element in current discussions, that is the superiority of place-based, customized and broad based innovation system policies over spatially-blind and narrow R&D policies.

Conceptualisations of RISs vary but most protagonists agree that these systems—like other innovation system variants—are made up of three core elements, that is, actors, networks and institutions. Key actors of RIS are the firms and industries located in the region as well as organisations that belong to the knowledge and support infrastructure such as research institutes, educational bodies and knowledge transfer agencies. Networks that facilitate knowledge flows and interactive learning between these actors are seen as eminently important for dynamic innovation activities to unfold. The 'functioning' of RIS is seen as being influenced by an institutional framework of formal rules and informal norms. A central argument in the RIS approach is that innovation does not take place in isolation, it includes interactive learning in localized innovation networks that are embedded in specific socio-cultural settings. But one should also underline that RISs are open systems in which organisations source knowledge through extra-regional production and innovation networks.

Despite advances in the understanding of regional industrial dynamic and in the formulation of efficient innovation policy, the RIS approach has also been exposed to some criticism. It is considered as a static framework, criticised for being regionally myopic, that it has become of little relevance in a globalised world economy, applied as a normative policy prescription and that it best can be used to promote innovation in already well-off regions. Thus, RIS studies have often been snapshots of the characteristics, and strengths and weaknesses, of particular well-functioning, successful, regional economies (Asheim et al. 2011a, b), while the historical development of the RISs is less reflected upon (Doloreux and Parto 2005). Critics also point to the fact that the approach is primarily concerned with the structural elements of the innovation system, demonstrated in the set-up of the knowledge and industrial sub systems and the knowledge flow between these (Uyarra 2010). The importance of actors, such as entrepreneurs in universities and firms, for innovation performance are much less considered. Furthermore, the

RIS approach has been accused to overstating regional inter-firm relations and the role of the regional knowledge infrastructure at the expense of extra-regional relations and factors (Doloreux and Parto 2005). RIS thinking assumes 'that in practice the necessary resources, capacity and levers are likely to be available at the regional level' (Uyarra and Flanagan 2016: 310). Critics also maintain that the approach has often been used in an instrumental way in fostering standardised models for best innovation practise that neglect differentiated contexts (Fløysand and Jakobsen 2010).

This book departs from the extensive literature on RIS and demonstrates that some of these critiques are overstated. However, the book's aim is not to provide a synthesis and review of the large body of existing work on RIS. Rather, the main intention and focus is on exploring new avenues for research on RIS and shedding light on the criticized aspects and issues that have thus far received less attention. It brings together leading scholars in the field as well as younger research talent who contribute in various ways to the further development of the RIS approach. The book includes a selection of interesting topics which are gathered together in three main parts: *first*, theoretical advances on RIS research, *second*, empirical cases of RIS development, and, *third*, discussion of regional innovation policy approaches.

1 Theoretical Advances

1.1 Theoretical Antecedents and Conceptual Development of the RIS Approach over the Years

The RIS notion emerged in the early 1990s and has since then been further developed through various conceptual refinements. The RIS concept is grounded in the literature on innovations systems. There are different variants of such systems, including in addition to regional also national, technological and sectoral innovation systems (Cooke 1992; Lundvall 1992; Asheim and Isaksen 1997; Carlsson and Stankiewicz 1991; Malerba 2002). The theoretical foundations of these approaches are found in models of interactive innovation, evolutionary economics and institutional schools of thought. Consequently, system approaches conceptualise innovation as outcome of non-linear, collaborative and cumulative learning processes that are shaped by formal and informal institutions at various spatial scales.

The RIS approach also shows close connections to other territorial innovation models such as innovative milieus, industrial districts, learning regions and clusters (Moulaert and Sekia 2003), which since the 1980s have sought to offer deep explanations of the uneven geography of innovation and endogenous factors and processes that shape the knowledge generation and innovation capacities of regions. These concepts build on Alfred Marshall's (1920) early ideas on the innovation-enhancing effects related with the geographical concentration of firms (as a particularly important form of localisation economies) and share a common interest in explaining how socio-institutional and cultural factors at the regional level enable or constrain localized circulation of knowledge and economic coordination.

Since its introduction more than two decades ago, various conceptual advances of the RIS notion have been made. Particularly well known is the work by Asheim and Gertler (2005) who introduced the concept of knowledge bases to contest too narrow R&D-based and high technology-oriented views on regional innovation. Knowledge bases refer to the critical knowledge needed in firms' innovation activity, and three different knowledge bases are distinguished: analytical (science based), synthetic (experience based) and symbolic (art based). The differentiated knowledge base approach has since then been continuously advanced (Asheim et al. 2011a, b, see also chapter "A Concise History of the Knowledge Base Literature: Challenging Questions for Future Research"), leading to a significant further development of the RIS literature (see also the Special Issue of Economic Geography 93(5) published in 2017).

RISs may not only vary in terms of their underlying knowledge bases. Over the past decade, various other typologies have been developed to explain the variegated nature of regional innovation and to capture the sources of differences between RIS (see also chapter "Variety of Regional Innovation Systems and Their Institutional Characteristics"). Well known in this regard are the typologies by Cooke (2004) and Asheim and Coenen (2005) [building on Asheim and Isaksen (1997, 2002)], who argue that RIS vary in terms of their territorial embeddedness, Cooke's (2004) work on institutional and entrepreneurial RIS, which reflect the varieties of the capitalism dichotomy of coordinated and liberal market economies and Tödtling and Trippl's (2005) work, which zooms in on innovation problems and system deficiencies in various region types.

Early conceptualisations of RIS have focused on regions situated within national borders of Western countries. The last years have seen attempts to apply the RIS concept to other spatial contexts, leading to a further refinement of the notion. Analytical efforts have been made to understanding the particularities of RIS in post-socialist countries and regions (Radosevic 2002; Blazek and Zizalova 2010), developing countries (Asheim and Vang 2006) and cross-border areas (Trippl 2010; Lundquist and Trippl 2013).

1.2 Recent Conceptual Advances and Future Research Challenges

Recent years have seen new developments within the RIS literature. Scholars have sought to forge a more dynamic perspective of RIS, according particular attention to conditions and factors that drive new regional path development and RIS transformation (Tödtling and Trippl 2013; Isaksen and Trippl 2016). Conceptual analyses have begun to investigate how RISs influence the nature and direction of regional economic change and new growth paths. This work connects the RIS approach with evolutionary theories on path dependence to examine how RISs promote or hinder economic diversification, thereby moving beyond overly micro-focused and firm-focused models of evolutionary economic geography, advocating a broader, more comprehensive view on regional industrial path development.

Recent conceptual work suggests that different types of RIS show varying capacities to nurture new path development. This is attributed to differences in the degree of 'thickness' and diversity of the organisational structures of RIS. These features are seen to shape the capacity of RIS to grow new paths by means of endogenous assets and to influence their potential to develop new paths by attracting, absorbing and anchoring non-local knowledge and resources. The question of exogenous sources of path development has only recently been put on the research agenda (Trippl et al. 2017) and requires deeper enquiries and a stronger integration of the RIS concept with other conceptual frameworks, most notably with the global production and innovation networks approaches.

Another key challenge for future research is to complement the focus on organisational RIS structures by more detailed conceptual and empirical analyses of institutional factors. Arguably, the RIS literature is replete with claims that institutions matter, but further elaborations and deeper insights are often missing (see also chapter "Variety of Regional Innovation Systems and Their Institutional Characteristics"). Recent attempts to revisit the notion of institutional thickness (Zukauskaite et al. 2017) could serve as a useful steppingstone in this regard.

There are also endeavours underway that go beyond the question of how existing RIS structures and configurations shape new path development, seeking to provide conceptual insights into how RIS themselves are changing to provide preconditions for or 'respond' to the rise of new regional industrial path development. Little is still known about how RISs and new industrial paths co-evolve. Explaining transformative dynamics at the system level and coming to grips with the mechanisms that underpin RIS changes are key areas for current and future conceptual research on RIS.

The chapters brought together in Part I of this volume address several of the research challenges outlined above. One chapter reflects on how evolutionary insights could lead to a better understanding of knowledge base dynamics and regional diversification. Three other chapters pay particular attention to the institutional dimension of RISs, shedding light on the distinctive institutional frameworks that characterise different RIS types, elaborating on the socio-cultural geographies of innovation and offering new insights into how institutional entrepreneurs and navigators institutionalise new practices and activities within RISs.

1.3 Chapters in Part I

In chapter "A Concise History of the Knowledge Base Literature: Challenging Questions for Future Research" Ron Boschma takes stock of the literature on differentiated knowledge bases (DKB) and ventures out to develop an agenda for future research. The author argues that early work on DKB (dubbed as DKB 1.0) has highlighted the varying nature of learning and innovation between activities that are shaped by their underlying knowledge base. He critically reviews the claims that link knowledge bases to RIS and other spatial phenomena. Boschma highlights how more recent work (dubbed as DKB 2.0) has devoted attention to combinatorial knowledge dynamics and incorporated evolutionary concepts such as variety and relatedness to investigate which combinations within and between knowledge bases fuel learning and innovation of firms, industries and regions. Boschma outlines elements of a future research agenda inspired by evolutionary thinking to further push our understanding of the link between knowledge base combinations and regional diversification and how pre-existing regional structures enable shifts in knowledge bases over time. Other promising lines of research identified in this chapter are to analyse the nexus between various proximity forms and knowledge bases and to examine the role of institutions in knowledge base dynamics.

Chapter "Variety of Regional Innovation Systems and Their Institutional Characteristics" by Elena Zukauskaite seeks to put the institutional dimension of RISs on a more solid footing. The author contributes to a further conceptual development of existing RIS typologies by elaborating on the distinctive institutional frameworks of various RIS types and their particular institutional bottlenecks. Three main causes of institutional bottlenecks are identified and discussed, that is, lack of or poorly developed institutions, inappropriate institutions, and contradicting/ poorly aligned institutions. The institutional perspective advocated in this chapter holds a strong potential to advance the RIS approach. It makes regulative, normative and cognitive institutional elements of the RIS framework more explicit and prominent and provides a set of interesting insights into institutional sources of variety of RIS in a systematic way.

In chapter "The Sociocultural Basis for Innovation" Jon P. Knudsen zooms in on the sociocultural basis for innovation. The author identifies several gaps in our understanding of the nexus between institutional configurations and the variegated nature of economic and innovative activities. Knudsen argues amongst other things that our ability to *describe* the relationship between institutional set-ups and economic behaviour is far better developed than our ability to *explain* this relationship. Building on the varieties of capitalism approach, the author critically reflects on models of hegemonic regional innovation logics and contends that Norway hosts both a liberal and a coordinated market economy model within its borders. The chapter concludes that more multi-paradigmatic research is required to come to terms with the socio-cultural geographies of innovation.

Chapter "Institutional Agency and Path Creation" by Markku Sotarauta and Nina Suvinen scrutinise the role of institutional path creation and related agency in local economic renewal. The authors discuss how actors navigate through multi-layered and conflicting sets of institutions when striving for changes at the local level. They advance the idea that institutional influences shaping path creation are similar to tides, that is, the rise and fall of belief systems due to the attraction of models in global circulation, top-down institutions and local needs. Four phases of institutional tides and related meta-strategies are identified, including institutional opportunism (working against the institutional tide), institutional protection (adapting to a turning institutional tide), institutional expansion (exploiting the innovation hype) and institutional offensive. The conceptual arguments are illustrated by empirical findings from the Finnish city of Tampere and its transformation from an industrial to a knowledge city. This chapter contributes to advancing the RIS literature by encouraging a focus on how new practices, activities, norms or beliefs become institutionalised in innovation systems and by providing deeper explanations of the complex nature of institutional change.

2 Empirical Investigations of RIS

The regional innovation system approach is the basis for a number of empirical studies of regional innovation performance and processes. Doloreux and Porto Gomez (2017) find that most articles (about 85%) in the RIS field include empirical investigations. They identified nearly 300 empirical articles on RISs in leading scholarly journals between 1998 and 2015.

Empirical studies require practical definitions of RISs. The question is then what constitutes a RIS, such as its geographical extent, the number of firms and knowledge organisations present in a region, the amount of interactive learning and so on. Early studies tended to be myopic in laying too much weight on collaboration and knowledge flow among regional actors only. RISs are however open in the sense that firms and knowledge organisations exchange information and knowledge, and enter into research and innovation projects, with actors from many places, also those found at distant locations. The innovation dynamics of European regions, for example, depend much on national institutional frameworks (according to Carrincazeaux and Gaschet 2015). While regional conditions are important for the innovation performance of different RISs, the performance depends also to a considerable degree on their wider spatial environment and the governing macroeconomic conditions (Fritsch and Graf 2011). In general, firms and organisations regard relevance and quality of knowledge as more important than proximity to knowledge sources. This fact 'raises the question of how to delineate innovation systems and how to draw boundaries' (Asheim et al. 2016: 47).

Even if actors in RISs participate in distant knowledge and innovation networks, well-developed RISs are characterised by the local accumulation of knowledge exchange, interactive learning and innovation activity in specific industries. RISs can be described as 'local nodes of interactive learning in global networks' to build on a phrase put forward by Gertler and Levitte (2005) to portray the geography of knowledge flow in Canadian biotechnology firms. Geographical proximity stimulates trust based relations and cooperation between persons and organisations in innovation processes, which is particularly important when key knowledge is 'sticky' with important tacit elements. Important is also the fact that regions often represent important levels of governance with the capability to develop or adapt innovation policy and systems to specific regional industries and characteristics (Asheim et al. 2016). It is also the case that firms in different types of RISs engage to different degree in global innovation networks (see chapter "Regional Innovation Systems and Global Flows of Knowledge"). Based on a study of ICT firms in China, India and three European countries (Estonia, Norway and Sweden) Chaminade and Plechero (2015: 228) find that ‘firms in regions with RISs that are neither too thick nor too thin engage more in GINs’ (global innovation networks). Firms in organisationally and institutionally thick RIS find innovation partners nearby or within the nation and have thus less need for global sourcing of knowledge. The engagement in GINs seems to compensate for weaknesses in RISs. Firms in thin RISs therefore often need to acquire extra-regional knowledge but may lack absorptive capacity to engage in GINs (op. cit.). Subsidiaries of multinational corporations in thin RIS are however involved in GINs.

The findings of Chaminade and Plechero (2015) illustrate that the question of what constitutes a RIS is difficult to answer in general. The political, institutional and industrial contexts that ‘enclose’ RISs differ very much. The concept was to a large extent inspired by and developed from experiences in fairly small European countries (e.g. Cooke 1992; Asheim and Coenen 2005), and in particular by examples from regions with strong endogenous innovation capabilities. RIS is increasingly a study object in quite other contexts. Nearly two thirds of all empirical RIS articles between 1998 and 2015 focus on European regions (according to Doloreux and Porto Gomez 2017). Regions in China and in other Asian countries are, however, more and more often studied by use of the RIS approach (op. cit.).

Asheim et al. (2016) question whether RISs exist in emerging and developing countries in particular. However, the RIS concept can be used as ‘a focusing device’ (to follow how Lundvall (2007) argues that the notion of national innovation systems should be understood). The RIS concept then helps to organise and focus empirical studies and the concept may be ‘useful to identify the systemic deficiencies that hamper innovation’ (Asheim et al. 2016: 51).

2.1 Varieties of RIS in Different National Contexts

Empirical studies of regional innovation systems demonstrate that the constitution and the working of RISs vary between different contexts, such as countries (see chapter “Regional Innovation Systems and Transformative Dynamics: Transitions in Coal Regions in Australia and Germany”). One starting point to characterise observable differences in RISs is the distinction between Institutional Regional Innovation Systems (IRIS) and Entrepreneurial Regional Innovation System (ERIS). The first one is, according to Cooke (2004), the traditional Western European model to stimulate innovation activities. Most innovation-promoting actors, such as universities, research laboratories, technology transfer organisations, incubators and investors, are public. ERIS, on the other hand, have strong private or marketised elements, including a rich private infrastructure of innovation support. ERIS are in particular directed to stimulate small business and scalable start-up entrepreneurship (Yoon et al. 2015). Cooke (2001) also refers to ERIS as ‘new economy innovation systems and ‘private innovation systems’. The model is particularly found in ‘new economy’, R&D based industries in the USA. It must however be added that large federal budgets fuel the commercialisation and innovation process through the funding of basic research sectors. Thus, regions in which ERIS develop ‘are dependent on public research funds for basic scientific investigation, but exploitation and commercialization of scientific findings is looked after by venture capitalists, corporate venturing arms of larger firms’, (Cooke 2001: 962) and a number of other private investors. Cooke (2001) hypothesised that the dominance of IRIS may explain the (at that time) relatively poor European innovation rate compared to the more dynamic market-led innovation system of the USA.

Yoon et al. (2015) regard the dichotomy between IRIS and ERIS as far too simplified when applied on the East Asian case. These authors distinguish between mature entrepreneurial RIS and still-evolving entrepreneurial RIS. The first one is the original ERIS developed by Cooke, while still-evolving ERIS is a specific East-Asian phenomenon of supporting large corporate entrepreneurship with significant contributions of government institutions. Individual entrepreneurs also ‘heavily depend on the government-run investment institutions to receive financial support on their start-up activities’ (Yoon et al. 2015: 85). Start-ups are mainly spin-offs from government research institutes and national champions. Government has, however, not actively participated in the commercialisation processes, which is seen as a shortcoming as long as private investors such as venture capital are weak in many East Asian RIS. East-Asian still-evolving ERIS include public support to large corporate entrepreneurship processes and spinoffs, but the last ones experience problems in getting financial support for commercialisation.

While the concepts of IRIS and ERIS capture some empirical contrasts between regional innovation systems in Western Europe, the USA and East Asia, these are less relevant to other parts of the world, such as developing countries and regions with a ‘thinner’ institutional framework. One characteristic of some peripheral regions is a fairly well-developed public R&D sector and a regional industry that is less capable of utilising the research based knowledge. The Valencia region in Spain, for example, has supported biotechnology research activity in public universities and research organisations. Todt et al. (2007) regard this as a necessary but not sufficient condition for the development of a biotechnology industry in Valencia. The policy has been guided by the vision of linear innovation and more or less automatic commercialisation of research results and industrial development. This has however led to few results, in fact ‘there hardly exist any biotechnology industry in the region’ (Todt et al. 2007: 70), due to a weak application oriented activity in the R&D sector and few relations with the regional industry. Valencian researchers engage in global epistemic communities which lead to the fact that locally produced knowledge flow in tightly linked networks of researchers, R&D-teams and firms throughout the world. The knowledge is hardly accessible by local firms with low absorptive capacity for scientific knowledge. Thus, peripheral regions in industrialised countries and the global periphery often lack well-developed RISs due to few innovative firms, and in many places also few higher education institutions, research organisations, and consequently little local knowledge exchange (see chapter “Mapping Inventors’ Networks to Trace Knowledge Flows Among EU Regions”). The RIS literature therefore recommends peripheral regions and countries to bring in external knowledge to trigger innovation activities in different ways (Schiller 2011; Trippl et al. 2017).

Technological spillover through foreign direct investments is considered as one main way to the upgrading of industries in less developed countries. This strategy has, however, in many cases included the transfer of low cost manufacturing which leads to only small improvements in the innovation capability of local companies (Yang 2016). A study of innovation activity in domestic and foreign owned firms in the electronics industry in Pearl River Delta in China in 2008 indicated no catch-up process on the part of the domestic firms (Schiller 2011). The study rather provided evidence for a growing capability gap between the two groups of firms. Domestic firms received few external, technological inputs, and few domestic firms pursued an active innovation strategy partly due to limited managerial and financial resources. Consequently, the internal orientation of domestic firms restrained inflow or external knowledge and close linkages between foreign firms and their parent companies made these less concerned with the regional innovation system (Schiller 2011).

Such experiences have led China to focus more on strategies to raise endogenous innovation capabilities (Yang 2016). These include to develop RISs, which however are combined with the building of capacities by local actors to couple critical regional assets and the needs and priorities of transnational corporations, and with national innovation strategies to develop some strategic emerging industries. Based on this policy development, Yang (2016) argues that RISs are conceptualised (and materialise) differently in China and western countries. Chinese 'RIS are state-led and designated by the national, provincial and municipal levels' (op. cit. p. 332). RIS in western countries are seen to be shaped by light-handed government intervention and the results of a more bottom-up and socially embedded process. This argument is in line with Yoon et al. (2015) who contend that most RISs in East Asia were led by governments, in contrast to more spontaneous development of RISs that prevails in western countries.

2.2 Chapters in Part II

Part two of the book contributes with new approaches and empirical investigations to the contemporary RIS literature. While RIS research investigates a whole range of stakeholders involved in innovation activity, a particular focus is on firms and knowledge organisations. Martin Gjelsvik and Michael Trippl study in chapter "Financial Organizations: An Overlooked Element in Regional Innovation Systems" how a differentiated set of financial organizations, including banks, venture capital and seed capital, contribute to economic renewal and new path development in four Norwegian regions. The authors find that banks primarily support path extensions (the continuation of an existing industrial path) and path upgrading (transformation of established paths into new directions) and to some degree path importation (when established industries are transplanted to regions) and branching (new paths grow out of existing industries and capabilities). Venture capital has evolved from risk taking entities financing start-ups into private equity funds primarily engaging in buy-outs and restructuring of existing industries. Seed capital to fund start-ups is scarce; and has become even scarcer after the financial crisis.

The early literature on RIS has been criticized for emphasizing the role of the region as locus for interactive learning and knowledge exchange. Even though the importance of extra-regional knowledge is widely acknowledged, there has been only little emphasis on the particular role and the nature of global knowledge flows. Roman Martin, Heidi Wiig Aslesen, Markus Grillitsch and Sverre Herstad focus in chapter "Regional Innovation Systems and Global Flows of Knowledge" on the global dimension of RIS and discuss how firms can tap into global flows of knowledge. The chapter examines how firms in the new media industry in southern Sweden and in the Oslo Region in Norway acquire knowledge globally. This industry covers a range of activities related to the generation of media content and the development and use of media technology, and is seen to rely on symbolic and synthetic knowledge. The authors find that such firms actively use a variety of mechanisms to source knowledge globally. Informal, low-cost mechanisms, in particular virtual communities and online platforms, temporary professional gatherings, and personally embedded networks, are used much more frequently than formal, high-cost mechanisms, and they are clearly important. Even small and medium sized enterprises in symbolic industries as new media are often deeply involved in global knowledge sourcing activities.

In chapter "Knowledge Bases and Relatedness: A Study of Labour Mobility in Norwegian Regions" Rune Fitjar and Bram Timmermans dig into knowledge flows on the individual level, i.e. through mobility of educated workers. Their focus is on the knowledge bases of different industries characterised by the educational background of their workers and on the skill relatedness across different industries. The authors analyse the relatedness across industries in Norwegian regions, where pairs of related industries have a comparative large mutual mobility of educated workers. The analysis shows how industries with similar and different knowledge bases are related. Combinatorial knowledge base industries are central in many regions. Industries dominated by the synthetic knowledge base are also often central, even in regions which are not necessarily specialised in this knowledge base. In the Norwegian context, analytical and symbolic industries tend to be small, even in regions with relatively high shares of workers in these knowledge bases. This suggests that such knowledge is often applied in larger synthetic or combinatorial knowledge base industries.

Chapter "Mapping Inventors' Networks to Trace Knowledge Flows Among EU Regions" by Belussi, De Noni and Orsi also deals with flows of knowledge. The chapter investigates the geographic extension of collaborative invention processes, measured by co-invented patents, in EU (plus Norway and Switzerland). The chapter demonstrates a long-lasting, skewed patenting distribution with a highly concentrated core of innovative regions along so-called "blue banana", which starts in Finland and Sweden, descending along Germany, Switzerland, south east of France, and North of Italy. In addition, high patent activity is found in the southern part of England, some central regions of France, and the areas belonging to south of

France and Catalonia. The absolute number of co-invention of patents is also highest in these central areas of Europe. But interestingly enough, a very different picture emerges when the share of co-invented patents on the total number of patents is measured. It is the peripheral regions of EU, where patenting activity is weak, that demonstrate the highest number of co-invented patents measured on total patents. The authors hypothesize that (actors in) peripheral regions engage in extra-regional invention activity to compensate for weak regional technological capacity.

Chapter "Regional Innovation Systems and Transformative Dynamics: Transitions in Coal Regions in Australia and Germany" by Lars Coenen, Stephanie Campbell and John Wiseman analyses the processes that drive transformative change in the Ruhr and Latrobe Valley coal regions and discusses theoretical lessons and relevant RIS policy implications. The chapter contributes to a recent approach in RIS research to gain a better understanding of the processes and mechanisms that drive regional transformative changes. The chapter illustrates three interrelated challenges for the RIS approach and policies when addressing transformative change. A first challenge concerns problems in changing the direction of key regional development pathways due to lock-in. Secondly, the two coal regions suffer from weak regional capabilities in entrepreneurship. Thirdly, climate awareness and policy have put pressure to reduce coal mining and burning which has amplified the risk for distrust and antagonism between different actors in the regional innovation system. This again makes it difficult for the actors in the innovation system to collaborate, to coordinate collective action and to engage in reciprocal learning processes. The authors argue that such challenges may call for a very different policy approach than to address systemic problems of the regional innovation system, that is usually advocated. Rather, an approach is needed that aims to change institutions and involve new actors. An experimental approach is proposed, in which innovation projects act as pop-up innovation systems that explore, examine, experiment, test and evaluate the feasibility of new technologies and institutional arrangements, whether they are workable solutions to given problems and can create sufficient demand.

3 RIS Policy

Part III of this book deals with regional innovation systems and policy. RIS theory is inherently based on the idea that public interventions are legitimate and even necessary for RIS to function effectively (Laranja et al. 2008). Supporting processes and mechanisms that stimulate innovation in a region is an integral part of the RIS approach, and in recent years, RIS has developed into a popular policy framework to design, implement, and evaluate innovation policies in many OECD countries (Asheim et al. 2011a, b; Uyarra and Flanagan 2013; Coenen et al. 2017). A central argument in the literature is that innovation policy should always be customized and place-based, taking into account the specificities of regions and their respective innovation potentials and capabilities (Isaksen 2001; Nauwelaers and Wintjes 2003; Tödtling and Trippl 2005; Boschma 2009; Asheim et al. 2011a, b).

A prominent typology to design such context-sensitive policies has been proposed by Tödtling and Trippl (2005), who identify typical challenges faced by different types of regions: peripheral regions that are characterized by organisational thinness, old industrial regions suffering from technological lock-in and over-specialisation, and metropolitan regions that experience fragmentation in terms of lacking connectivity and interactions between RIS actors. These challenges are often referred to as structural innovation system failures, based on a typology by Klein Woolthuis et al. (2005). This can include (1) infrastructural failures that relate to lacking physical and knowledge infrastructure; (2) institutional failures that relate to the absence or shortcomings of formal or informal institutions; (3) network failures that relate either to overly dense networks (strong network failure) or to too weak systemic interaction (weak network failure); and (4) capability failures that relate to the lack of appropriate resources and competences in the (regional) innovation system. Innovation policy has the purpose to tackle these various system deficiencies, whereas the RIS literature regards the region as the preferred level to design and implement such policies. This calls for policy strategies that are customised to the specific organisational and institutional structures and knowledge bases of a RIS (Tödtling and Trippl 2005; Asheim et al. 2011a, b; Martin and Trippl 2014).

Partly triggered by advances in EEG, regional economic evolution has recently become an important new subject in RIS research (see also chapters "Innovation Policies for Regional Structural Change: Combining Actor-Based and System-Based Strategies", "Entrepreneurship Policies and the Development of Regional Innovation Systems: Theory, Policy and Practice" and "Policies for New Path Development: The Case of Oxfordshire"). The RIS literature has a certain tradition of analysing structural change, for example in the work on old industrial regions (e.g. Grabher 1993; Kaufmann and Tödtling 2000). However, attempts to systematically study regional development over time have been made only recently, and policy approaches that address regional economic evolution are currently entering the research agenda. These approaches focus not only on firms and their innovation activities, but on a wide range of actors, institutions, and policy actions in a region (Strambach 2010; Tödtling and Trippl 2013; Asheim et al. 2016; Isaksen and Trippl 2016). This is often discussed in connection to the notion 'new regional industrial path development', understood as path renewal and new path creation (Isaksen 2015; Isaksen and Trippl 2016). The first one is defined as diversification of existing industries into new but related ones (Boschma and Frenken 2011), whereas the latter covers the rise of industries that are entirely new to the region. While path renewal places most emphasis on policy-supported intensification of knowledge creation and re-combination between firms, new path creation puts main emphasis on science-driven modes of innovation, for which the organisational support structure and knowledge infrastructure of the RIS is vital. Subject to the organisational and institutional endowment, the degree of related variety and the openness towards external knowledge sources, different RIS require different policies to stimulate new path development. This implies that the role of policy is mostly to identify, facilitate and strengthen combinatorial knowledge dynamics between firms and the knowledge infrastructure of the RIS (Strambach and Klement 2013; Asheim et al. 2016; Isaksen and Trippl 2016; Martin and Martin 2017).

The RIS approach has recently also gained attention as framework for addressing innovation-based regional development under the label of smart specialisation (see chapter "The Heroic Assumptions of Smart Specialisation: A Sympathetic Critique of Regional Innovation Policy"). Smart specialisation has become a prominent policy tool in the context of EU cohesion policy (Foray 2015). It refers to the capacity of regions to discover new opportunity domains based on local resources and competences, and has particularly been designed as policy strategy for less developed regions (Trippl et al. 2015). Smart specialisation strategies encourage regions to identify development opportunities and induce structural change. They target the integration of existing specialisations with the development of new specialisations, thus the diversification into areas related to existing regional strongholds. For this reason, some RIS scholars argue that 'smart diversification' would be a more appropriate expression for this approach (Asheim et al. 2016). Smart specialisation aims at building capabilities in certain fields in which a region has potential to develop a unique selling proposition and competitive advantage in the near future (Foray 2015). Such a new development path is typically initiated by an entrepreneurial vision, also termed entrepreneurial discovery. From a RIS perspective, entrepreneurial discovery can be understood as a result of interactions and knowledge exchange between RIS actors (Asheim et al. 2016). Decisive is thereby a strategic interaction between private and public actors in the RIS, including researchers, policy makers and entrepreneurs. An active involvement of researchers in the policy marking process is also advocated in chapter "Regional Innovation System as a Framework for the Co-Generation of Policy: An Action Research Approach", whereas the role of entrepreneurship for regional evolution is taken up in chapter "Entrepreneurship Policies and the Development of Regional Innovation Systems: Theory, Policy and Practice".

3.1 Chapters in Part III

The five chapters gathered in the third part of this book address several of the new research avenues on RIS and policy outlined above.

In chapter "Innovation Policies for Regional Structural Change: Combining Actor-Based and System-Based Strategies," Arne Isaksen, Franz Tödtling and Michaela Trippl deal with innovation policies for regional structural change. The authors offer a conceptual analysis of conditions and influences that enable and constrain new path development, and discuss the contours of policy strategies that are suitable for promoting new path development in different types of RIS. As regards policy strategies, a distinction is made between system-based and actor-based policies. System-based policies aim to improve the functioning of the RIS by targeting system failures, whereas actor-based strategies support entrepreneurs and innovation projects by firms and other stakeholders. The authors argue that these strategies will have only a limited effect when applied alone, and need to be combined to effectively support structural change in different types of RIS.

In chapter "Entrepreneurship Policies and the Development of Regional Innovation Systems: Theory, Policy and Practice," Helen Lawton Smith discusses entrepreneurship policies in light of RIS research. The author argues that the literature tends to overlook the important role of agency for regional economic change, and addresses this by focussing on entrepreneurship as driving force behind regional evolution. The chapter provides an appraisal and synthesis of the RIS approach in relation to entrepreneurship policies, and highlights a number of research areas where theoretical, empirical and policy-based topics are currently underdeveloped. Three major themes are discussed. The first is the agency of entrepreneurs and entrepreneurship policies, where Lawton Smith argues that entrepreneurship is a localised event. The second is the rationale for entrepreneurship policies, where regional innovation policies should be enabling, empowering and sustaining entrepreneurship, enterprise and innovation. The third relates to the nature of entrepreneurship policies, where the chapter stresses the need for change and continuous adaption of entrepreneurship policies over time. The chapter proposes entrepreneurship as promising avenue for future RIS research.

In chapter "Regional Innovation System as a Framework for the Co-generation of Policy: An Action Research Approach," James Karlsen and Miren Larrea argue in favour of an action research approach where researchers and policy makers co-generate regional innovation policy. The authors argue that action research is well equipped for the regional development challenges that RIS researchers are often asked to contribute to. They analyse the actual implementation of such an approach in the Basque Country, and draw three theoretical lessons. The first relates to positionality, where researchers and policy makers take positions as insiders or outsiders, and where researchers become active participants influencing and being influenced by the policy process. The second refers to the challenge of emergence, where action research challenges the conventional form of interaction between academia and policy, which usually follows a linear mode of knowledge production. The third refers to the need to make the different ideological positions of researcher and policy makers explicit, to avoid potential problems related to the co-generative nature of action research. The chapter argues in favour of a careful but active involvement of RIS researchers into the policy making process.

In chapter "The Heroic Assumptions of Smart Specialisation: A Sympathetic Critique of Regional Innovation Policy," Pedro Marques and Kevin Morgan provide a sympathetic critique of current regional innovation policy approaches and challenge some of the implicit assumptions of smart specialisation. In line with smart specialisation, EU cohesion policy aims at reducing regional disparities by placing great emphasis on innovation and competitiveness in all regions, rather than investments into infrastructure. The authors argue that despite its ambition and potential benefits, smart specialisation is likely to be hindered by low institutional capacity in precisely those regions that need the most help, namely in less developed RIS. The authors argue that this policy is crippled by several implicit 'heroic assumptions', which will limit its effectiveness and impact on reducing regional disparities. The chapter draws on concrete examples from Greece and Romania to discuss the realities of policy making in peripheral regions of Europe.

In chapter "Policies for New Path Development: The Case of Oxfordshire," Helen Lawton Smith, Michaela Trippl, Rupert Waters and Elena Zukauskaite discuss policy strategies for new path development. The authors reflect on the possibility to incorporate policy into the EEG debate on new path development, which traditionally has placed less emphasis on the role of the state. In order to understand new path development, the authors argue for a multi-scalar perspective on policy, for which RIS provides a suitable framework. The case of Oxfordshire in the UK is used to explore the link between public policy and new path development. The authors highlight three main findings. First, path development is not confined to local processes, as spill-over effects and outcomes are multi-scalar. Second, the time dimension needs to be emphasised, as regional economies and policy targets may change over time. Third, the national state is significant in shaping regional policies, not only, but in particular in the case of UK. The chapter argues for a stronger consideration of multi scalar policy in research on new path development and RIS.

Some of the critical remarks on the RIS approach raised in the introduction of this chapter are dealt with throughout the book. Several chapters, and in particular chapters "A Concise History of the Knowledge Base Literature: Challenging Questions for Future Research" and "Regional Innovation Systems and Transformative Dynamics: Transitions in Coal Regions in Australia and Germany," have demonstrated how evolutionary approaches contribute to the conceptualization and empirical investigation of transformative changes of RIS. This adds a deeper understanding of the historically-shaped factors and conditions that influence the development of regional industries and the configuration of the RIS. The work on the importance of the institutional dimension of RIS and of institutional entrepreneurs in chapters "Variety of Regional Innovation Systems and Their Institutional Characteristics," "The Sociocultural Basis for Innovation" and "Institutional Agency and Path Creation" increases our knowledge of the sources of variety of regional economies and on the complex nature of RIS changes. Chapters "Regional Innovation Systems and Global Flows of Knowledge" and "Mapping Inventors' Networks to Trace Knowledge Flows Among EU Regions" underline the importance of the interplay of local and global knowledge flows and links, also in peripheral regions, and the role that RISs play in accessing and anchoring global knowledge. The role of policy actors and entrepreneurs for regional industrial change is discussed in chapters "Regional Innovation Systems and Transformative Dynamics: Transitions in Coal Regions in Australia and Germany" and "Innovation Policies for Regional Structural Change: Combining Actor-Based and System-Based Strategies," while the importance of adapting innovation policy to the specific characteristics of different regional economies is discussed in several chapters in Part III.

Overall, the book sheds light on some of the criticized aspects that have thus far received little attention, and thereby contributes to theoretical advances, empirical understanding and improved policy relevance of the RIS approach. Furthermore, and maybe more importantly, it outlines new avenues for future research and provides ideas for how to further deepen and broaden our knowledge on regional innovation systems and policy.

References

Asheim, B. T., & Coenen, L. (2005). Knowledge bases and regional innovation systems: Comparing Nordic clusters. *Research Policy, 34*(8), 1173–1190.

Asheim, B., & Gertler, M. S. (2005). The geography of innovation: Regional innovation systems. In J. Fagerberg, D. C. Mowery, & R. R. Nelson (Eds.), *The Oxford Handbook of Innovation* (pp. 291–317). Oxford: Oxford University Press.

Asheim, B., & Isaksen, A. (1997). Location, agglomeration and innovation: Towards regional innovation systems in Norway? *European Planning Studies, 5*(3), 299–330.

Asheim, B., & Isaksen, A. (2002). Regional innovation systems: The integration of local 'sticky' and global 'ubiquitous' knowledge. *Journal of Technology Transfer, 27*, 77–86.

Asheim, B., & Vang, J. (2006). Regional innovation systems in Asian countries: A new way of exploiting the benefits of transnational corporations. *Innovation, 8*(1–2), 27–44.

Asheim, B., Boschma, R., & Cooke, P. (2011a). Constructing regional advantage: Platform policies on related variety and differentiated knowledge bases. *Regional Studies, 45*(7), 893–904.

Asheim, B. T., Lawton Smith, H., & Oughton, C. (2011b). Regional innovation systems: Theory, empirics and policy. *Regional Studies, 45*(7), 875–891.

Asheim, B. T., Grillitsch, M., & Trippl, M. (2016). Regional innovation systems: Past – present – future. In R. C. Shearmur & D. Doloreux (Eds.), *Handbook of the geographies of innovation* (pp. 45–62). Cheltenham: Edward Elgar.

Blazek, J., & Zizalova, P. (2010). The biotechnology industry in the Prague metropolitan region: A cluster within a fragmented innovation system? *Environment and Planning C: Government and Policy, 28*(5), 887–904.

Boschma, R. (2009). *Evolutionary economic geography and its implications for regional innovation policy*. http://econ.geo.uu.nl/boschma/OECD.pdf

Boschma, R. A., & Frenken, K. (2011). Technological relatedness and regional branching. In H. Bathelt, M. Feldman, & D. F. Kogler (Eds.), *Beyond territory: Dynamic geographies of knowledge creation and innovation* (pp. 64–81). Abingdon: Routledge.

Braczyk, H. J., Cooke, P., & Heidenreich, M. (1998). *Regional innovation systems. The role of governance in a globalised world*. London: Routledge.

Carlsson, B., & Stankiewicz, R. (1991). On the nature, function and composition of technological systems. *Journal of Evolutionary Economics, 1*(2), 93–118.

Carrincazeaux, C., & Gaschet, F. (2015). Regional innovation systems and economic performance: Between regions and nations. *European Planning Studies, 23*(2), 262–291.

Coenen, L., Asheim, B., Bugge, M., & Herstad, S. J. (2017). Advancing regional innovation systems: What does evolutionary economic geography bring to the policy table? *Environment and Planning C, 35*(4), 600–620.

Chaminade, C., & Plechero, M. (2015). Do regions make a difference? Regional innovation systems and global innovation networks in the ICT industry. *European Planning Studies*, 23(2), 215–237.

Cooke, P. (1992). Regional innovation systems: Competitive regulations in the new Europe. *Geoforum, 23*(3), 365–382.

Cooke, P. (2001). Regional innovation systems, clusters and the knowledge economy. *Industrial and Corporate Change, 10*(4), 945–974.

Cooke, P. (2004). Introduction. Regional innovation systems – An evolutionary approach. In P. Cooke, M. Heidenreich, & H.-J. Braczyk (Eds.), *Regional innovation systems. The role of governance in a globalised world* (2nd ed., pp. 1–18). London: Routledge.

Doloreux, D., & Parto, S. (2005). Regional innovation systems: Current discourse and unresolved issues. *Technology in Society, 27*, 133–153.

Doloreux, D., & Porto Gomez, I. (2017). A review of (almost) 20 years of regional innovation systems research. *European Planning Studies, 25*(3), 371–387.

Fløysand, A., & Jakobsen, S.-E. (2010). The complexity of innovation: A relational turn. *Progress in Human Geography, 35*(3), 328–344.

Foray, D. (2015). *Smart specialisation – Opportunities and challenges for regional innovation policy*. London: Routledge.

Fritsch, M., & Graf, H. (2011). How sub-national conditions affect regional innovation systems: The case of the two Germanys. *Papers in Regional Science, 90*(2), 331–354.

Gertler, M. S., & Levitte, Y. M. (2005). Local nodes in global networks: The geography of knowledge flows in biotechnology innovation. *Industry and Innovation, 12*(4), 487–507.

Grabher, G. (1993). The weakness of strong ties: The lock-in of regional development in the Ruhr area. In G. Grabher (Ed.), *The embedded firm. On the socioeconomics of industrial networks* (pp. 255–277). London: Routledge.

Isaksen, A. (2001). Building regional innovation systems: Is endogenous industrial development possible in the global economy? *Canadian Journal of Regional Science, XXIV*(1), 101–120.

Isaksen, A. (2015). Industrial development in thin regions: Trapped in path extension? *Journal of Economic Geography, 15*(3), 585–600.

Isaksen, A., & Trippl, M. (2016). Path development in different regional innovation systems: A conceptual analysis. In M. D. Parrilli, R. D. Fitjar, & A. Rodríguez-Pose (Eds.), *Innovation drivers and regional innovation strategies* (pp. 66–84). New York: Routledge.

Kaufmann, A., & Tödtling, F. (2000). Systems of innovation in traditional industrial regions: The case of Styria in a comparative perspective. *Regional Studies, 34*(1), 29–40.

Klein Woolthuis, R., Lankhuizen, M., & Gilsing, V. A. (2005). A system failure framework for innovation policy design. *Technovation, 25*(6), 609–619.

Laranja, M., Uyarra, E., & Flanagan, K. (2008). Policies for science, technology and innovation: Translating rationales into regional policies in a multi-level setting. *Research Policy, 37*(7), 823–835.

Lundquist, K.-J., & Trippl, M. (2013). Distance, proximity and types of cross-border innovation systems: A conceptual analysis. *Regional Studies, 47*(3), 450–460.

Lundvall, B.-Å. (1992). *National systems of innovation: Towards a theory of innovation and interactive learning*. London: Pinter.

Lundvall, B.-Å. (2007). National innovation systems-analytical concept and development tool. *Industry and Innovation, 14*(1), 95–119.

Malerba, F. (2002). Sectoral systems of innovation and production. *Research Policy, 31*(2), 247–264.

Marshall, A. (1920). *Principles of economics: An introductory volume*. London: Macmillan.

Martin, H., & Martin, R. (2017). Policy capacities for new regional industrial path development – The case of new media and biogas in southern Sweden. *Environment and Planning C: Politics and Space, 35*(3), 518–536.

Martin, R., & Trippl, M. (2014). System failures, knowledge bases and regional innovation policies. *disP – The Planning Review, 50*(1), 24–32.

Moulaert, F., & Sekia, F. (2003). Territorial innovation models: A critical survey. *Regional Studies, 37*(3), 289–302.

Nauwelaers, C., & Wintjes, R. (2003). Towards a new paradigm for innovation policy? In B. T. Asheim, A. Isaksen, C. Nauwelaers, & F. Tödtling (Eds.), *Regional innovation policy for small-medium enterprises* (pp. 193–220). Cheltenham: Edward Elgar.

Radosevic, S. (2002). Regional innovation systems in Central and Eastern Europe: Determinants, organizers and alignments. *The Journal of Technology Transfer, 27*(1), 87–96.

Schiller, D. (2011). The role of foreign and domestic firms in regional innovation systems of latecomer countries: Empirical evidence from the electronics industry in the Pearl River Delta. *Erdkunde, 65*(1), 25–42.
Strambach, S. (2010). Path dependence and path plasticity: The co-evolution of institutions and innovation—the German customized business software industry. In R. Boschma & R. Martin (Eds.), *The handbook of evolutionary economic geography* (pp. 406–431). Northampton: Edward Elgar.
Strambach, S., & Klement, B. (2013). Exploring plasticity in the development path of the automotive industry in Baden-Württemberg: The role of combinatorial knowledge dynamics. *Zeitschrift für Wirtschaftspolitik, 57*(1–2), 67–82.
Todt, O., Gutiérrez-Gracia, A., de Lucio, I. F., & Castro-Martiínez, E. (2007). The regional dimension ofinnovation and the globalization of science: The case of biotechnology in a peripheral region of the European Union. *R&D Management, 37*(1), 65–74.
Tödtling, F., & Trippl, M. (2005). One size fits all? Towards a differentiated regional innovation policy approach. *Research Policy, 34*(8), 1203–1219.
Tödtling, F., & Trippl, M. (2013). Transformation of regional innovation systems. From old legacies to new development paths. In P. Cooke (Ed.), *Re-framing regional development. Evolution, innovation and transition* (pp. 297–317). London: Routledge.
Trippl, M. (2010). Developing cross-border regional innovation systems: Key factors and challenges. *Tijdschrift voor Economische en Sociale Geografie, 101*(2), 150–160.
Trippl, M., Asheim, B., & Miörner, J. (2015). Identification of regions with less-developed research and innovation systems. In M. D. Parrilli, R. D. Fitjar, & A. Rodriguez-Pose (Eds.), *Innovation drivers and regional innovation strategies* (pp. 23–44). London: Routledge.
Trippl, M., Grillitsch, M., & Isaksen, A. (2017). Exogenous sources of regional industrial change: Attraction and absorption of non-local knowledge for new path development. *Progress in Human Geography*. https://doi.org/10.1177/0309132517700982
Uyarra, E. (2010). What is evolutionary about 'regional systems of innovation'? Implications for regional policy. *Journal of Evolutionary Economics, 20*(1), 115–137.
Uyarra, E., & Flanagan, K. (2013). Reframing regional innovation systems. Evolution, complexity and public policy. In P. Cooke (Ed.), *Re-framing regional development. Evolution, innovation and transition* (pp. 146–163). London: Routledge.
Uyarra, E., & Flanagan, K. (2016). Revisiting the role of policy in regional innovation systems. In R. Shearmur, C. Carrincazeaux, & D. Doloreux (Eds.), *Handbook on the geographies of innovation* (pp. 309–321). Cheltenham: Edward Elgar.
Yang, C. (2016). Evolution of regional innovation systems in China: Insights from emerging indigenous innovation in Shenzhen. In R. Shearmur, C. Carrincazeaux, & D. Doloreux (Eds.), *Handbook on the geographies of innovation* (pp. 322–333). Cheltenham: Edward Elgar.
Yoon, H., Yun, S., Lee, S., & Phillips, F. (2015). Entrepreneurship in East Asian regional innovation systems: Role of social capital. *Technological Forecasting and Social Change, 100*, 83–95.
Zukauskaite, E., Trippl, M., & Plechero, M. (2017). Institutional thickness revisited. *Economic Geography, 93*(4), 325–345.

Part I

Theoretical Advances on Regional Innovation Systems Research

A Concise History of the Knowledge Base Literature: Challenging Questions for Future Research

Ron Boschma

Abstract

This chapter aims to sketch a short history of the differentiated knowledge base (DKB) literature that has been initiated and pioneered by Bjorn Asheim. In its formative years, the DKB approach described three knowledge bases and explored the nature of knowledge sourcing and its geographical extent within each knowledge base. We identify seven claims proposed by DKB scholars concerning the geography of knowledge bases. Lately, DKB 1.0 has been challenged on several grounds. In recent years, a second generation of DKB literature, dubbed as DKB 2.0, has emerged, becoming more tightly connected to the evolutionary approach in economic geography. DKB 2.0 takes a combinatorial approach to innovation and links it to evolutionary concepts like related variety and proximity. Its prime focus is on identifying combinations between knowledge bases and, to an increasing extent, combinations within knowledge bases, and assessing whether these combinations enhance innovative performance. As DKB 2.0 is still in an embryonic stage, we identify promising avenues for future research, inspired by evolutionary thinking.

Keywords

Knowledge base · Evolutionary economic geography · Related variety · Proximity · New growth paths

R. Boschma (✉)
Department of Human Geography and Planning, Utrecht University, TC Utrecht, The Netherlands

UiS Business School, University of Stavanger, Stavanger, Norway
e-mail: r.a.boschma@uu.nl

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_2

1 Introduction

The differentiated knowledge base (DKB) literature has been introduced in the field of economic geography in the mid 2000s by Bjorn Asheim and colleagues at Lund University (Asheim and Gertler 2005). It had its roots in the Innovation Studies literature, and more in particular the literature on Regional Innovation Systems that drew attention to the collective nature of learning and innovation in regional contexts and their institutional underpinnings (Cooke 2001; Asheim and Coenen 2005, 2006). In its formative years, the DKB literature shed light on the nature of knowledge sharing and its geographical extent which were claimed to vary between analytical, synthetic and symbolic knowledge bases (Manniche 2012; Martin 2012). We argue that the DKB literature has started to shift more recently to a more dynamic and combinational approach, linking it partly to evolutionary concepts like related variety and proximity (Asheim et al. 2011; Mattes 2012; Strambach and Klement 2012; Grillitsch and Trippl 2014; Grillitsch et al. 2016; Ingstrup et al. 2017; Klement and Strambach 2017).

The objective of this paper is to sketch a concise history of the DKB literature, to outline and review critically the main contributions so far, and to set out research challenges. We explore how the literature on Evolutionary Economic Geography (EEG) (Boschma and Frenken 2006; Martin and Sunley 2006) has contributed to the further development of the DKB view in economic geography more recently. We make explicit how the EEG literature on variety, relatedness and proximity, has become more tightly linked to the DKB literature (Asheim et al. 2011). We argue there is potential in the DKB approach to explore combinatory potentials of knowledge bases, their impact on regional development, and their dynamics over time.

The paper is structured as follows. Section 2 discusses the formative years of the DKB approach (dubbed as DKB 1.0) and outlines its strengths and weaknesses. The weaknesses may partly be attributed to the lack of a combinatorial and dynamic approach to DKB. Section 3 briefly introduces concepts like related variety and proximity developed in EEG as these have become applied more and more in the most recent literature on DKB to addresses these weaknesses. Section 4 discusses shortly the main features of an emerging new generation in the DKB literature (termed DKB 2.0), and it explores where and how DKB 2.0 and EEG may fruitfully meet in future research. Section 5 draws conclusions.

2 DKB 1.0

Bjorn Asheim has been a key initiator and promoter of the DKB concept. In the 2000s, Bjorn formed a group of talented, young scholars at CIRCLE of Lund University (Lars Coenen, Markus Grillitsch, Hogni Hansen, Roman Martin, Jerker Moodysson, Jan Vang, Elena Zukauskaite) who all worked on the DKB concept. The knowledge base concept was first developed and applied in a Nordic research project starting in 2001, coordinated by Lars Coenen (Asheim et al. 2017). From the mid

2000s onwards, the first pioneering publications (Asheim and Gertler 2005; Asheim and Coenen 2005, 2006) emerged to underline that processes of learning and innovation differ between industries because their underlying knowledge base differs. The DKB approach was presented as a critical response to conceptualizations of knowledge that had been grasped in terms of high-tech (R&D-intensive) versus low-tech (R&D-extensive) (OECD 1996), tacit versus codified knowledge (Gertler 2003), and Science and Technology (STI) modes of learning and innovation versus Doing, Using and Interacting (DUI) (Lundvall and Johnson 1994). The DKB literature proposed a distributed view on knowledge bases that had the ambition to go beyond and transcend these conventional distinctions (Jensen et al. 2007; Manniche 2012).

A key source of inspiration was Laestadius (1998) who associated categories of analytical and synthetic knowledge to the Artistotelian notions of 'episteme' and 'teche' (Asheim and Gertler 2005). The DKB literature developed a broader vision of knowledge bases and added a third category of symbolic knowledge (Asheim et al. 2007), linking it to the notion of 'art' (Martin 2012). According to Asheim and Coenen (2005), the proposed knowledge bases (also known as the SAS taxonomy) had some resemblance with the seminal taxonomy proposed by Pavitt (1984) in which industries with synthetic knowledge bases were associated with Pavitt's categories of supplier-dominated and production-intensive industries, while industries with analytical knowledge corresponded closely to Pavitt's science-based industries.

From the beginning, the ambition of the DKB approach was to link the knowledge bases to geography. At this experimental stage, all kinds of claims were developed, many of them ambitious. DKB studies tended to follow a comparative case study approach to provide empirical evidence for some of these claims. For instance, Asheim and Coenen (2005) linked five clusters in the Nordic countries to a particular knowledge base, Coenen et al. (2006) compared the (analytical science-based) pharmaceutical bioregion of Scania and the (more synthetic knowledge based) agro-food bioregion in Saskatoon in Canada, and Martin and Moodysson (2013) made a comparison between (science-based) life sciences, the (engineering-based) food industry and the (arts-based) new media in the Scania region in Sweden. Another study typical of a DKB approach (Martin 2013) described how innovation networks in European regions differed between analytical, synthetic and symbolic industries, in terms of their structure and geographical configuration, the type of actors holding a strategic position, and the type of relations between actors.

The first claim in the DKB literature aimed to link the various knowledge bases to different types of regional innovation systems (Asheim 1998; Cooke 1998). In their seminal contribution, Asheim and Coenen (2005) proposed that the innovation process in industries is shaped by their underlying specific knowledge base. In 'a territorially embedded regional innovation system', the innovation process would build primarily on synthetic knowledge and geographically localised inter-firm learning processes. This would stand in contrast to 'a regionalised national innovation system' in which few links exist between local industry and the scientific knowledge infrastructure, and innovation is mainly based on analytic knowledge. This is different from 'a networked regional innovation system' in which advanced technologies are developed that often combine analytic and synthetic knowledge.

A second and more testable set of claims in the DKB literature concerned the structure of knowledge networks, in particular the nature of knowledge sourcing and its geographical extent within each knowledge base (Coenen et al. 2006; Moodysson 2008; Martin and Moodysson 2011, 2013; Broekel and Boschma 2011; Plum and Hassink 2011; Aslesen and Freel 2012; Martin 2012, 2013; Grillitsch and Trippl 2014; Herstad et al. 2014; van Tuijl and Carvalho 2014; van Tuijl et al. 2016). Studies showed that the importance of geographical proximity for learning and innovation differs between knowledge bases (Martin and Moodysson 2013): it turned out to be especially important for symbolic and, to a lesser extent, synthetic knowledge, while analytical knowledge creation relied the least on local sources of knowledge. In analytical industries, linkages with organizations providing research, higher education and skilled labour were crucial, while innovation in synthetic industries was more driven by collaboration with suppliers and customers, often on a national scale. In symbolic industries, non-formalised knowledge sources tended to be more important, and therefore, the local milieu was considered crucial. As Martin (2013) put it, "... networks in analytical industries are not much constrained by geographical distance: knowledge is exchanged in a highly selective manner between research units and scientists in globally configured epistemic communities. Synthetic industries source knowledge within nationally or regionally configured networks between suppliers and customers, and within communities of practice. Symbolic industries rely on knowledge that is culturally defined and highly context specific, resulting in localized networks that are temporary and flexible in nature" (p. 1418).

A third claim of the DKB literature concerns the geographical distribution of the different knowledge bases and, indirectly, the tendency of knowledge bases to concentrate geographically. Linking occupation data to knowledge bases, Martin (2012) analyzed whether Swedish regions differ in the way they are specialized in a particular knowledge base. The study showed that regions differed with respect to specialization in the three knowledge bases. Few regions were dominated by more than one knowledge base, and specialization in synthetic knowledge was found in many regions, in contrast to the other knowledge bases.

This is closely connected to another DKB claim that industries drawing on different knowledge bases would show different degrees of spatial concentration. The DKB literature has been quite explicit on this matter, as in Asheim and Gertler (2005): "... the innovation process in industries based on analytical forms of knowledge is no less spatially concentrated than those forms of innovative economic activity based on synthetic types of knowledge. Indeed, if anything, there is compelling evidence to suggest that the former may exhibit an even higher degree of geographical concentration than the latter ..." (p. 298). This was considered a remarkable outcome given the greater prominence of codified knowledge in the innovation process in analytical industries that was supposed to travel more easily over large geographical distances. To Asheim and Gertler (2005), the highly uneven geography of innovation in analytically based industries could be attributed to highly localized knowledge spillovers, a specialized labor market offering very specific job career opportunities available only in just a few places, and the crucial importance of locations with a high quality of life. This tendency of analytical knowledge to concentrate geographically seemed to be inconsistent with the earlier finding that geographical distance is of less importance in analytical industries. To reconcile both findings, the DKB view argued there are only a few of these innovation hubs in analytical industries worldwide that are strongly connected through knowledge exchange, especially through the mobility of scientists.

A fourth claim of the DKB literature, closely connected to the previous claims, is that knowledge bases concentrate in particular regions. Asheim et al. (2007) argued that creative industries drawing on symbolic knowledge would rely heavily on local buzz, and for that reason, are more inclined to thrive in large diversified cities. Local buzz is considered of crucial importance because of the one-off project-nature of production and collaboration, and the reliance on knowing people with the right skills and talents in creative industries. Large cities with a great diversity of knowledge and people would offer such an attractive setting. This is different from industries based on synthetic knowledge in which face-to-face communication, focusing on technical problem solving, bi-lateral knowledge exchange and customized solutions, rather than buzz, is considered of major importance. According to Asheim et al. (2007), synthetic knowledge-based industries could thrive in any agglomeration or cluster, irrespective of the urban-rural dimension, as long as there is spatial proximity to users and suppliers. For industries oriented on analytical knowledge, exchange of scientific knowledge, rather than buzz, was considered crucial, which could be organized through epistemic communities at a global scale. This required locations with excellent global connections and local proximity to leading universities and research organizations.

However, it is fair to say that the DKB literature has not investigated systematically the preferences of knowledge bases for certain locations on the urban-rural dimension. With respect to locational preferences, Asheim and Hansen (2009) made some ambitious claims connecting the DKB view to the creative class concept (Florida 2002). They argued that the residential locational preferences of the creative class in terms of Florida's distinction between people climate and business climate would differ between the three knowledge bases. Symbolic knowledge would be more closely connected to people's climate, while synthetic knowledge would be more focused on business climate, and analytical knowledge base would be somewhat in between these two positions. To build up their case, they referred to other studies that indicated that engineers tend to live in suburbs because they would be more conservative and family oriented, while artists and designers would have a stronger preference for city centres where the buzz is, and scientists would often live and work in larger city regions because of job opportunities (business climate) but also for reasons related to the people's climate. Linking occupational categories to each of the three knowledge bases in Sweden, Asheim and Hansen (2009) concluded that "... in regions where synthetic knowledge bases dominate, business climate scores tend to be higher that people climate scores, and that a people climate tends to be of greater importance than a business climate in regions that are dominated by the analytical and, especially, the symbolic knowledge bases" (p. 439).

Particularly relevant for our discussion later is that the DKB literature has also made some strong (and often rather bold) claims about the role of path dependency in the different knowledge bases. Past economic structures would have different impacts on the evolution of the three types of knowledge bases and what types of innovations (radical versus incremental innovations) were likely to predominate. Asheim and Hansen (2009) hypothesised that regions more reliant on synthetic knowledge would display a more path-dependent evolution of their regional economies, and would be less inclined to depart from established trajectories. Asheim and Coenen (2005) argued that regions relying on synthetic knowledge bases would mainly produce incremental innovations because the innovation process is primarily based on the application of existing knowledge or new combinations of knowledge. Because of that, such regions would normally not have an ability to change technological trajectories, which posed a serious threat to their long-term development. According to Asheim and Hansen (2009), this would stand in contrast to the analytical and symbolic knowledge bases which were expected to rely less on established structures in regions. These two knowledge bases were more attracted to diversity in urban environments, and therefore more responsive to develop radical innovations, especially in industries based on analytical knowledge (Asheim and Coenen 2006). However, such statements have never been put to any systematic empirical tests. Moreover, it raises many questions. For instance, would this imply that radical innovations can only be made within a synthetic knowledge base by linking to other knowledge bases? We discuss this further in Sect. 4 where we discuss the rise of a combinatorial approach in the DKB literature.

Another claim of the DKB literature from its start is that the institutional tissue underpinning the different knowledge bases is different. The DKB literature has connected to the national and regional innovation system literature (Freeman 1987; Cooke 1998, 2001), the varieties of capitalism (Hall and Soskice 2001) and the national business system literatures (Whitley 1999) to discuss what types of institutions are characteristic for each knowledge base (Asheim and Coenen 2006; Zukauskaite 2013; Zukauskaite and Moodysson 2016). So-called coordinated market economies would be characterized by regulatory and institutional frameworks at the national and regional level that favour close user-producer interactions embedded in network governance structures that are more common in industries that draw primarily from synthetic knowledge bases (Asheim and Coenen 2006). This strong emphasis on interactive learning processes would promote the geographical concentration of firms in these industries and requires a common social and institutional context (Asheim and Gertler 2005). In contrast, liberal market economies would focus less on strong, long-term systemic relationships. They provided an institutional framework that favours more industries with an analytical knowledge base in which university-industry links, scientific labour mobility, academic entrepreneurs, incubators, short-term research projects and venture capital are encouraged that promote innovations (Asheim and Coenen 2006). In this institutional framework, the DKB literature has been less explicit on the specific features of the institutional texture that would support industries drawing on symbolic knowledge. In both liberal and coordinated market economies, such project-oriented industries could thrive, but the nature of projects would differ, as the institutional setting in coordinated economies would facilitate more long-term projects and a higher stability in team membership.

Martin et al. (2011) explored the implications for regional innovation policy when a DKB approach is applied (Martin and Trippl 2014). They have done so by looking at regional policy support programs targeting three industries in the Scania region in Sweden. Data collection was based on structured interviews with firm representatives and in-depth interviews with policy representatives. One of the conclusions was that policies aimed at regional networking between academia and industry would be more appropriate for analytical industries (but with not too much of an intra-regional focus), but to a lesser extent for synthetic and symbolic industries. They concluded that policy initiatives should be fine-tuned to the needs of firms that result from being active in different knowledge bases.

In sum, the first generation of the DKB literature shed light on the different nature of learning and innovation between activities that are strongly shaped by their underlying knowledge base. From its very start, the DKB view connected to geographical issues and developed a number of (sometimes rather ambitious) claims linking types of knowledge bases to all kinds of spatial phenomena like: (1) types of regional innovation systems; (2) the geographical extent of knowledge sourcing; (3) the degree of spatial concentration; (4) preferences for particular regions; (5) the role of path dependence in the evolution of regions; (6) institutional underpinning at national and regional scale; and (7) the nature of regional innovation policy.

Despite valuable insights, the DKB literature has also met critique (e.g. Manniche et al. 2016). The most fundamental one comes down to a tendency to ascribe knowledge bases to certain professions (e.g. Asheim and Hansen 2009), entire industries (e.g. Martin 2012) and particular regions (e.g. Asheim and Coenen 2005). This has been shown as highly problematic as activities in practice draw upon more than one knowledge base. The proponents of the DKB view acknowledged this problem from the very start, as, for instance, in Asheim and Gertler (2005): "… it makes sense to conceive of individual industrial sectors being arrayed along a continuum between purely analytical and synthetic industries, with many—such as the automotive industry—occupying an intermediate position along this spectrum" (p. 47). Having said that, their main interest remained focused, till very recently, on whether entities (occupations, industries, regions) are dominated by a certain knowledge base from which, subsequently, all previously mentioned claims are derived. We refer to this as DKB 1.0.

A second main critique on DKB 1.0 is its static approach to knowledge bases, and its poor understanding of the role of history. Broadly speaking, DKB 1.0 aimed to map the configuration of knowledge networks, being contingent on the dominant knowledge base in place (Manniche et al. 2016), and focused on knowledge bases as a given resource tied to specific industries and regions (Ingstrup et al. 2017). A third main critique is that some claims set out earlier were descriptive rather than explanatory (Manniche et al. 2016), and some claims (especially the most ambitious ones) have not been tested empirically in a systematic way (Herstad et al. 2014; Grillitsch et al. 2016).

In Sect. 4, we will argue DKB 1.0 is very different from recent developments in the DKB literature that take a combinatorial approach and incorporate evolutionary concepts like variety, relatedness and related variety (e.g. Asheim et al. 2011; Fitjar and Timmermans 2017). There is a clear shift of attention to a combinatorial approach in which organizations, industries and regions rely on combinations of different knowledge bases, and that is also what makes them more likely to prosper (Strambach and Klement 2012; Grillitsch and Trippl 2014; Tödtling and Grillitsch 2015; Grillitsch et al. 2016; Ingstrup et al. 2017). There is also a tendency to employ a wider range of mixed methods, including quantitative studies that allow for more systemic testing, as compared to the DKB 1.0 literature that clearly favored a comparative case study approach. We refer to this second generation of DKB studies as DKB 2.0. Here, we clearly depart from Manniche et al. (2016) that refers to the emergence stage of the DKB view as 'Combinatorial Knowledge Base typology 1.0'. In these formative days, however, we argue that only lip service was paid to the relevance of combinations of knowledge bases, and that this was not investigated empirically.

As DKB 2.0 incorporates concepts of Evolutionary Economic Geography (EEG) to develop a more dynamic and combinatorial approach, we shortly introduce the EEG literature on variety, related variety and relatedness in Sect. 3. We will use that as input to outline some features of the emerging DKB 2.0 and to explore further links with EEG for future research.

3 EEG and Relatedness

This section focuses briefly on notions of related variety and relatedness developed in EEG (Boschma and Frenken 2006). These notions basically explained how processes of knowledge creation and diffusion are subject to path dependency (Martin and Sunley 2006). These processes are perceived to be imperfect, as actors have no full access nor a perfect ability to respond to external information. Therefore, actors tend to search locally in cognitive terms (cognitive proximity) and geographical terms (geographical proximity), and are also more likely to exchange knowledge and collaborate in R&D with other actors in these same two dimensions. This makes that actors are more likely to be successful in terms of diversification when they build on related capabilities within the same organization (Breschi et al. 2003), when they are located in regions with related externalities (Frenken et al. 2007), and when they share related capabilities with agents in their networks (Boschma and Frenken 2010).

This connects closely to the Schumpeterian view of innovations as emerging from new combinations (Fleming 2001). This implies that variety within regions conditions the scope for innovation, following Jacobs (1969). EEG argues that many technologies, products, industries and professions cannot be meaningfully combined. New combinations often stem from related activities that share similar capabilities. On the one hand, relatedness refers to similarities between activities in the cognitive dimension, and thus opportunities for interactive learning. On the other hand, relatedness includes complementarities, that is, the need to bring together different activities and combine them to produce new knowledge and innovations (Breschi et al. 2003; Broekel and Brachert 2015).

Frenken et al. (2007) has argued that variety must be related in regions to produce knowledge spillovers and to generate combinations across activities. Frenken and Boschma (2007) applied the relatedness concept to regional diversification and branching. Hidalgo et al. (2007) constructed a product space in which related products are positioned in a network, and found strong and robust evidence that countries develop new export products related to existing products. Neffke et al. (2011) found evidence of capabilities providing opportunities for diversification at the regional scale: regions were more likely to diversify into new industries related to existing local industries. Since then, a large body of studies has confirmed the importance of regional branching (see for an overview, Boschma 2017) in the case of new industries (e.g. Essleztbichler 2015), new technologies (e.g. Rigby 2015; Tanner 2016) and new professions (e.g. Muneepeerakul et al. 2013).

4 DKB 2.0 and EEG

This section explores where EEG meets the most recent DKB literature. We argue that the DKB literature has evolved recently in the direction of an evolutionary approach to knowledge bases, as it has addressed, at least to some extent, some of the critiques formulated in Sect. 2. We outline the essence of what we dub DKB 2.0, and we discuss how DKB 2.0 could be strengthened further, and in which directions promising research avenues lay ahead.

First of all, what DKB 1.0 has in common with the EEG literature on relatedness is a search for commonalities and differences between activities in terms of knowledge and innovation. The relatedness literature is interested in exploring which pieces of knowledge can and which cannot be effectively combined, as captured by concepts like relatedness, cognitive proximity and related variety (Frenken et al. 2007; Quatraro 2010, 2016). It focuses on which pieces of knowledge provide learning opportunities (similarity) and complementary resources (complementarity) (Breschi et al. 2003), and assesses which combinations of knowledge enhance spillovers, regional growth and regional diversification (Boschma 2017). This focus is different from DKB 1.0 that had an interest to describe more in detail what features of knowledge are characteristic for each knowledge base, and which industries could be grouped together in that respect. Despite the fact that DKB 1.0 drew attention to cross-sectoral knowledge linkages (e.g. Coenen et al. 2006), DKB 1.0 did not investigate whether industries that belonged to the same knowledge base provided similar and complementary resources for learning and innovation. In that sense, DKB 1.0 was a-combinatorial, as it was not primarily interested to examine combinations within each knowledge base or between knowledge bases, and their economic effects. In contrast, DKB 2.0 is combinatorial, as its prime focus is on combinations between knowledge bases and, to an increasing extent, combinations within knowledge bases, and whether these provide learning opportunities and enhance the innovative performance of firms, industries and regions.

The most simple combinatory approach in DKB 2.0 has been the identification of mixtures of the three knowledge bases leading to novel combinations and innovation (Moodysson et al. 2008; Manniche 2012; Hoyssa 2014). A classic example is the evolution of the automobile industry which has been traditionally been dominated by synthetic knowledge (engineering) and symbolic knowledge (design of cars), but is shifting increasingly to analytical knowledge, as illustrated by computer-led mechanization (robotics) and the development of the self-driving car (sensor-based safety systems, communication systems, high-resolution mapping). This latter development has led to the belief that Silicon Valley might take over and dominate the future car industry. A typical study following such a combinatory approach is Martin and Trippl (2015) who observed that the ICT cluster in Scania in Sweden was built on the combination of analytical, synthetic and symbolic knowledge bases in the region. Grillitsch et al. (2016) did the first systematic study to explore which combinations of knowledge bases within the firm and the region are most conducive to innovative performance of firms. One of the main conclusions was that firms tended to benefit most from locations with a mixture of all three knowledge bases.

However, DKB 2.0 provides a much richer exploration of more possible knowledge combinations than just between the three pre-defined knowledge bases (Hoyssa 2014). Here, there is a clear link to be made with the evolutionary literature on variety, relatedness and related variety (Martin 2012) that could take up a range of questions like: does related variety within each knowledge base have an impact on knowledge creation and innovation, can unrelated variety be associated with combinations between knowledge bases, does related variety transcend boundaries of knowledge bases, and when the latter happens, would that have a positive economic effect, as it would enable crossovers between related activities in different knowledge bases? This could also bring a further sharpening of the recombinatory approach (Strambach and Klement 2012) in which cumulative knowledge is often simply equated with knowledge creation within one knowledge base while recombinatory knowledge is associated with combinations of different knowledge bases. This opens up a whole new research agenda for DKB 2.0 to determine how much related and unrelated variety exists within each knowledge base, which combinations are made between both related and unrelated pieces of knowledge within and between knowledge bases, and what the economic effects of such combinations would be in terms of innovation, employment and productivity.

A number of recent papers are starting to address these questions. Grillitsch et al. (2016) did a study on the impact of variety within each knowledge base on the innovative performance of firms and regions. Their findings indicate that variety within each knowledge base was only positive for analytical knowledge, but not for synthetic and symbolic knowledge. Other papers are starting to explore the importance and economic significance of (related) variety within one knowledge base. In doing so, they deepen our understanding of the particular composition of knowledge in a knowledge base which was clearly not the focus of DKB 1.0. Doing a study on the symbolic knowledge base, Lazzeretti et al. (2017) investigated the whole sector of all creative industries, and found that related variety within creative industries had a positive effect on employment growth. Klement and Strambach (2017) took an explicit combinatory approach on the symbolic knowledge base to examine the role of the various variety dimensions for innovation in one particular creative industry (the music sector) in urban regions in North America and Europe. Based on information of users taken from social media platforms, they found that neither variety nor specialization in music types in an urban region will promote innovation in the music industry. What mattered for the combination of new symbolic knowledge (but not so much for its creation) was a certain degree of relatedness between combinable elements locally available in this knowledge base, as proxied by ranges of related music genres.

Instead of looking at (related) variety within one knowledge base, Fitjar and Timmermans (2017) explored the extent to which related variety crosses boundaries between the three knowledge bases. Their study on Norway is an important one, as it shows that industries are related to other industries in regions both within the same KB and across different KB, They did not, however, assess the economic effects of relatedness within and across KB. Sedita et al. (2017) demonstrated in a recent study on Italy that the positive effect of related variety on employment growth is stronger in regions with a large share of synthetic and symbolic (but not analytical) KB industries. In addition, they found an interaction effect between related variety and the share of symbolic KB industries, suggesting that symbolic industries in particular are dependent on the regional presence of related industries.

What is still missing in the DKB 2.0 literature here is an explicit focus on regional diversification. A combined approach on (related) variety and knowledge bases will provide new insights to the new path development literature. Fitjar and Timmermans (2017) has been the first to develop hypotheses in this direction but did not (yet) test for those. As they put it, "regions with relatedness ties mainly across industries with the same knowledge base could still suffer from lock-in and limited opportunities for new path development, while other regions with less relatedness can nonetheless manage to link industries with different knowledge bases. Conversely, … the region does not necessarily benefit from having a balanced mix of different knowledge bases if these are not related" (Fitjar and Timmermans 2017, p. 17). Following this line of thought, one could think of assessing potentials of regions to develop new paths alongside the two dimensions of relatedness and KB, comparing regions in terms of: (1) related variety within the same KB; (2) related variety across KB; (3) unrelated variety within the same KB; (4) unrelated variety across KB.

Second, where DKB 2.0 and the evolutionary approach come together is a shared research interest in dynamic processes of change and transformation. As mentioned before, DKB 1.0 was static, as its main focus was on the configuration of knowledge networks, being contingent on the knowledge base in place (Manniche et al. 2016). As explained in Sect. 2, DKB 1.0 had a very poor understanding of the role of history and path dependence. DKB 2.0 is clearly challenging this static view of DKB 1.0 and its focus on knowledge bases as a given resource tied to specific industries and regions (Ingstrup et al. 2017).

Broadly speaking, this dynamic combinatorial perspective in DKB 2.0 has been taken on board in two types of studies so far. The first type of studies focuses on innovation projects or innovation events (Strambach and Klement 2012; Manniche et al. 2016; Davids and Frenken 2017). For instance, Moodysson et al. (2008) analyzed innovation projects in the Medicon Valley life-science cluster in Sweden and showed that these projects consisted of mixtures of analytical and synthetic modes of knowledge creation, but that different stages of innovation also required a different dominant knowledge base, leading to dynamics in the knowledge network relations. The second type studies builds on the cluster life cycle literature (Menzel and Fornahl 2010), showing that the reliance of clusters on one or two dominant knowledge bases shifts over time (Martin 2012). Martin and Trippl (2015) looked at the evolution of the ICT cluster in Scania and found that the emergence of this Swedish cluster in the 1980s was enabled by a strong analytical and synthetic knowledge base in the region, followed by a new growth trajectory that required combination with new symbolic knowledge in media and design. Ingstrup et al. (2017) showed in the case of a design cluster in Denmark that it evolved from a cluster with a dominant synthetic knowledge base in the 1860s–1940s, a symbolic knowledge base in the 1950s–1990s to a cluster adopting an analytical knowledge base in the 2000s. Isaksen and Trippl (2016) is another kind of study in this context that explored how new analytical or new synthetic path of developments unfolded in peripheral regions, which they perceive as exogenous events of new path development.

What still need to be developed further in DKB 2.0 is a stronger conceptualization of the role of history. These studies take on board the role of dynamics and changing combinations of KB over time, and in that sense they clearly belong to DKB 2.0. However, some of these studies still stick to associate a particular period of time with a dominant knowledge base, and in that sense, they are still part of the first generation of DKB 1.0. Relevant questions that require further attention in DKB 2.0 to make it a truly historical approach are, for instance: is each shift implying a radical break with the past, how did clusters manage to evolve from one knowledge base to another, and did clusters build on pre-existing structures (variety, relatedness, knowledge bases, institutions, et cetera) to make these shifts? Such a take on DKB would bring it more closely to an evolutionary approach on regional diversification that is interested in the role of path dependence in particular spatial settings, and the role of pre-existing structures in shaping new growth paths in regions.

Third, a promising research avenue is to link more tightly the EEG literature on proximity to the KB literature. Broadly speaking, DKB 1.0 primarily focused on the role of geographical proximity (and to some extent institutional proximity) which was perceived to vary between the three knowledge types. In EEG, the related variety and relatedness concepts focused on the role of cognitive and geographical proximity in processes of learning, innovation and diversification. In addition, EEG has focused on other types of proximity that enable the formation of new combinations (Boschma and Frenken 2010; Hansen 2014). Because actors have different capabilities, they prefer to interact and collaborate not only with those that have similar knowledge (cognitive proximity) and are located in the same place (geographical proximity), but also with whom they share norms and values (institutional proximity), social ties (social proximity) or organizational boundaries (organizational proximity).

Mattes (2012) was the first paper that connected the proximity framework to the KB literature, claiming that the various types of proximity are important to a greater or lesser extent depending on the underlying type of knowledge base. In that sense, it can be seen as an extension of DKB 1.0 including more proximity dimensions than just geographical proximity, but it also takes a combinatory approach typical for DKB 2.0, although still in a static way. Davids and Frenken (2017) adopted a proximity approach to KB, but added a dynamic perspective to it, looking at different stages of new product development in science-based industries. They distinguished between three stages of new product development (research, development and marketing), each of which is associated with a prevailing knowledge base that is used and produced (analytical, synthetic and symbolic, respectively). The paper claims this has implications for the relative importance of proximity types over time, as the development process of new products passes from one stage to the next.

Finally, we think DKB 2.0 could be more explicit on the role of institutions at the macro and micro level, despite the fact that DKB 1.0 took on board the role of institutions, and more recent papers account for the role of institutional proximity (Mattes 2012; Davids and Frenken 2017). First of all, the DKB literature has been heavily influenced by the institutional system literature but empirical studies still have to make more explicit how institutions are linked to particular knowledge bases. For instance, does the organizational and geographical structure of each knowledge base look the same no matter where, or do these aspects of the same knowledge base look very differently in different institutional contexts? The Varieties of Capitalism literature may be a source of inspiration here (Hall and Soskice 2001; Boschma and Capone 2015), but also the literature on social capital. To my knowledge, this has not been tested yet. Second, there is a need to make the institutional perspective more dynamic and more in line with DKB 2.0. One potential way to go forward is to explore how the expanding literature on institutional entrepreneurship (Battilana et al. 2009) can be connected to the KB approach. For instance, could one expect institutional entrepreneurship to be more important in one of the three knowledge bases, and what role are they expected to play in making new combinations within and between different knowledge bases?

5 Conclusions

This objective of this chapter was to sketch a short history of the DKB literature that has been initiated and pioneered by Bjorn Asheim and a group of young scholars at Lund University since the early 2000s. We proposed to split the DKB literature in two parts: (1) DKB 1.0 during its formative years; and (2) DKB 2.0 that is still experimental and emerging.

The first generation labelled as DKB 1.0 focused on the nature of learning and innovation within activities (industries, regions) that is shaped by their underlying knowledge base. DKB 1.0 described what features of knowledge are characteristic for each knowledge base, and which industries have those in common. DKB 1.0 connected the three KB's to many geographical phenomena, such as how each knowledge base affects the spatial extent of knowledge sourcing. We summarized these in seven claims. DKB 1.0 has been criticized for ascribing knowledge bases to specific professions, industries and regions, as, in reality, these tend to draw upon more than one knowledge base. DKB 1.0 was not primarily interested in studying combinations within each knowledge base or combinations between knowledge bases, and their economic effects. Moreover, it developed a static view on knowledge bases, merely mapping their knowledge networks, and it had a very poor understanding of history.

We argued that a second generation of the KB literature, dubbed as DKB 2.0, has emerged in more recent years, which is also more closely connected to an evolutionary approach in economic geography. DKB 2.0 takes a combinatorial approach to innovation and links it to evolutionary concepts like variety, relatedness and related variety. DKB 2.0 is combinatorial, as its prime focus is on identifying combinations between knowledge bases and, to an increasing extent, combinations within knowledge bases, and assessing whether these various combinations provide learning opportunities and enhance the innovative performance of firms, industries and regions. DKB 2.0 employs a wider range of mixed methods, including quantitative studies that allow for more systemic testing, as compared to DKB 1.0 that favored a comparative case study approach. Studies in DKB 2.0 have started to investigate which combinations between knowledge bases are most productive in economic and innovative terms. Using concepts like variety, relatedness and related variety, studies make an attempt to assess which combinations within and between knowledge bases enhance the performance of firms, industries and regions. Some of these studies focus on the importance of related variety within one knowledge base and the extent to which related variety transcends the boundaries between knowledge bases. This promises a much richer exploration of possible knowledge combinations than just between the three pre-defined knowledge bases.

Because DKB 2.0 is still unfolding, we identified a number of promising research avenues inspired by evolutionary thinking. Clearly, what is still found missing in DKB 2.0 is an explicit focus on regional diversification. We believe a combined approach on (related) variety and knowledge bases is likely to generate new insights to the literature on new path development. Secondly, DKB 2.0 is also meant to be dynamic. Studies are starting to show, for instance, that the reliance of firms or clusters on dominant knowledge bases may shift over time, possibly leading to dynamics in the structure of their knowledge networks. However, this literature is still embryonic, and lacks a strong conceptualization of history, as it has not yet taken up the question of whether pre-existing structures (variety, relatedness, knowledge bases, institutions, et cetera) enable them to make these shifts and develop new growth paths in regions. Thirdly, another promising research avenue is to link more tightly the proximity literature to the study of KB. Studies have started to make strong claims about the varying importance of forms of proximity depending on the underlying type of knowledge bases, but empirical studies are lacking so far. Finally, we propose to study the role of institutions in knowledge base dynamics more systematically at both the macro and micro level.

References

Asheim, B. T. (1998). Territoriality and economics: On the substantial contribution of economic geography. In O. Jonsson & L. O. Olander (Eds.), *Economic geography in transition*, *The Swedish geographical yearbook* (Vol. 74, pp. 98–109). Lund: Lund University.

Asheim, B. T., Boschma, R., & Cooke, P. (2011). Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies, 45*(7), 893–904.

Asheim, B., & Coenen, L. (2005). Knowledge bases and regional innovation systems: Comparing nordic clusters. *Research Policy, 34*(8), 1173–1190.

Asheim, B., & Coenen, L. (2006). Contextualising regional innovation systems in a globalising learning economy: On knowledge bases and institutional frameworks. *Journal of Technology Transfer, 31*, 163–173.

Asheim, B., Coenen, L., & Vang, J. (2007). Face-to-face, buzz and knowledge bases: Socio-spatial implications for learning, innovation and innovation policy. *Environment and Planning C: Government and Policy, 25*, 655–670.

Asheim, B. T., & Gertler, M. S. (2005). Regional innovation systems and the geographical foundations of innovation. In J. Fagerberg, D. Mowery, & R. Nelson (Eds.), *The Oxford handbook of innovation* (pp. 291–317). Oxford: Oxford University Press.

Asheim, B., Grillitsch, M., & Trippl, M. (2017). Combinatorial knowledge bases, regional innovation and development dynamics. *Economic Geography*, forthcoming.

Asheim, B. T., & Hansen, H. K. (2009). Knowledge bases, talents and contexts: On the usefulness of the creative class approach in Sweden. *Economic Geography, 85*(4), 425–442.

Aslesen, H. W., & Freel, M. (2012). Industrial knowledge bases as drivers of open innovation? *Industry and Innovation, 19*(7), 563–584.

Battilana, J., Leca, B., & Boxenbaum, E. (2009). How actors change institutions: Towards a theory of institutional entrepreneurship. *The Academy of Management Annals, 3*, 65–107.

Boschma, R. (2017). Relatedness as driver behind regional diversification: A research agenda. *Regional Studies, 51*(3), 351–364.

Boschma, R., & Capone, G. (2015). Institutions and diversification: Related versus unrelated diversification in a varieties of capitalism framework. *Research Policy, 44*, 1902–1914.

Boschma, R. A., & Frenken, K. (2006). Why is economic geography not an evolutionary science? Towards an evolutionary economic geography. *Journal of Economic Geography, 6*(3), 273–302.

Boschma, R. A., & Frenken, K. (2010). The spatial evolution of innovation networks. A proximity perspective. In R. A. Boschma & R. Martin (Eds.), *The handbook of evolutionary economic geography* (pp. 120–135). Cheltenham: Edward Elgar.

Breschi, S., Lissoni, F., & Malerba, F. (2003). Knowledge-relatedness in firm technological diversification. *Research Policy, 32*, 69–87.
Broekel, T., & Boschma, R. (2011). Aviation, space or aerospace? Exploring the knowledge networks of two industries in the Netherlands. *European Planning Studies, 19*, 1205–1227.
Broekel, T., & Brachert, M. (2015). The structure and evolution of inter-sectoral technological complementarity in R&D in Germany from 1990 to 2011. *Journal of Evolutionary Economics, 25*, 755–785.
Coenen, L., Moodysson, J., Ryan, C., Asheim, B., & Phillips, P. (2006). Comparing a pharmaceutical and an agro-food bioregion: On the importance of knowledge bases for socio-spatial patterns of innovation. *Industry and Innovation, 13*(1), 393–414.
Cooke, P. (1998). Introduction: Origins of the concept. In H. Braczyk, P. Cooke, & M. Heidenreich (Eds.), *Regional innovation systems* (pp. 2–25). London: UCL.
Cooke, P. (2001). Regional innovation systems, clusters and the knowledge economy. *Industrial and Corporate Change, 10*(4), 945–974.
Davids, M., & Frenken, K. (2017). Proximity, knowledge base and the innovation process: Towards and integrated framework. *Regional Studies*. https://doi.org/10.1080/00343404.2017.1287349
Essleztbichler, J. (2015). Relatedness, industrial branching and technological cohesion in US metropolitan areas. *Regional Studies, 49*(5), 752–766.
Fleming, L. (2001). Recombinant uncertainty in technological search. *Management Science, 47*(1), 117–132.
Florida, R. (2002). *The rise of the creative class*. New York: Basic Books.
Fitjar, R. D. & Timmermans, B. (2017). *Knowldege bases and relatedness. A study of labour mobility in Norwegian regions*. Papers in Evolutionary Economic Geography, no. 7.16. Utrecht: Utrecht University.
Freeman, C. (1987). *Technology policy and economic performance: Lessons from Japan*. London: Pinter.
Frenken, K., & Boschma, R. A. (2007). A theoretical framework for economic geography: Industrial dynamics and urban growth as a branching process. *Journal of Economic Geography, 7*(5), 635–649.
Frenken, K., Van Oort, F. G., & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional Studies, 41*(5), 685–697.
Gertler, M. S. (2003). Tacit knowledge and the economic geography of context, or the undefinable tacitness of being (there). *Journal of Economic Geography, 3*, 75–99.
Grillitsch, M., Roman, M., & Srholec, M. (2016). knowledge base combinations and innovation performance in Swedish regions. *Economic Geography*. https://doi.org/10.1080/00130095.2016.1154442
Grillitsch, M., & Trippl, M. (2014). Combining knowledge from different sources, channels and geographical scales. *European Planning Studies, 22*(11), 2305–2325.
Hall, P., & Soskice, D. (Eds.). (2001). *Varieties of capitalism: The institutional foundations of comparative advantage*. Oxford: Oxford University Press.
Hansen, T. (2014). Juggling with proximity and distance: Collaborative innovation projects in the Danish cleantech industry. *Economic Geography, 90*(4), 375–402.
Herstad, S. J., Aslesen, H. W., & Ebersberger, B. (2014). On industrial knowledge bases, commercial opportunities and global innovation network linkages. *Research Policy, 43*, 495–504.
Hidalgo, C. A., Klinger, B., Barabasi, A. L., & Hausmann, R. (2007). The product space and its consequences for economic growth. *Science, 317*, 482–487.
Hoyssa, M. (2014). *How to account for combinatory knowledge dynamics in the micro level? Illustrating an enhanced conceptual approach through three cases of science-based innovation*, Paper presented at the Geography of Innovation Conference, Utrecht.

Ingstrup, M. B., Jensen, S., & Christensen, P. R. (2017). Cluster evolution and the change of knowledge bases: The development of a design cluster. *European Planning Studies, 25*(2), 202–220.

Isaksen, A., & Trippl, M. (2016). Exogenously led and policy-supported new path development in peripheral regions: Analytical and synthetic routes. *Economic Geography*. https://doi.org/10.1080/00130095.2016.1154443

Jacobs, J. (1969). *The economy of cities*. New York: Vintage Books.

Jensen, M. B., Johnson, B., Lorenz, E., & Lundvall, B. A. (2007). Forms of knowledge and modes of innovation. *Research Policy, 36*(5), 680–693.

Klement, B., & Strambach, S. (2017). *Innovation in creative industries: Does (related) variety matter for the creativity of urban music scenes? Working paper*. Marburg: Marburg University.

Laestadius, S. (1998). Technology level, knowledge formation and industrial competence in paper manufacturing. In G. Eliasson & C. Green (Eds.), *The micro foundations of economic growth* (pp. 212–226). Ann Harbour: The University of Michigan Press.

Lazzeretti, L., Innocenti, N., & Capone, F. (2017). The impact of related variety on the creative employment growth. *The Annals of Regional Science, 45*(7), 893.

Lundvall, B. A., & Johnson, B. (1994). The learning economy. *Journal of Industry Studies, 1*, 23–43.

Manniche, J. (2012). Combinatorial knowledge dynamics: On the usefulness of the differentiated knowledge bases model. *European Planning Studies, 20*, 1823–1841.

Manniche, J., Moodysson, J., & Testa, S. (2016). Combinatorial knowledge bases: An integrative and dynamic approach to innovation studies. *Economic Geography*. https://doi.org/10.1080/00130095.2016.1205948

Martin, R. (2012). Measuring knowledge bases in Swedish regions. *European Planning Studies, 20*(9), 1569–1582.

Martin, R. (2013). Differentiated knowledge bases and the nature of innovation networks. *European Planning Studies, 21*(9), 1418–1436.

Martin, R., & Moodysson, J. (2011). Innovation in symbolic industries: The geography and organization of knowledge sourcing. *European Planning Studies, 19*(7), 1183–1203.

Martin, R., & Moodysson, J. (2013). Comparing knowledge bases: On the geography and organization of knowledge sourcing in the regional innovation system of Scania, Sweden. *European Urban and Regional Studies, 20*(2), 170–187.

Martin, R., Moodysson, J., & Zukauskaite, E. (2011). Regional innovation policy beyond 'best practice': Lessons from Sweden. *Journal of the Knowledge Economy, 2*, 550–568.

Martin, R., & Sunley, P. (2006). Path dependence and regional economic evolution. *Journal of Economic Geography, 6*(4), 395–437.

Martin, R., & Trippl, M. (2014). System failures, knowledge bases and regional innovation policies. *disP - The Planning Review, 50*(1), 24–32.

Martin, R., & Trippl, M. (2015). *Cluster evolution, regional innovation systems and knowledge bases: The development and transformation of the ICT cluster in Southern Sweden*. Papers in Innovation Studies, No. 2015/24, Lund.

Mattes, J. (2012). Dimensions of proximity and knowledge bases: Innovation between spatial and non-spatial factors. *Regional Studies, 46*(8), 1085–1099.

Menzel, M.-P., & Fornahl, D. (2010). Cluster life cycles – dimensions and rationales of cluster evolution. *Industrial and Corporate Change, 19*(1), 205–238.

Moodysson, J. (2008). Principles and practices of knowledge creation: On the organization of "buzz" and "pipelines" in life science communities. *Economic Geography, 84*(4), 449–469.

Moodysson, J., Coenen, L., & Asheim, B. (2008). Explaining spatial patterns of innovation: Analytical and synthetic modes of knowledge creation in the Medicon Valley life science cluster. *Environment and Planning A, 40*, 1040–1056.

Muneepeerakul, R., Lobo, J., Shutters, S. T., Gomez-Lievano, A., & Qubbaj, M. R. (2013). Urban economies and occupation space: Can they get "there" from "here"? *PLoS ONE, 8*(9), e73676. https://doi.org/10.1371/journal.pone.0073676

Neffke, F., Henning, M., & Boschma, R. (2011). How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. *Economic Geography, 87*, 237–265.

OECD. (1996). *The knowledge-based economy*. Paris: OECD.

Pavitt, K. (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory. *Research Policy, 13*, 343–373.

Plum, O., & Hassink, R. (2011). Comparing knowledge networking in different knowledge bases in Germany. *Papers in Regional Science, 90*(2), 355–371.

Quatraro, F. (2010). Knowledge coherence, variety and productivity growth: Manufacturing evidence from Italian regions. *Research Policy, 39*, 1289–1302.

Quatraro, F. (2016). Co-evolutionary patterns in regional knowledge bases and economic structure. Evidence from European regions. *Regional Studies, 50*(3), 513–539.

Rigby, D. (2015). Technological relatedness and knowledge space. Entry and exit of US cities from patent classes. *Regional Studies, 49*(11), 1922–1937.

Sedita, S., De Noni, I., & Pilotti, L. (2017). Out of the crisis: An empirical investigation of place-specific determinants of economic resilience. *European Planning Studies, 25*(2), 155–180.

Strambach, S., & Klement, B. (2012). Cumulative and combinatorial micro-dynamics of knowledge: The role of space and place in knowledge integration. *European Planning Studies, 20*(11), 1843–1866.

Tanner, A. N. (2016). The emergence of new technology-based industries: The case of fuel cells and its technological relatedness to regional knowledge bases. *Journal of Economic Geography, 16*(3), 611–635.

Tödtling, F., & Grillitsch, M. (2015). Does combinatorial knowledge lead to a better innovation performance of firms? *European Planning Studies, 23*(9), 1741–1758.

van Tuijl, E., & Carvalho, L. (2014). Knowledge sourcing, knowledge bases, and the spatial organisation of car design. *Environment and Planning A, 46*(8), 1966–1982.

van Tuijl, E., Dittrich, K., & van der Borg, J. (2016). Upgrading of symbolic and synthetic knowledge bases: Evidence from the Chinese automotive and construction industries. *Industry and Innovation, 23*(3), 276–293.

Whitley, R. (1999). *Divergent capitalism. The social structuring and change of business systems*. Oxford: Oxford University Press.

Zukauskaite, E. (2013). *Institutions and the geography of innovation. A regional perspective*, PhD thesis. Faculty of Social Sciences, Lund University, Lund.

Zukauskaite, E., & Moodysson, J. (2016). Multiple paths of development: Knowledge bases and institutional characteristics of the Swedish food sector. *European Planning Studies, 24*, 589–606.

Variety of Regional Innovation Systems and Their Institutional Characteristics

Elena Zukauskaite

Abstract

Regional Innovation Systems (RISs) come in many shapes. Current RIS typologies, however, pay insufficient attention to institutional factors and as a consequence they fall short of capturing an essential source of variety of RISs in a systematic way. This chapter contributes to a further conceptual development of the RIS approach by capturing regional variety not only in terms of actors and networks but also in terms of institutions. It is shown that an institutional perspective can enrich existing RIS typologies by providing insights into the distinctive institutional frameworks of different RIS types and their particular institutional bottlenecks. Three main causes of institutional bottlenecks are identified, that is, lack of or poorly developed institutions, inappropriate institutions, and contradicting/poorly aligned institutions. As shown in this chapter the institutional perspective advocated here holds a strong potential to contribute to a further conceptual development of the RIS approach.

Keywords

Institutions · Institutional bottlenecks · Types of regional innovation systems

1 Introduction

There seems to be a widespread agreement in the academic literature that any definition of regional innovation systems (RISs) is incomplete without reference to institutions. The claim that institutions matter can already be found in the antecedents of the RIS approach, that is, (i) the national innovation system (NIS) concept (see, for instance, Johnson's 2010 analysis of the role of institutions in innovation processes) and

E. Zukauskaite (✉)
School of Health and Welfare, Halmstad University, Halmstad, Sweden
e-mail: elena.zukauskaite@hh.se

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_3

(ii) various territorial innovation models. The latter have highlighted the significance of the regional socio-institutional environment from which innovations emerge (Doloreux and Parto 2005). The key argument advanced in this literature is that uncertainty is increasing in the globalizing knowledge economy. Therefore, competitive advantage can be preserved by possessing some unique assets that cannot be easily copied (like traditions, values), and by creating patterns of behaviour that facilitate and enable fast responses to changing environments (Storper and Scott 1995; Storper 1997; Porter 1998; Bathelt et al. 2004).

However, a closer look clearly reveals that the elaboration of the term 'institution' is rather limited in the RIS literature (see Zukauskaite 2013 for a comprehensive critical appraisal of the use of the notion in the RIS debate). Institutions are usually defined either as an infrastructure in the form of research and funding organizations and technology transfer agencies or as historically formed conditions related to regional traditions or path-dependency (Asheim and Isaksen 1997; Cooke 2004; Iammarino 2005). Various authors have emphasized that due attention should be given to the relation between institutions and knowledge exchange (see for instance, Cooke et al. 1997; Asheim and Gertler 2005). Innovation linkages between RIS actors are seen as vital for a well-functioning innovation system. A huge literature does exist that portrays innovation as an interactive and systemic phenomenon, that is, as the outcome of cooperation between firms or between firms and research organizations. It is argued that such interactions are influenced and shaped by the regional institutional framework. Regions are considered as organizing units bringing together the infrastructure needed for innovative activities (Florida et al. 2017). Physical proximity at the region level (sometimes also seen as a proxy for cultural proximity; see, for instance, Gertler 2004), implies the existence of trust, which is considered as a basic precondition for collaboration and knowledge exchange. In addition to trust, network creation and collaboration are facilitated by democratic participation in the regional life. Civic institutions and communal spirit within the region could lead to knowledge exchange among different actors, which in turn benefits innovation activities and economic development (Amin and Thrift 1995; Scott 1998).

RISs are conceptualized as open, nationally and internationally connected systems. This directs our attention to institutions at higher spatial scales. Already Martin (1994) argued that regions are the places where different kinds of institutions—national, regional, global and organizational ones—interact. That is, the regional institutional framework includes national and global regulations as well as industry specific laws, standards and routines (Asheim et al. 2011a). This idea is further supported by Farole et al. (2011) who have convincingly argued that both formal and informal institutions need to be considered in RIS analyses. However, regardless the re-occurring calls to account for the institutional diversity in the region, it is hardly conceptualized and empirically analyzed in RIS studies (Gertler 2010).

As will be shown below, the lack of an adequate conceptualization of institutions is also reflected in various typologies that have been developed to capture the variety of RISs. Variety is usually conceptualized and empirically analyzed in terms of actors involved and types of networking. In other words, actors and networks are the main dimensions that are used to describe and analyze different types of RISs. However, if institutions are crucial for regional development and innovation, as the protagonists of the concept repeatedly claim, RISs might also differ in their institutional characteristics. Current RIS typologies, however, pay insufficient attention to the institutional dimension and as a consequence they fall short of grasping institutional sources of variety of RISs in a systematic way.

The aim of this chapter is to shed light on the formal and informal institutional characteristics of different types of RISs. This chapter does not develop a new typology of RISs, but rather analyzes existing ones from an institutional perspective, seeking to make regulative, normative and cognitive aspects of the RIS approach more explicit and prominent. We provide profound insights into the distinctive institutional framework of different types of RISs and we identify particular institutional bottlenecks that can be found in each of these types. It is argued that such an institutional analysis has the potential to further advance our conceptual understanding of RISs and enhance our knowledge of the institutions of various RIS types.

The remainder of this chapter is structured as follows. Section 2 offers a conceptualization of institutions that is in line with recent advances in the field. Section 3 provides a critical analysis of various RIS typologies, highlighting the ways in which they grasp variety of RISs as well as how (if at all) institutional characteristics are discussed. In Sect. 4 institutions are incorporated into typologies of RISs. Finally, Sect. 5 concludes.

2 Conceptualizing Institutions

Conceptualizations of institutions in economic geography and the innovation systems literature have been inspired by many disciplines and school of thoughts. Old (Veblen 1898; Hodgson 1998) and new (North 1990; Williamson 2000) institutional economics are certainly among the most influential ones, but increasingly insights from other disciplines are incorporated into the geographical analysis of institutions. In particular, the new institutionalism in organizational studies, historical institutionalism and social psychology are worth mentioning in this regard (see, for example, Gertler and Wolfe 2002; Gertler 2004, 2010).

As indicated above, RIS studies tend to refer to universities, schools, banks and policy support organizations as institutional infrastructure of the region often with no explicit consideration about the relation between organizations and institutions (see Farole et al. 2011; Bathelt and Glückler 2014 for a discussion). However, in order to conceptualize institutions in different types of RISs, there is a need to distinguish between the two phenomena. Following North (1990), institutions are understood as formal and informal rules such as regulations, values and routines while organizations such as universities, banks, schools, policy organizations, and firms are actors that follow, disobey or initiate the rules.

Table 1 Institutions and spatial dimension

Type of institutions	Examples	Main spatial dimension
Regulative	Laws, standards, sanctions: national taxation policy, EU regulation, international agreements	Global and national
Normative	Values, social obligations, expectations: trust, positive attitudes towards learning and innovation	Regional and global
Cultural-cognitive	Beliefs, views taken for granted: shared understanding of the best ways to organize activities	Regional and global

Source: Own elaboration based on Scott (2008: 51)

This idea is further supported by Scott (2008) who argues that institutions comprise regulative (regulations), normative (norms) and cultural-cognitive (beliefs) elements that structure (enable and constrain) the behavior of individuals and organizations. The regulative element of institutions refers to rules, laws, sanctions, which are legally enforced. This type of institutions is usually codified in laws, standards, agreements (such as intellectual property rights), taxation policies and labor relations. Such institutions also include different guidelines that regulate various types of support (that is, funding and infrastructural support for science, technology, innovation, regional development, and so on) (see also North 1990; Williamson 2000). As discussed above, regulative institutions are often found at the national level (such as national laws) and the global one (like industry standards, EU regulations) (see Edquist 2005; Cooke and Propris 2011). In regions with high levels of political autonomy, that is, in federal states with a considerable degree of decentralization of power, some of the regulative institutions discussed above can also be found at the sub-national level (see Table 1).

Normative institutions consist of values, social obligations and binding expectations, which are morally governed. They specify how things should be done and define appropriate ways to reach goals or to organize certain activities. The cultural-cognitive aspect of institutions refers to the views of the world, which are taken for granted. They are based on shared understandings and logic of action and mimetic behavior (Scott 2008). Cognitive and normative institutions are facilitated by geographical proximity and are therefore often specific to certain regions. However, there might also be norms and beliefs that are specific to industries or communities of practice. They often exceed the regional level and are related to other types of proximity than geographical one (Boschma 2005). For example, academic communities across different countries share some underlying understanding what high quality research is and follow established ways (i.e. peer-review process) to achieve it.

Normative and cultural-cognitive elements of institutions differ when it comes to their enforcement. Normative institutions are enforced via moral codes of conduct when deviation from the norm leads to moral shaming and social exclusion. Cultural-cognitive institutions are taken for granted (Scott 2008). There is no need for special enforcement mechanisms since the alternative (that is deviation) cannot be explicitly considered by those subscribing to a particular cultural-cognitive institution. Having said that, it has to be acknowledged that the empirical distinction between normative and cultural-cognitive institutions is not always a clear-cut. It is contingent to time, place and community.[1]

The types of institutions outlined above are not isolated, but experienced and enacted in an interrelated manner (Scott 2010). Various scholars have highlighted that formal and informal institutions are mutually reinforcing. Without supporting normative and cultural-cognitive institutions, enforcement of regulations would be very costly (North 1990; Scott 2008). However, institutions can also be interrelated in a complementary or contradicting manner. For example, institutions that have the same goal (for instance, promotion of innovation) and the same function (for instance, providing funding structures for innovation) are reinforcing each other. Institutions that have the same goal but different functions (for instance, providing funding structures for innovation and encouraging positive attitudes towards innovation) are complementary. Institutions are related to each other in a contradictory manner if they have opposing goals (for instance, promotion of innovation versus preservation of historically formed structures and interests) (see, Zukauskaite (2013) for a more in-depth critical discussion of various forms of interrelationships between different institutions). Furthermore, it is important to note that regions are embedded in national and global environments and they usually host different industries and a heterogeneous population of firms and other organizations. This suggests that the institutional framework of the region can be very complex, leading to various kinds of relations between different kinds of institutions.

3 Typologies of Regional Innovation Systems

Regions differ from each other in many respects such as size, firm density, industrial specialization patterns, knowledge bases, presence of research and supporting organizations, political autonomy, aspects of governance and so on. In order to grasp this variety of regional characteristics different typologies of RISs have been developed over the past years.

In this section, we take a closer look on four typologies that figure prominently in the RIS literature to find out how they treat the institutional dimension of regional innovation processes. The typologies presented below have been selected for an analysis of institutions because they are amongst the most well-known ones and have been widely used by scholars working in the field of innovation systems.[2] We seek to explore to what extent and in what ways these typologies do consider

[1] An example of this contingency as well as fluidity of institutions in the Swedish context is an institution of hand-shaking which has made a transition from a taken for granted behavior (cultural-cognitive element) to a morally governed activity (normative element), associated with norms regarding gender equality and tolerance.

[2] We use Asheim and Coenen (2005), Cooke (2004) and Tödtling and Trippl (2005) as the main references when analyzing the typologies. However, we are aware that Asheim and Coenen (2005)

Table 2 RIS typologies and institutional characteristics

Typology	Type of RIS	Institutional characteristics	Type of institutions
Asheim and Coenen (2005)/ Cooke (2004)	Territorially embedded/Localist-grassroots	Geographical and relational proximity Well-developed relations among SMEs and between firms and policy makers	Normative, cultural-cognitive
	Regionalized national/ Globalized-dirigiste	Central government policies, central funding, epistemic communities, globally oriented networks	Regulative, cultural-cognitive
	Regionally networked/ Interactive-networked RIS	Regional institutional infrastructure intentionally strengthened Well-developed networks at different scales	Normative, regulative
Cooke (2004)	IRIS	Long-term interests of shareholders, public investment in innovation	Normative, regulative
	ERIS	Profit making interest of shareholders	Normative
Tödtling and Trippl (2005)	Locked-in RIS	Functional, cognitive, political lock-ins	Cultural-cognitive
	Organizationally thin RIS	Thin institutional structure	Normative, cultural-cognitive
	Fragmented RIS	Not mentioned	–

Source: Own summary

various forms of institutions as they have been defined in Sect. 2. The findings of our analysis are summarized in Table 2.

3.1 Territorially Embedded, Regionalized National and Regional Networked RISs

One of the most detailed typologies was developed by Asheim and Coenen (2005). They distinguish between territorially embedded, regionally networked and regionalized national RISs. In many ways this typology resembles Cooke's (2004) distinction between localist-grassroots, globalized-dirigiste and interactive-networked RISs. According to Asheim and Coenen (2005), a territorially embedded RIS is characterized by the presence of inter-firm learning stimulated by the conjunction of geographical and relational proximity with almost no direct interaction with knowledge generation organizations. The regional support infrastructure provides industry specific, hands-on services and short-term problem solving. Furthermore, the nature of

and Cooke (2004) build upon previous work by Asheim and Isaksen (1997, 2002), Asheim (1998), Cooke (2001), Cooke et al. (2003) and Brazcyk et al. (1998).

knowledge exchange and collective learning is primarily local, rarely transcending regional boundaries. Cooke (2004) adds that firms in such RISs usually use local funding sources for innovation and usually have strong links with regional policy makers.

In a regionalized national innovation system innovation is often organized in a linear mode where highly codified scientific knowledge is transferred to the industry for commercialization. Co-operation is most likely to arise between people with the same education or occupational background. This functional similarity facilitates the circulation and sharing of knowledge through epistemic communities crossing regional and even national boundaries. Funding for innovation comes from national or global levels. The global dimension of this type of RISs is further highlighted by Cooke (2004) who argues that the industrial structure of such RISs is dominated by global multinational companies surrounded by local suppliers. Research activities are geared towards the needs of MNEs and might be performed in global collaboration with the research organizations around the world.

Finally, a regionally networked RIS is considered an ideal type of RISs involving private and public cooperation of a planned character. It has a balanced private sector including small and large firms in different sectors. Knowledge exchange can vary from the local level, to regional, national and global ones, depending on the needs and goals. The research competence in such systems ranges from basic to applied research and meets the demands of a variety of different types of firms. Cooke (2004) points out that system co-ordination is likely to be high because of the large number of stakeholders and the presence of associations, industry clubs and the like. Funding of innovation activities is guided by agreements among banks, government agencies and firms.

The typologies presented above thus attempt to identify various kinds of RISs by focusing attention on three distinguishing features, that is, actor constellations (small versus large firms), type of innovation processes (experience based (DUI) versus science based (STI)) and collaboration patterns (within or outside the region, private-private actors, private-public actors), leaving the concept of institutions implicit to the framework. However, some of the RIS characteristics highlighted above could be related to institutions. Different types of networks such as links between SMEs in territorially embedded RISs or connections within epistemic communities in regionalized national innovation systems could possibly point to varying normative and cultural-cognitive institutions. Furthermore, geographical and relational proximity is mentioned when describing territorially embedded RISs which suggests presence of normative and cultural-cognitive institutions, supporting trust, knowledge exchange and encouraging mimetic behavior. In the empirical application of the typology, Asheim and Coenen (2005) mention that joint norms, conventions, and routines are of crucial importance for interactive learning among the firms in territorially embedded RISs. Reference to collaborations transcending regional boundaries in regionalized national innovation system and networked regional innovation systems imply a significant role of regulative institutions at national and global levels. Furthermore, the reference to knowledge sharing in epistemic communities in regionalized national innovation systems indicates the presence of normative and cultural-cognitive institutions crossing different geographical levels. However, these institutional aspects remain implicit in the typologies. They hint to possible institutional variety in different types of RISs, but further elaborations are missing.

3.2 Entrepreneurial and Institutional RISs

Another typology suggested by Cooke (2004) differentiates between institutional RISs (IRISs) and entrepreneurial IRSs (ERISs). IRISs are characterized by strong user-producer interactions, supporting regulatory frameworks such as public investment in research (laboratories and universities), and a dependence on bank borrowing (patient capital) leading more often to incremental rather than radical innovations. ERISs lack these strong systemic elements and instead get their dynamism from local venture capital, entrepreneurs, and market demand. They are well suited to generate both incremental and disruptive innovation. Since the dynamism comes from venture capitalists, the driving force is a more short-term profit boosting of shareholders rather than the more long-term perspectives of a broader group of stakeholders in an IRIS context (see also Cooke 2001; Asheim and Coenen 2006). These two types of RISs, thus, reflect the varieties of the capitalism dichotomy of coordinated and liberal market economies (Asheim and Coenen 2006; Asheim 2007).

In this dichotomy, institutions are mentioned in a very limited manner. Cooke's (2004) IRIS-ERIS typology does hardly go beyond a brief recognition of possibly different norms governing the actors (shareholders' profit making versus long term interests of shareholders) and the importance of public investment in research in IRISs. Regulative institutions that govern ERISs, such as low taxes and weak labor unions, which are typical characteristics of liberal market economies, are not mentioned at all.[3]

3.3 Organizationally Thin, Locked-in and Fragmented RISs

Tödtling and Trippl (2005) differentiate among RISs based on their potential innovation deficiencies. They identify three types of RISs failures (organizational thinness, lock-in and fragmentation) and assign them to specific types of regions. Similar to other typologies, variety is conceptualized in terms of actors, networks and activities. Organizationally thin RISs (often found in peripheral regions) feature low levels of clustering, SMEs with limited innovation capabilities operating in mature sectors and a weak endowment with supporting organizations. Due to the low number of innovative players in the region, extra-regional innovation networks tend to be more pronounced than intra-regional ones. Locked-in RISs (usually found in old industrial areas), in contrast, are characterized by organizational thickness. They host, strong

[3]For the insight regarding regulative institutions I am grateful to Björn Asheim who brought this to my attention.

clusters that are, however, overspecialized in old industries undergoing decline, a support structure that is too strongly oriented to the region's narrow industrial base and outdated technologies. More often than not, too strong economic and political ties suppress novel ideas and new economic activities. Finally, fragmented RISs (often found in metropolitan areas) are portrayed as systems that suffer from low levels of networking and knowledge flows between the large number of RISs actors (firms, research and educational bodies and supporting organizations) present in the area. Such connectivity problems might result from too much industrial and knowledge diversity (lack of synergies) or from networking barriers that prevent actors to capitalize on synergies.

Tödtling and Trippl (2005) do not offer a systematic account of the role of institutions in different types of RISs. Institutions are mentioned in the authors' description of locked-in RISs, which are characterized by functional lock-ins (too rigid inter-firm networks), cognitive lock-ins (homogenization of world views), and political lock-ins (strong, symbiotic relationships between public and private key actors hampering industrial restructuring). This could be further related to normative and cultural-cognitive institutions. Old industrial regions and their locked-in RISs have clearly established views on what legitimate and appropriate ways of organizing activities and networks are and serious questioning is applied when anyone deviates from established norms. Furthermore, a long history of a particular industrial structure leads to mimetic behavior among the actors, when a certain pattern of actions is copied by others and over time becomes taken-for-granted. Thus, homogenous cultural-cognitive institutions tend to prevail in these areas. According to the authors, peripheral regions are characterized by a 'thin institutional structure' (Tödtling and Trippl 2005: 1209). The authors do not elaborate on what is meant by that. However, it can be interpreted as the lack of institutions supporting knowledge exchange and networking, partly due to the lack of a critical mass of actors who could enact such institutions (Amin and Thrift 1995). Finally, for fragmented RISs institutions are not mentioned at all.

To summarize, our critical analysis of various well-known RIS typologies has clearly shown that they underappreciate institutional factors in their attempts to identify and categorize various kinds of RISs. In the next section, we highlight how an institutional perspective can enrich these typologies.

4 RISs Typologies and Institutions

As mentioned above, this chapter does not aim to develop a new typology of RISs, but rather seeks to grasp institutional variety within existing typologies. These typologies are developed with different purposes in mind and therefore institutional characteristics have to be defined along different dimensions. Asheim and Coenen's (2005) typology highlights the nature of the relations among actors. Thus, due attention is given to the relative importance of institutions at various geographical levels. Tödtling and Trippl's (2005) typology captures the main RIS deficiencies. Consequently, the main focus is on institutions that could lie behind or could add to the solution of the deficiency. Finally, Cooke (2004) describes IRISs and ERISs in relation to their ability to nurture different types of industries. Institutions that go in line with that ability are pointed out. By adding key institutional features to the typologies of RISs, we gain an additional explanatory dimension (apart from actors and networks) for a better understanding of relations among actors, regional deficiencies, and conditions for the development of different industries (see Table 3). In this way, the conceptual analysis developed in this chapter provides further insights into how institutional frameworks of the region and institutional bottlenecks shape innovation activities and types of innovation that dominate different RISs.

4.1 Institutional Features and Bottlenecks of Territorially Embedded, Regionalized National and Regionally Networked RISs

Normative and cultural-cognitive institutions among actors at the regional level are most influential in territorially embedded/localist-grassroots RISs. This is an outcome of the mimetic behavior of actors located in the region since non-local interactions are limited. Well-developed relations between local policy makers and local firms together with the lack of supra-local coordination suggest an inward orientation of the system. National and global regulative institutions are only important as providers of basic regulations such as labor and taxation policy, industry standards and intellectual property rights. Institutions that facilitate and encourage supra-regional interaction could hardly become a part of the institutional framework of the region. This is due to the preference for regional collaboration partners over distant ones and a dominant belief in established local practices. Thus, the main institutional bottleneck is a lack of institutions in the region that could promote supra-regional collaboration and interaction. Even in those cases when such institutions exist at national or global levels, there is a risk that they are disregarded by the regional actors and thus do not feed into the institutional framework of the region. This would also imply that there is a lack of interrelatedness among institutions at different geographical scales due to the superiority of the regional level. Supply-side policies such as funds supporting supra-regional collaboration will not be enough to overcome institutional bottlenecks as they object the dominant world-view of RIS actors.

Normative institutions come into being only if actors perceive certain norms and codes of conduct as beneficial to their performance and/or can be regarded as fair (Hall 2010). In order to support the change of norms towards more openness, regional policy makers can provide good practice examples from the same or other regions and use opinion leaders to persuade other actors. Close relations between SMEs and policy makers might create both opportunities for and constraints to such actions. On the one hand, it means that policy makers have easy access to the companies and possibilities to exert an influence on them. On the

Table 3 Institutions in different types of RIS

Typology	Type of RIS	Institutional framework: elements and relations	Bottleneck
Asheim and Coenen (2005)/ Cooke (2004)	Territorially embedded/ Localist-grassroots	• Strong role of regional normative and cognitive institutions • Role of national institutions is limited to basic regulations (e.g. labor regulation, tax policy) • Weak role of global institutions • Lack of interrelatedness	Lack of institutions for supra-regional collaboration
	Regionalized national/ Globalized-dirigiste	• Strong role of cognitive and normative institutions among actors within the same industry/with the same educational background (regional and supra-regional) • Weak regional institutions for collaboration across industries/organizational fields • Strong role of national regulative institutions predefining support and incentives structures for innovation • Mainly complementary relations	Lack of institutions for collaboration across industries/organizational fields
	Regionally networked/ Interactive-networked	• Strong role of normative institutions supporting learning and knowledge exchange at regional and supra-regional levels • Strong role of regulative institutions (e.g. formal contracts among regional actors) for knowledge exchange • Strong role of national incentives structures supporting extra-regional collaboration • Strong role of global regulations: standards, agreements, IPR, incentives structures for collaboration with distant partners • Reinforcing and complementary	Inappropriate or lacking global regulations

(continued)

Table 3 (continued)

Typology	Type of RIS	Institutional framework: elements and relations	Bottleneck
Cooke (2004)	IRIS	• Normative institutions at regional and national levels promote long-term interest and trust among stakeholders • High level of loyalty among employees and employers • Typical CME regulations at the national level • Basic global regulations: agreements, IPR, industry standards • Mainly complementary relations	Risk for institutional mismatch when IRIS emerge in LME type country
	ERIS	• Normative institutions at regional and national levels encourage focus on profit and market demand • Low loyalty between employers and employees • Typical LME regulations at the national level • Basic global regulations: agreements, IPR, industry standards • Mainly complementary relations	Risk of institutional mismatch when ERIS emerge in CME type country
Tödtling and Trippl (2005)	Locked-in RIS	• Strong cognitive and normative institutions at the regional level define legitimate ways of behavior • Work relations and practices are clearly regulated at national and global levels, presence of strong support structures • Alternatively support structures can be terminated if the regional industry declines • Complementary or contradictory relations	Lack of institutions supporting renewal and innovative ideas
	Organizationally thin RIS	• Lack of critical mass of actors needed to develop thick normative and cognitive institutions at the regional level • Regulative institutions at national and global levels that address the issues of less developed regions • Lack of interrelatedness	Lack of institutions addressing the issue of less developed regions

(continued)

Table 3 (continued)

Typology	Type of RIS	Institutional framework: elements and relations	Bottleneck
	Fragmented RIS	• Variety of different norms and beliefs; varying level of trust • Variety of different regulations (established rules and support structures for some industries; lacking or emerging ones for other industries) • Regulative institutions at national and global levels supporting collaboration among different stakeholders are most relevant • Complex relations: reinforcing, complementary, contradicting	Contradicting institutions might hamper innovation; Lack of institutions supporting collaboration

Source: Own draft

other hand, they might subscribe to the same normative and cultural-cognitive institutions and therefore do not realize the need for change.

Due to the national/global focus of regionalized national/globalized-dirigiste RISs regional institutions for collaboration across industries or organizational fields are poorly developed. The most influential ones are national institutions predefining support and incentives structures for innovation and industry practices. However, due to the functional focus of the actors cultural-cognitive and normative institutions of the epistemic community are also important for innovation and apply both to regional and supra-regional (global) levels. The relation between institutions is mainly complementary when the norms of epistemic communities supporting intra-industry interaction are complemented by support structures at the national level. There is a vast literature on related variety, constructing regional advantage, Triple Helix (among others) suggesting that collaboration across industries and organizational fields is more conducive to innovation and regional development than a single industry focus (Etzkowitz and Leydesdorff 1997; Asheim et al. 2007, 2011b). Thus, weak regional institutions for collaboration across industries/organizational fields are the main institutional bottlenecks of the system. Changes in epistemic communities might be important triggers for change. For example, cross-disciplinary collaboration in the field of functional genomics in southern Sweden was triggered by changes of norms in the epistemic community regarding what good quality research is about (see Zukauskaite 2015). If such change does happen, it is important that policy makers adjust their support for the industry and allow for further upgrading.

Regionally networked/interactive-networked RISs are often considered an ideal type of RISs. We expect institutions at all levels to be important for supporting knowledge exchange and innovation. Normative institutions that support knowledge exchange and learning at the regional level are further reinforced by national incentives and complemented by regulations and support structures at national and global levels. Some empirical studies suggest that such RISs also have formal contracts (regulative institutions) for collaboration among regional actors (Hallencreutz et al. 2008). Actors within regionally networked RISs have well-developed networks for global collaborations. Thus, global regulative institutions such as agreements, standards and intellectual property rights are crucial for the functioning of the RIS. However, regional actors might have a limited influence on global institutions. Thus, institutional bottlenecks might emerge due to the lack of, for example, industry standards or unfavorable labor and tax policies in countries where the preferred partners of RISs actors are located. Regional policy makers can hardly change institutions at other geographical levels, but they can lobby at international (EU) and national levels for the interest of actors in the region. Furthermore, they can also provide information about regulative challenges and in such a way reduce regulatory burdens (Miörner et al. 2017).

4.2 Institutional Features and Bottlenecks of Entrepreneurial and Institutional RISs

As suggested by Cooke (2004) normative institutions at regional and national levels in IRISs promote long-term interest and trust among stakeholders, encouraging collaboration among different actors. Due to low labor mobility, there is a high level of loyalty among employees and employers. This stands in stark contrast to ERISs where the level of loyalty among employees and employers is low and normative institutions encourage a focus on short-term profit making and market demand.

Cooke's (2004) typology of ERISs and IRISs reflects Hall and Soskice's (2001) concept of varieties of capitalism where specialization of the national economy is predefined by historically formed national institutional frameworks (Asheim and Coenen 2006; Asheim 2007). It would mean that the regions in Coordinated Market Economies (CMEs) are more likely to resemble IRISs whilst those in Liberal Market Economies (LMEs) resemble ERISs. Thus, in IRISs typical characteristics of regulative institutions at the national level are strict labor regulations, influential labor unions and other industry organizations, facilitating inter-organizational coordination, high taxes, and a focus on strong vocational training in the education system. In ERISs labor regulations are fluid, taxes are low, labor unions usually weak and the education system is focused on broad, general knowledge. Thus, the relation between institutions is mainly complementary. Low loyalty between employees and employers and a focus on profit and market demand (normative institutions) are complemented by fluid labor regulations (Hall and Soskice 2001). However, if the national environment does not support competitiveness of the firms

(CMEs, for example, are generally considered as less favorable settings for 'high-tech' industries such as biotech than LMEs), the regional environment might deviate from national models to support certain industries located there (Crouch et al. 2009). Strambach (2010) noted that industries can emerge despite an environment that is unfavorable for their development, pointing to the plasticity of institutional frameworks. Thus, it might be possible to find IRIS-like institutions in regions located in LMEs and ERIS-like institutions in CMEs suggesting partly contradicting relations between institutions at the national and regional levels. This points to institutional bottlenecks when the industry cannot achieve its full potential due to the regulations at the national level. Similarly, as with networked-RISs, the influence of regional policy makers on overcoming such institutional bottlenecks is rather limited. Lobbying at the national level in order to achieve better conditions for the industry in the region, providing information about regulatory frameworks, and continuous support of favorable institutions at the regional level are possible tools that can be used by policy makers.

Because of the national focus in capturing variety in ERISs and IRISs, it is hard to distinguish the role of global institutions. Both CMEs and LMEs (and thus both ERISs and IRISs) are subject to the same global institutional settings. ERISs are considered more beneficial for science-based industries such as biotechnology, while IRISs are better suited for engineering based industries such automotive. Some recent studies reveal that science-based industries are much more involved in global collaboration and knowledge exchange than engineering-based industries (see, for instance, Martin and Moodysson 2013). Thus, one could expect that global cooperation agreements, industry standards and incentive structures for collaboration are more relevant for actors in ERISs than in IRISs.

4.3 Institutional Features and Bottlenecks in Organizationally Thin, Locked-in and Fragmented RISs

Locked-in RISs are characterized by thick cognitive and normative institutions, which have emerged over time through mimetic behavior of organizations located in the region. They lead to shared understandings among the actors and predefine legitimate forms of behavior and activities. Alternative attitudes that are not in line with established norms and cultural-cognitive beliefs are questioned and often rejected (see, for example, the studies done by Grabher (1993) and Hassink (2010) on old industrial regions). Regulative institutions at the national and global level such as industry standards, regulations regarding work relations and practices are usually well-developed and in place. When it comes to support structures for industrial development (such regions are often dominated by one industry or a few closely related ones) there are several institutional alternatives. They might be well-developed and in line with the understanding of the regional actors of how the industry should develop. The support structures can be dismantled if the industry dominating in the region is declining and thus, not prioritized any longer by policy makers. Finally, support structures at national and global levels might aim to promote industry renewal.

However, RIS actors might be unwilling and/or incapable to absorb such support since it is not in line with the normative and cultural-cognitive institutions that prevail in the region. Thus, the relations between institutions might be complementary, reinforcing or contradicting. ‘Thick’ institutions that encourage traditional ways of organizing activities and hamper regional and industrial renewal form the main institutional bottlenecks in these areas. Similar to territorially embedded RISs, regional policy makers can use good practice examples and act via opinion leaders in order to overcome institutional lock-in.

In organizationally thin RISs there is a lack of a critical mass of actors for promoting regional development. According to Amin and Thrift (1994) this hampers the development of normative and cultural-cognitive institutions at the regional level (see also Zukauskaite et al. (2017) for a discussion on institutional and organizational thickness/thinness). Thus, one could expect such a RIS to be not only organizationally but also institutionally thin. Nevertheless, mimetic behavior and shared world views are likely to emerge among relatively small group of actors. This might lead the establishment of a normative and cultural-cognitive institutional framework representing values and beliefs characteristic to the region. This idea is supported by Trippl et al. (2016) who define industrial districts in the Third Italy as organizationally thin, but institutionally thick due to normative and cultural cognitive institutions supporting collaboration shared by the majority of actors. Normative and cultural cognitive institutional framework is expected to be homogeneous in these types of regions. However, it is still thin since there are only few actors who comply with the framework.

Most relevant regulative institutions at national and global levels are those that address the issue of less developed regions, that is, taxation policy, support structures, and so on. The lack of such institutions might further reinforce the weak innovation capacity of organizationally thin RISs. Since such RISs are institutionally thin, the relation between institutions is less important for regional development. Regional policy makers can address the problem of ‘lack of critical mass of actors’ by enlarging the region via, for example, improved transport infrastructure and collaboration agreements with neighboring regions. If support structures for less-developed regions are missing at the national level, policy makers can lobby for and actively apply them once they are in place. Once the region reaches a critical mass of actors, it has the possibility to develop institutions that support innovation and knowledge exchange since it is less bounded by historically formed traditions than for example, locked-in regions.

Fragmented RISs are typical for metropolitan regions that host a large number of actors with competing agendas. This leads to a variety of different norms and beliefs and varying levels of trust among the actors. Similarly, there is a variety of different regulations. For some industries and cooperation forms rules and support structures might be well-established, while for others regulations might be missing. Since the main deficiency of such RISs is fragmentation, the most relevant institutions at national and global levels are those that facilitate collaboration among different stakeholders. Missing or poorly developed institutions encouraging collaboration and knowledge exchange at various levels form the main institutional bottleneck. Furthermore, due to the variety of norms and regulations in the region, the relations are very complex. Complementary, reinforcing and contradicting institutions might be in action simultaneously. For example, it might be the case that national support structures and norms of global epistemic communities promote collaboration (complementary relations), while regulations that are specific to industries or organizational fields make legitimization of collaboration activities very complicated (see Zukauskaite (2015) for a further elaboration of this argument). Thus, poorly aligned institutions might also lead to institutional bottlenecks in fragmented metropolitan RISs. Regional policy makers might actively identify such contradictions and raise awareness of the problem at different levels and organizational contexts. In case of negative attitudes towards collaboration, policy makers can use good examples as well as suggest formal contracts in order to overcome the lack of trust among diverse actors.

5 Conclusions

Over the past 20 years or so, the RIS concept has received much interest in economic geography and innovation studies. There is a strong consensus within the academic debate that institutions are key elements of RISs, shaping the innovation dynamics of regions in essential ways. Despite the widespread recognition of the influence of institutions, the notion is still weakly conceptualized in the literature on RISs. As shown in this chapter, the lack of a proper conceptualization of institutions is also reflected in various well-known RIS typologies. These typologies have without any doubts enhanced our understanding of how RISs differ in terms of key actors and networks, capacity to facilitate innovation in various kinds of industries, and prevailing innovation problems resulting from distinct system failures. However, RISs also vary significantly in their institutional characteristics. Based on a critical analysis of prominent RIS typologies we have demonstrated that this work has paid only limited attention to institutions and as a consequence institutional sources of variety of RISs remain poorly understood.

This chapter sought to enrich existing RIS typologies by identifying key institutional features that shape and constrain innovation activities in various kinds of RISs. Inspired by the work done by Scott (2008) and others we advanced the argument that such an undertaking requires a focus on different types of institutions (regulative, normative, cultural-cognitive) at various spatial scales (regional, national, global) and their interrelationships. This enabled us to provide deep insights into the distinctive institutional frameworks of different types of RISs and their particular institutional bottlenecks. We offered a fine-grained conceptual analysis of the role played by regulative, normative and cultural-cognitive institutions and their interscalar relations and we highlighted how a focus on the presence (or absence) of various kinds of institutions and the particular nature of their interrelationships which can be reinforcing, complementary or contradictory can help explain differentiated innovation capacities of regions. We have identified three main causes of institutional bottlenecks, that is, lack of or poorly developed institutions, inappropriate institutions, and contradicting/poorly aligned institutions.

As shown in this chapter, the institutional perspective advocated here holds a strong potential to contribute to a further development of the RIS approach. It can inform empirical studies of RISs and might also pave the way for fresh insights into the scope but also limitations of innovation policies adopted at the regional level. Furthermore, it can also add to further conceptual advances of the RIS concept. Not least it could contribute to a better understanding of regional change. As revealed by Isaksen and Trippl (2016) different types of regions are likely to support different types of development of regional industrial paths. Better understanding of institutional frameworks and how they enable or constrain new regional path development in different types of regions could further inform studies of regional structural change (see also Zukauskaite et al. 2017).

Acknowledgement This chapter has benefited a lot from Michaela Trippl's insightful comments. I am also grateful to Arne Isaksen and an anonymous reviewer for further suggestions on how to improve the chapter. Any remaining errors or shortcomings are my sole responsibility.

References

Amin, A., & Thrift, N. (1994). Living in the global. In A. Amin & N. Thrift (Eds.), *Globalization, institutions, and regional development in Europe* (pp. 1–22). Oxford: Oxford University Press.

Amin, A., & Thrift, N. (1995). Institutional issues for the European regions: From markets and plans to socioeconomics and powers of association. *Economy and Society, 24*(1), 41–66.

Asheim, B. (1998). *Learning regions as development coalitions: Partnership as governance in European workfare states?* Paper presented at the Second European Urban and Regional Studies Conference on 'Culture, Place and Space in Contemporary Europe', University of Durham, UK.

Asheim, B. (2007). Differentiated knowledge bases and varieties of regional innovation systems. *Innovation. The European Journal of Social Sciences, 20*(3), 223–241.

Asheim, B., & Coenen, L. (2005). Knowledge bases and regional innovation systems: Comparing nordic clusters. *Research Policy, 34*(8), 1173–1190.

Asheim, B., & Coenen, L. (2006). Contextualising regional innovation systems in a globalising learning economy: On knowledge bases and institutional frameworks. *Journal of Technology Transfer, 31*(1), 163–173.

Asheim, B., & Gertler, M. S. (2005). The geography of innovation: Regional innovation systems. In J. Fagerberg, D. S. Mowery, & R. R. Nelson (Eds.), *The Oxford handbook of innovation* (pp. 291–317). Oxford New York: Oxford University Press.

Asheim, B., & Isaksen, A. (1997). Location, agglomeration and innovation: Towards regional innovation system in Norway? *European Planning Studies, 5*(3), 299–330.

Asheim, B., & Isaksen, A. (2002). Regional innovation systems: The integration of local 'sticky' and global 'ubiquitous' knowledge. *Journal of Technology Transfer, 27*, 77–86.

Asheim, B., Coenen, L., Moodysson, J., & Vang, J. (2007). Constructing knowledge-based regional advantage: Implications for regional policy. *Int. J. Entrepreneurship and Innovation Management, 7*(2), 28–43.

Asheim, B., Smith, H. L., & Oughton, C. (2011a). Regional innovation systems: Theory, empirics and policy. *Regional Studies, 45*(7), 875–891.

Asheim, B. T., Boschma, R., & Cooke, P. (2011b). Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies, 45*(7), 893–904.

Bathelt, H., & Glückler, J. (2014). Institutional change in economic geography. *Progress in Human Geography, 38*(3), 340–363.

Bathelt, H., Malmberg, A., & Maskell, P. (2004). Clusters and knowledge: Local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography, 28*(1), 31–56.

Boschma, R. (2005). Proximity and innovation: A critical assessment. *Regional Studies, 39*(1), 61–74.

Braczyk, H., Cooke, P., & Heidenreich, M. (Eds.). (1998). *Regional innovation systems*. London: UCL Press.

Cooke, P. (2001). Regional innovation systems, clusters, and the knowledge economy. *Industrial and Corporate Change, 10*(4), 945–974.

Cooke, P. (2004). Regional innovation systems – an evolutionary approach. In P. Cooke, M. Heidenreich, & H.-J. Braczyk (Eds.), *Regional innovation systems: The role of governance in a globalized world* (pp. 1–18). London: Routledge.

Cooke, P., & Propris, L. D. (2011). A policy agenda for EU smart growth: the role of creative and cultural industries. *Policy Studies, 32*(4), 365–375.

Cooke, P., Roper, S., & Wylie, P. (2003). 'The golden thread of innovation' and Northern Ireland's evolving regional innovation system. *Regional Studies, 37*(4), 365–379.

Cooke, P., Uranga, M. G., & Etxebarria, G. (1997). Regional innovation systems: Institutional and organizational dimensions. *Research Policy, 26*(4-5), 475–491.

Crouch, C., Schroder, M., & Voelzkow, H. (2009). Regional and sectoral varieties of capitalism. *Economy and Society, 38*(4), 654–678.

Doloreux, D., & Parto, S. (2005). Regional innovation systems: Current discourse and unresolved issues. *Technology in Society, 27*(2), 133–153.

Edquist, C. (2005). Systems of innovations: Perspectives and challenges. In J. Fagerberg, D. C. Mowery, & R. R. Nelson (Eds.), *The Oxford handbook of innovation* (pp. 181–208). Oxford: Oxford University Press.

Etzkowitz, H., & Leydesdorff, L. (1997). *Universities and the global knowledge economy: A tripple helix of university-industry-government relations*. London: Pinter.

Farole, T., Rodriguez-Pose, A., & Storper, M. (2011). Human geography and the institutions that underlie economic growth. *Progress in Human Geography, 35*(1), 58–80.

Florida, R., Adler, P., & Mellander, C. (2017). The city as innovation machine. *Regional Studies, 51*(1), 86–96.

Gertler, M. S. (2004). *Manufacturing culture: The institutional geography of industrial practice*. Oxford: Oxford University Press.

Gertler, M. S. (2010). Rules of the game: The place of institutions in regional economic change. *Regional Studies, 44*(1), 1–15.

Gertler, M. S., & Wolfe, D. A. (2002). Innovation and social learning: An introduction. In M. S. Gertler & D. A. Wolfe (Eds.), *Innovation and social learning: Institutional adaptation in an era of technological change* (pp. 1–24). New York: Palgrave Macmillan.

Grabher, G. (1993). Rediscovering the social in the economics of interfirm relations. In G. Grabher (Ed.), *The embedded firm: On the socioeconomic of industrial networks* (pp. 1–31). London: Routledge.

Hall, P. A. (2010). Historical institutionalism in rationalist and sociological perspective. In J. Mahoney & K. Thelen (Eds.), *Explaining institutional change: Ambiguity, agency, and power* (pp. 204–224). Cambridge: Cambridge University Press.

Hall, P. A., & Soskice, D. (2001). An introduction to varieties of capitalism. In P. A. Hall & D. Soskice (Eds.), *Varieties of capitalism: The institutional foundations of comparative advantage* (pp. 1–70). Oxford: Oxford University Press.

Hallencreutz, D., Bjerkesjö, P., & Daal, C. (2008). *Skånes regionala innovationssystem*. Region Skåne, Malmö: En funktionsanalys.

Hassink, R. (2010). Locked in decline? On the role of regional lock-ins in old industrial areas. In R. Boschma & R. Martin (Eds.), *The handbook of evolutionary economic geography* (pp. 450–470). Cheltenham: Edward Elger.

Hodgson, G. M. (1998). The approach of institutional economics. *Journal of Economic Literature, 36*(1), 166–192.
Iammarino, S. (2005). An evolutionary integrated view of regional systems of innovation: Concepts, measures and historical perspectives. *European Planning Studies, 13*(4), 497–519.
Isaksen, A., & Trippl, M. (2016). Regional industrial path development in different types of regions: A conceptual analysis. In D. Parrilli, R. Fitjar, & A. Rodriguez-Pose (Eds.), *Innovation drivers and regional innovation strategy* (pp. 66–84). London: Routledge.
Johnson, B. (2010). Institutional learning. In B.-Å. Lundvall (Ed.), *National systems of innovation: Toward a theory of innovation and interactive learning*. London: Anthem Press.
Martin, R. (1994). Economic theory and human geography. In R. Martin & G. Smith (Eds.), *Human geography: Society, space and social science* (pp. 21–53). Basingstoke: Macmillan.
Martin, R., & Moodysson, J. (2013). Comparing knowledge bases: On the geography and organization of knowledge sourcing in the regional innovation system of Scania, Sweden. *European Urban and Regional Studies, 20*(2), 170–187.
Miörner J., Zukauskaite E., Trippl M., & Moodysson J. (2017). Creating institutional preconditions for knowledge flows in cross-border regions. *Environment in Planning C: Politics and Space*, online first: doi: https://doi.org/10.1177/2399654417704664.
North, D. (1990). *Institutions, institutional change and economic performance*. Cambridge: Cambridge University Press.
Porter, M. E. (1998). Clusters and the new economics of competition. *Harvard Business Review, 76*(6), 77–90.
Scott, A. J. (1998). Community, local democracy and citizenship. *Prospects, 28*(2), 328–331.
Scott, W. R. (2008). *Institutions and organizations*. London: Sage Publications.
Scott, W. R. (2010). Reflections: The past and future of research on institutions and institutional change. *Journal of Change Management, 10*(1), 5–21.
Storper, M. (1997). *The regional world*. New York: The Guilford Press.
Storper, M., & Scott, A. J. (1995). The wealth of regions: Market forces and policy imperatives in local and global context. *Futures, 27*(5), 505–526.
Strambach, S. (2010). Path dependance and path plasticity: The co-evolution of institutions and innovation – the German customized business software industry. In R. Boschma & R. Martin (Eds.), *The handbook of evolutionary economic geography* (pp. 406–431). Cheltenham, Northampton, MA: Edward Elgar.
Trippl, M., Asheim, B., & Miörner, J. (2016). Identification of regions with less-developed research and innovation systems. In M. D. Parrilli, R. D. Fitjar, & A. Rodriguez-Pose (Eds.), *Innovation drivers and regional innovation strategies* (pp. 23–44). London: Routledge.
Tödtling, F., & Trippl, M. (2005). One size fits all? Towards a differentiated regional innovation policy approach. *Research Policy, 34*(8), 1203–1219.
Veblen, T. (1898). Why is economics not an evolutionary science? *The Quarterly Journal of Economics, 12*(4), 373–397.
Williamson, O. E. (2000). The new institutional economics: Taking stock, looking ahead. *Journal of Economic Literature, 38*(3), 595–613.
Zukauskaite, E. (2013). *Institutions and the geography of innovation: A regional perspective*. Lund: Lund University.
Zukauskaite, E. (2015). Organizational change within medical research in Sweden: On the role of individuals and institutions. *Environment and Planning C: Government and Policy, 33*(5), 1190–1206.
Zukauskaite, E., Trippl, M., & Plechero, M. (2017). Institutional thickness revisited. *Economic Geography, 93*(4), 325–346.

The Sociocultural Basis for Innovation

Jon P. Knudsen

Abstract
This chapter argues how economic behaviour in geography could be understood as historically anchored varieties of practice. Contemporary European patterns replicate deep anthropological dispositions as suggested by authors like Geert Hofstede and Emmanuel Todd, and substantiated by Duranton et al. (Types and the persistence of regional disparities in Europe. Economic Geography, 85(1), 23–47, 2009). Old, formative schemes are still operating and new institutional forms, be they cultural, economic or political, are conditioned by their mechanisms. This also goes for innovation. However, in the field of innovation policies, culturally explained variations, cleavages and mismatches are translated to a different cognitive and rhetorical universe, where the problems to be addressed are assessed on a systemically legitimated formula devoid of cultural references, and where it otherwise is difficult to ascertain whether the logics behind the problems are being passed on or lost in translation. Building on a culturally argued and regionally modified concept of Variety of Capitalism (VoC), I illustrate my point by a reanalysis of Norwegian patterns of innovation. I suggest that the country harbour at least three different regional VoC-types, each of which has its own hegemonic logic of innovation. The consequences for policy formation are important as national policy schemes often fail to recognise regional variations in institutional preconditions and capacities for policy absorption by neglecting culturally conditioned economic diversities.

Keywords
Innovation · Socio-cultural perspective · Institutions · Variety of capitalism · Emmanuel Todd · Norway

J.P. Knudsen (✉)
Department of Working Life and Innovation, University of Agder, Grimstad, Norway
e-mail: jon.p.knudsen@uia.no

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_4

1 Introduction

The idea that economic behaviour is too complex to be understood by economic theory alone has been crucial to the development of social science thinking. Alfred Marshall (1890: 198) observed more than a century ago that there were some unique qualities in the social and cultural fabric that had a decisive impact on economic development and entrepreneurship in certain regions; this made them stand out as, what we would label today, industrial districts. The factors causing these special qualities were, however, difficult to theorise about, and Marshall subsequently put understanding them on hold by labelling them as 'something in the air'. Moving to scholars of more integrative perspectives on societal development, this lack of understanding is deliberately linked to the division of labour rapidly emerging from the end of the nineteenth century. The French historian Marc Bloch (1993 [1939]: 59) thus wrote:

> [t]he framework of institutions which governs a society can [. . .] be understood only through a knowledge of the whole human environment. For though the artificial conception of man's activities which prompts us to carve up the creature of flesh and blood into the phantoms *homo economicus, philosophicus, juridicus* is doubtless necessary, it is tolerable only if we refuse to be deceived by it.

Max Weber offers an interesting case in this respect. As one of the foremost analysts of these processes of differentiation while at the same time retaining an integrative argument about the logics of economic behaviour, he argued the scientific outlook should be kept within the realm of the cultural sciences. Economic behaviour should be understood and explained as patterns of collective and individual actions guided by culturally coded rationales pertaining to specific geographical and historical contexts. One of his main undertakings subsequently was to offer in-depth analyses into these rationales on a global scale (Weber 1947[1922]), of which his analysis of the genesis of Western capitalism still forms a cornerstone in the canon of the social sciences.

The end of the interwar period witnessed the increasing emancipation of economics, and to some extent business studies, from other cultural and social sciences, and thus also to a disregard for the integrative heritage as exemplified above. The new economic sciences instead turned to the natural sciences for inspiration, adopting their quantitative techniques as a substitute for substantial theorising with the dogmatising of *economic man* as an ahistorical and aspatial constant, rendering further inquiries into the epistemological and ontological bases for scientific knowledge superfluous.

Although Joseph Schumpeter (1934) already in 1911 had produced a sophisticated argument—in which he also recognised the interdependence between economic and other institutionalised rationales—for a market solution to economic growth and prosperity through initial phases of creative destruction, the social and political climate of the 1930s was not ready for it. The interwar period instead exemplified the failure of the market economy. Hence, the belief in planning as a way of passing the new-born economic insight into political action while discarding the fallacies of its market version triumphed through the New Deal in the US, social democracy in Scandinavia, communism in the Soviet Union, and fascism in Germany, Italy and Spain.

In the aftermath of World War II, the belief in the virtues of planning lived on even into the era of the Cold War. The developed part of the world was divided between a communist East and a market-based West, but even in the market-oriented countries, planning was adopted as a favoured take on steering and policy formation (Sæther and Eriksen 2014). Eventually, this way of thinking was met with two types of criticism. One came from market liberalists who argued that the idea of a market, and of spontaneous bottom-up processes as sources of rational behaviour, being substituted by top-down planning, was flawed. Empirical support for this view was taken from the economic crisis of the 1970s and from the later downfall of communism in Eastern Europe. The other criticism came from various strands of evolutionary economists and social scientists. Within this latter category, we find researchers that ascribe primordial importance to the geographical and historical evolvement of the economy. Most of them take an institutional perspective on the economy in which the institutional elements are derived from sources other than from the economy itself.

2 The Role of Institutions

Currently, a need to recouple economic thinking with other social science traditions has been emphasised by several authors (Gertler 2010). The central role of Douglass C. North should especially be highlighted as he made the importance of institutions to economic functioning his main point in his address after having received the 1993 Nobel memorial prize in economics (North 1994). There, he also remarked on our rudimentary understanding of how economic behaviour is influenced by institutions in general, and even more so regarding the working of socio-cultural institutions. Returning to the Weberian position of seeing culture as guiding actions, Geert Hofstede has made timely updates to the terminology by speaking of culture as the software of the mind (Hofstede 1991). We become differently 'programmed' through socialisation and eventually also by our deliberate choices. Differences resulting from these processes mark the behaviour and value systems of social groups, regions and nations, thus embedding them into different logics, values and preferences which become codified as hegemonic.

One of the early observers of the effect of variation in sociocultural institutions on the economy, Alexis de Tocqueville, in his classical works on economic and social life in early nineteenth century North America (de Tocqueville 2003[1835-1840]), made explicit reference to the linkages between social organisation, cultural institutionalisation and economic practices. He was specifically preoccupied with the tendency within the American society to coordinate social action from the bottom-up, not only as spontaneous market behaviour, but also through the formation of all types of associations and societies comprising civil society, a feature that strongly contrasted with the experiences of his French upbringing. Within modern comparative political studies, *The English Societies* in Europe, America and Oceania soon became established as a special category of economies (Rokkan 1967). The more complicated question was what to make of the rest.

3 Varieties of Capitalism

The present day attempts to answer this question are the focus of the literature labelled Variety of Capitalism (VoC) after the seminal book *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage* (Hall and Soskice 2001). Here a basic distinction is made between liberal market economies (LME) and an antithetical group of coordinated market economies (CME) mainly centred on the Germano-Nordic realm and Japan. For both categories, it is argued that generic patterns of cultural traits such as languages, social mores, political organisation and religious creeds largely realign with the institutionalisation of economic behaviour and working life relations (Friel 2005; Gertler 2004; Hall and Soskice 2001; Schultenover 1999; Teague 1977). The nexus is then established between the institutions regulating the economy and institutions guiding other spheres of society.

Historically, the VoC-literature should be connected to the integrative perspective on the economy as referred to initially. There are several academic traditions tying the two together. One of them addresses the debate about the existence of different lines of thinking on liberalism identifying *ordo-liberalism* as a distinctly German way of contextualising liberalism in an organic social structure, almost paralleling the distinction between liberal and organic conservatism within political analysis (Ptak 2009). Proponents of such versions of liberalism should also be identified in the Scandinavian realm. Tentatively, we could point to N. F. S. Grundtvig in Denmark and Hans Nielsen Hauge in Norway as candidates, both having had an important and culturally grounded impact on economic thinking and practice in their respective countries, moulding liberalism into socially concerned frameworks for fostering bottom-up economic entrepreneurship (Grytten 2013; Lundvall 2002: 191–192). Another line of thought involves attempts by early post World War II economists and political sociologists to classify economic and other institutions on a comparative geographical scale (Albert 1993; Flora et al. 1999; Piore and Sabel 1984; Rokkan 1967). In this tradition, the specific historical conditions of institutional formation at the geographical crossroads in Europe is analysed to explain the emergence of newer regional patterns of institutional heterogeneity. A third linkage could be the literature theoretically rearguing the socio-cultural impact on, or interdependence with, economic institutions (Fukuyama 2011; Greif 2006; Hofstede 1991; Todd 1987, 1990, 1998). Here, scholars concentrate on the ideal-typical aspects of individual and group behaviour as they result from their structural conditioning.

Following the initial writing on VoC, three developments should be noted. First, a proliferation of an original bipolar Euro- or OECD-centred model into a multipolar model encompassing Southern and Eastern Europe has taken place (Amable

2003; Hancké et al. 2007; Schneider and Paunescu 2012). Second, the application of the model to other national cases soon followed, notably in Asia, which entailed a subsequent plethora of categories (Witt and Redding 2013; Zhang and Peck 2016). Third, the concept is being brought from the national to the regional level by identifying regional patterns of institutional cleavages making the theory apt to more fine-grained geographical analysis (Colombo and Regini 2016; Knudsen et al. 2017; Schröder and Voelzkow 2016; Zhang and Peck 2016).

The basic value added from the VoC-tradition is its ability to shed light on how various configurations of institutional reciprocity condition the formation of qualitatively different economies more than its ability to isolate one or a few institutional features within those same economies. As such, the VoC analyses help us to grasp the common logics or rationales of regional or national economic systems.

4 The LME–CME Dichotomy

I will now return to the initial model of Hall and Soskice (2001) to elaborate further on its socio-cultural aspects for two reasons; firstly, to keep the number of factors manageable, and secondly, because of its relevance to my empirical illustrations which will be derived from the realms of LMEs and CMEs, more specifically in the case of Norway, a country that happens to host both of these models within its borders.

The coordinated market economies are characterised by being strongly regulated by other social spheres, by civil society or by the state. The economy is *not* accorded a systemic prerogative over other institutions regarding rationales guiding behaviour. Coordinated economies are often marked by long-term perspectives on investments and capital formation. Banks, families or the state are favoured sources of investment financing. Employment relations tend to be stable, reflecting, as I will return to, the values of the underlying stem family systems of these societies. Stability, reliability and trust are valued over speed and flexibility. The preferred mode of innovation will also be incremental rather than radical, piecemeal improving mirroring the values of such societies.

Liberal market economies are woven into other values. Here the logic of the economy is given a primordial role over other institutions. The dynamics of capitalism are to a larger degree than in the coordinated market economies understood as the driving forces of society. Hence, the virtues and logic derived from private entrepreneurship is accorded a general status with over-arching social values. The capital perspective is short, results are expected to be immediate, and the quarterly reporting rhythm influences social life to generate a general state of speed and impatience (Schultenover 1999). The word business, literally meaning the state of being busy, reveals the nature of the economic and social logics. Making a career by moving between opportunities and employers will prove more rational than opting for lifelong company employment. The concept of innovation is radical. The path-breaking innovations that change societies are accorded almost a mythical status as are the innovators who make a fortune by bringing them to the market.

Closing in on Northern Europe, we should understand these two types of capitalism by looking at how the processes of modernisation took place in the Germano-Nordic and the English-speaking societies, respectively. The Germano-Nordic modernisation initially followed a cultural road with the launch of a widespread basic school system generating a high level of literacy in the population prior to any industrial break-through. There is a backdrop here involving the mutual approach between religious and secular authorities legitimated through Lutheran theology, the restoration of vernacular languages for public use and the socio-geographical effects of the Gutenbergian heritage (Porter 1990: 179–195; Sandberg 1982), which space forbids me to pursue.

In Britain, the course of events followed a different path. The industrial revolution took place without any prior educational revolution or rise in literacy (Todd 1990). This may offer an historical explanation of the different institutional hegemonic order in the English-speaking societies in Europe and overseas, though we should admit, following Hirschman (1976), that the institutional borrowings and impulses across European borders have been substantial over the centuries. His provocative conclusion is that the capitalist and the economic actor *do not* follow a pure, deductible rationality, but rather one that is geographically and historically contingent, brought about by often unforeseen events and outcomes. Taking this insight to the VoC-terminology, we can no longer speak of *economic man* as a meaningful category for analytical use, we will instead have to identify context-sensitive *economic men* as they seek to gravitate towards that point within a given society where their actions find institutional support (Hall and Soskice 2001: 9).

Where institutional balance is found in space and time, actions will make sense to the actors and to their surroundings. Moreover, only then will actions pay off economically. The socio-cultural and the economic spheres thus become intertwined and contribute to confirm each other as validly institutionalised. Where these processes realign productively, we may claim that the specific variety of institutional integration in place is strengthened. Different VoC-typologies thus go along with a conforming variety of socio-cultural typologies. To analyse these varieties, we have, as just mentioned with the example of economic man, to do away with some contextually stripped categories. Instead, we must recognise that some concepts as well as theories are only valid under certain geographical and historical conditions. James Coleman (1964: 517) formulated this point concisely when he wrote that we always deal with *sometimes true theories*.

Another important track leading to our present VoC-discussion is the literature from the 1980s and the 1990s on regional industrial systems and regionally based clusters. The analysis of *The Third Italy* by Piore and Sabel (1984) and the reformulation of the global economy as consisting of a vast number of regionally competing economies (Porter 1990), both addressed the role of socio-cultural conditions for innovation, specialisation, and economic development in geographical entities below the state level. Piore and Sabel thus offer a thorough description of the relations between the economy and other institutional factors in a part of Italy strongly marked by formal and informal institutions, the latter exemplified by family and business networks. However, their analysis of the family system is very general and without any reference to the specific and sharply delimited type of communitarian family later pointed to as so typical for this part of Italy (Todd 1990: 329–347). Though the analysis is classic, it also gives rise to some questions. Most importantly from a socio-cultural perspective would be to ask why the communitarian family operates as a vehicle for innovation and industriousness in this region while it seems to have the opposite impact where it elsewhere dominates the socio-demographic structure (Todd 1987; Norris and Inglehart 2004). Referring to the ambiguous effects of tightly knit social capital (Putnam 2000; Florida 2005), we may ask if this kind of family structure has some *bridging* qualities in the Italian case for some contingent reason that unleashes it from its normal *bonding* role in most other contexts. In that case, the policy model value of the Third Italy may be lower than previously believed. This line of argument may be congruent with the observation of diminishing success over the years for the model as its time window has come to a close (Marangoni and Solari 2006).

When Porter (1990) deals with regional economic systems, he links them to their historical past, and he does so rather descriptively. He does not seek theories derived from the socio-cultural repertoire, nor does he seem to look for any. He merely states that he has no theoretical position on the role of culture in the economy, adding that cultural particularities wherever they appear will wither away under the pressure of globalisation (Porter 2000). Taken together, his theorising consists of a catalogue of historical summaries and institutional variations melted into a universal theory of why deviations occasionally, and specialisations more generally, pay off.

Though VoC-categories appear as historically distinct, it is also noticed that they may be swayed by international trends and hegemonic pressures. Thus, several CME-economies are claimed to have moved in a LME-direction over the last few decades to form a continuum of intermediate forms. It is tempting to label this observation an effect of LME-induced globalisation (Schneider and Paunescu 2012), but it may equally be ascribed to internal dynamics in the economies in question. Such dynamics we may see as framing, as well as being conditioned by, path-bound actions in space and time. ‘Paths’ have over the years become a concept to grasp nascent patterns of actions as they emerge within national, regional and local spaces. Formal and informal institutions mark and delimit paths for economic actors. By doing so, they enable and close opportunities available to goal attainment. Institutional framing allows an economy to thrive and prosper along with its institutional potential, but at the same time institutional framing may also operate mechanisms of lock-in that hamper growth, turning frames into barriers. The question is then not about stimulating innovation in the normal economic sense of the word, but to search for basic change in formal and informal institutions to redesign the overall societal framing and to bring in new rules of the game. It should be doubted, I will argue, whether such undertakings are within the normal scopes of policy making at all, especially regarding informal institutions.

5 Formal and Informal Institutions

Formal institutions appear as laws, regulations and political decisions. In organisational forms, they appear as public bodies, companies and third sector organisations. Their communication is explicit, following known forms and procedures. Informal institutions are such phenomena as cultures, values, mores and traditions. These may also be codified as formal institutions, but their basic logic is made legitimate through initially tacit or unwritten codes of practice. There is a thin line between formal and informal institutions, as formal institutions in the end need cultural legitimacy to exist and prevail. At the same time, informal institutions tend to become formal over time through processes of codification and bureaucratisation. This will in turn cause new spontaneous informal institutions to be created, but where these in early Western modernisation took the form of broad, popular movements, they currently tend to be more ad hoc-oriented, fluctuating and mono-causal in scope (Østerud 2007). Still, however, it can be maintained that a basic cultural substratum of implicitly ideologized social practices guides the interchange between informal and formal institutions in the Western world (Charles et al. 2008). The further analysis of these processes, as they pertain to institutional takes on innovation, addresses the working of political arenas or fields in the broadest sense of the terms (Normann et al. 2017).

Analytically, we can see these political fields as composed of an input- and an output-sphere. The input-sphere is made up of popular participation through various channels, while the output-sphere consists of decisions, allocations and law-making. These two spheres correspond roughly to the distinction between *politics* and *policies*. And while the input-side is largely nourished by informal institutions, the output-side depends on formal institutions for its functioning. Hence, formal institutions are influenced by politics through shifting input-signals. At the same time, the potential of formal institutions to regulate and sway informal institutions is highly uncertain as mechanisms and processes that guide basic social behaviour and cultural practices may not be accessible to political operations. There are clear obstacles in present day secular western societies to entering the realm of religious practices as opposed to pre- and early modern Europe when religious and military matters were at the centre of interest for any ruler.[1] These obstacles pertain to the legitimacy as well as to the substantial fallacies of addressing the *life world* through *system*-approaches. Nevertheless, it is an observation to be made that academicians and politicians alike often seem to neglect such hindrances in their quest for instrumental solutions to pressing problems. These are important reminders to innovation policy makers since many of the underlying conditions and values guiding innovative practices by necessity will be difficult to influence by political schemes and measures. For an innovation policy to make sense, it must be able to interpret the logics of informal institutions at the same time as it must act through the formal institutions in place. Alternatively, it should argue for new formal institutions to be set up if needed.

[1]A retake on the theme is nevertheless made by the present rise of political attention to religious practices as a perceived source of conflict between (post-)Christian and Muslim values.

6 The Cultural Theory of Emmanuel Todd

We have much knowledge on the interplay between formal institutions and economic behaviour, and we have some knowledge on how formal institutions are influenced by informal institutions. Where we still lack insight is in what mechanisms affect and guide informal institutions. Thus, our ability to *describe* the relations between institutions and economic behaviour are better developed than our ability to *explain* these relations (Duranton et al. 2009; North 1994).

Tapping into the theoretical universe of the French demographer Emmanuel Todd (1987, 1990, 1998, 2011) may help us to advance our knowledge on these relations (Duranton et al. 2009; Mamadouh 1999; Schultenover 1999). His basic thesis is that institutions at micro and macro levels mirror each other, meaning that the institutions regulating us in macro follow the same rationales as those socialising us in micro. These rationales will subsequently also guide the creation of cultural forms, religious or secular. At the same time, cultures present and represent these rationales to us symbolically. This way of reasoning makes Todd isolate the basal variables guiding the formation of institutions where these are most easily attained, namely at the micro level, in the family. The variables chosen, authority and equality, are the same as Habermas (2001: 59) later came to identify '. . .as the sum total of the causal determinants of inequality and domination (. . .) that constitute society' as distinguished from the state. While institutions at the micro and macro level thus reproduce and confirm each other, Todd repeats the insight that primary socialisation outpaces secondary socialisation in terms of its socialising impact.

Gathering and systematising data on family, property and heritage patterns from all over Western Europe at the NUTS3 level, Todd (1990) has constructed a typology consisting of four basic family types with several subtypes. This model was later refined and extended to the global scale (Todd 2011), but in this article, I will make use of the basic model as it serves my empirical illustrations best and as it has also been put to use in a deliberate, though more polemic than scientific, discussion of capitalist forms by Todd (1998) himself (Fig. 1).

In the model, the family is analysed along dimensions of verticality and horizontality. The vertical dimension measures the degree of authority, where households consisting of three generations are believed to express more authority than households consisting of two generations only. The horizontal dimension measures the degree of equality, where heritage rules treating siblings on equal terms are judged to monitor general patterns of equality while heritage rules favouring one of the siblings or allowing for random procedures of heritage are thought to show tolerance for inequality. When forced into the model as shown above, four basic family types emerge.

The communitarian family represents a three-generational family where a strong father lives together, or in the vicinity, with equally positioned sons. Upon his death, they will inherit from him on equal terms, and each of them may in turn become the father of a new communitarian family. **The stem family** represents a three-generational family normally practicing primogeniture, meaning that the eldest son

Fig. 1 The basic family model. Source: Emmanuel Todd (1990)

		Equality	
		Yes – Siblings treated equally	No – Siblings treated unequally
Authority	Yes - Three generational household	Communitarian family	Stem family
	No - Two Generational household	Egalitarian nuclear family	Absolute nuclear family

inherits the property, while younger siblings are compensated otherwise and have to leave in order to marry into other three generational families or start their own family. The two **nuclear family** types are both characterised by two generations only, with children leaving their parental household to form their own household elsewhere. In the **egalitarian nuclear family**, children are treated equally regarding heritage, while in the **absolute nuclear family** children may be treated on unequal bases, often through a will. The various types have their different geographies. In a historical setting, as in the present day, families will appear in a myriad of forms in all societies. Family types appear as typical for a specific region, either because they are the most common of many minority forms, because they have been more dominant historically speaking, or because they represent a type that displays prestige or attain specific legal or cultural attention. Following Todd (1990: 62), the approximate mapping of these types offers a pattern as shown in Fig. 2.

For each of these regionally hegemonic family types, there are political and religious cultures that interpret and represent them and their values, and hence these cultures also tend to be understood as typical and hegemonic of their respective regions. The same is also true for types of capitalism as well. To take Britain as an example, the two-generational family dominated the central part of England and Scotland already in the middle ages (Laslett 1965). We thus encounter demographic

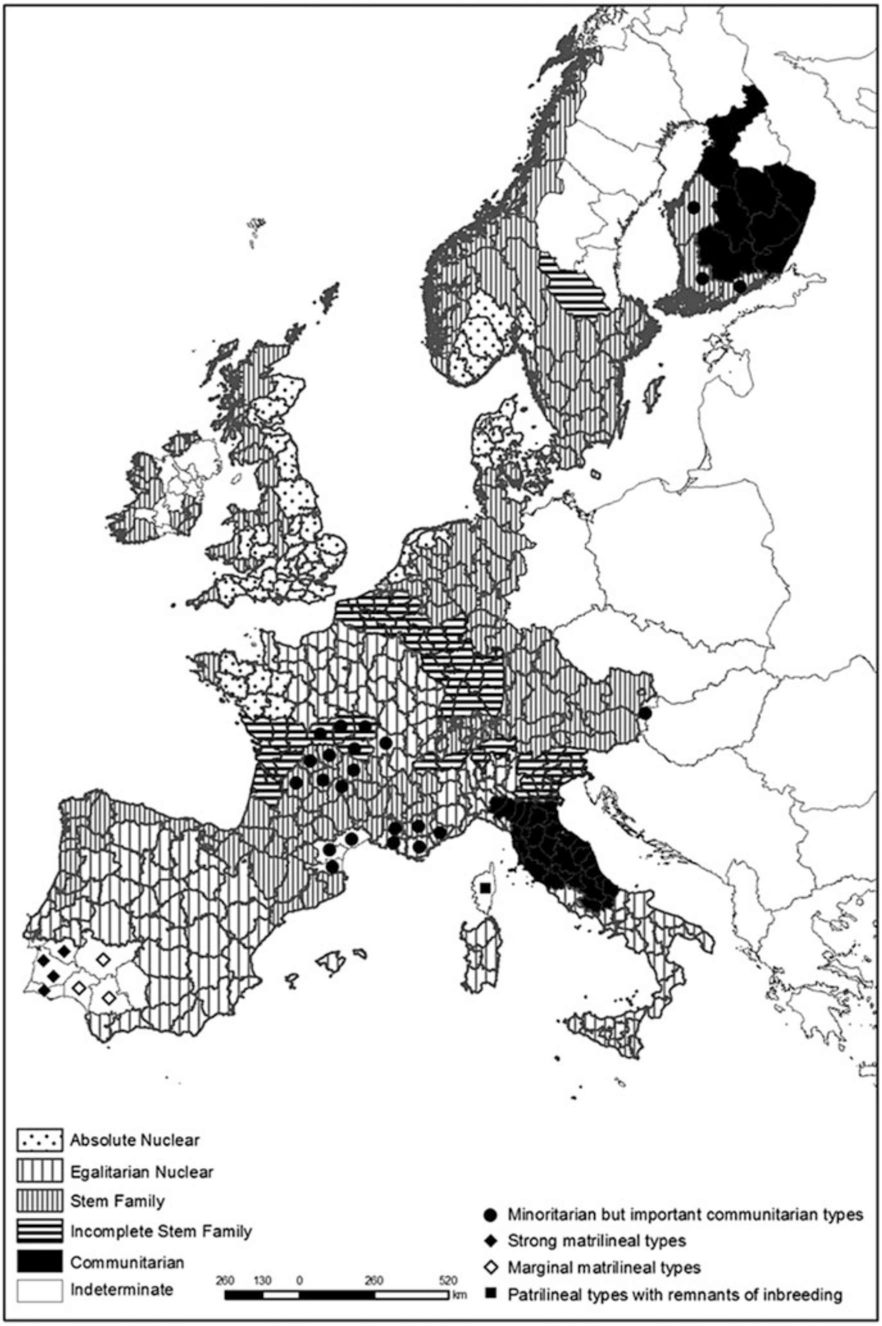

Fig. 2 The classical Todd (1990) map of Western European family types. Source: Duranton et al. (2009: 29)

patterns that are stunningly stable and resistant, historically and geographically, displaying what Reher (2004) has labelled ‘persistent contrasts’. The absolute nuclear family is not, as popularly believed, a recent invention. It is only perceived as such because of its historical and ideological association with a specific integration between economic and social order that has gone from being a regional phenomenon to become the prescribed demographic order of global capitalism, just like the English language took a similar tour in the realm of symbolic interaction. Thus, Duranton et al. (2009) find, in a comprehensive quantitative study testing the Todd-hypothesis on a large battery of contemporary socio-economic variables, that it has more statistically explanatory power than most other theories at hand.

7 From Culture to Economy and Innovation

Let us pursue this way of reasoning in the field of innovation. Innovation behaviour as outlined by Schumpeter (1934[1911]), should basically be understood as requiring acceptance of economic inequality and of the ability to challenge authority. The first of these parameters should be the most crucial given that innovation presupposes the ability to concentrate capital and to earn profit above average rates from investments. The concentration of capital and the ability to claim super-profit needs institutional support. Two of the family types referred to fulfil this requirement whereas two of them do not. Moreover, lack of authority may be labelled a desirable, though not necessary, condition for innovators. In principal, we can therefore rank the four family types according to their theoretical propensity to foster innovation practices as shown in Fig. 3.

The absolute nuclear family appears as the most innovation-leaning institutional type by freeing the innovator both from vertical (authority) and horizontal (equality) restrictions. The communitarian family type appears as the least innovation-friendly by its insistence on valuing both authority and equality. The stem family should be judged slightly more favourable than the egalitarian nuclear family for its tolerance of inequality, which is not being compensated by the alternative rejection of authority by the latter.

Geographically, the absolute nuclear family type corresponds roughly with the core area of the North West European LME type. From here, this family type and its concomitant form of capitalism has spread to Anglophone countries all over the world. By legitimising ruptures and inequalities, this family type socialises values that are needed to make mobility and turbulence, economically, geographically and socially acceptable to society. The political values of this family type are liberalism and pragmatic socialism. Its main religious form is reformed Protestantism. Especially, liberalism and reformed Protestantism have become unmitigated and enhanced in their North-American extrapolations. Both ideologies highlight that the individual solely is responsible for his or her actions and for his or her destiny (Knudsen 2016). The innovator is hence described in radical terms: he is a self-made man, incarnating Schumpeterian agency.

Family type	Theoretical acceptance for innovation behaviour
Absolute nuclear family	++
Stem family	+
Egalitarian nuclear family	÷
Communitarian family	÷÷

Fig. 3 The family model and its theoretical acceptance for innovation behaviour

The European core area of the CME type of capitalism is the German and Scandinavian speaking parts of the continent. These are largely dominated by the stem family, and hence the cultural values are different from the LME societies (Fauve-Chamoux and Ochiai 2009). Important virtues are loyalty, place attachment, and continuity. The geographical and institutional fixation is historically displayed by the ideal of transmitting capital, be it the family farm or the family company, in better shape from one generation to the next. By this, the logic of innovation can be described as place-bound incrementalism. Capital should be augmented by piecemeal and steady work rather than by radical and spectacular interventions. The concomitant political ideologies are organic conservatism and social democracy, both highlighting vertical authority as a core value. Social democracy hence adopts the thesis of democratic centralism, but deviates from communism, and the absolute quest for equality, by accepting the market. The ideal-typical religious form of the stem family is Lutheranism, which deviates from reformed Protestantism by its insistence on vertical structures linking national churches and states.

These schemes apply on a general basis. There are however important variations between and within countries that merit a closer discussion. The Nordic countries in general, and Norway more specifically, serve to illustrate the case. The Nordic countries are split between different family types (Löfgren 1974; Todd 1990: 62). In Finland, the stem family dominates the historically Swedish-speaking coastal band, while the rest of the country is marked by the tradition of the communitarian family type. Denmark is dominated more by the absolute nuclear family than by the stem family, while Norway appears to be split between the two. Sweden is dominated by the stem family, but its northern part presents a difficult case due to its complex ethnic composition. The Norwegian case with a south-eastern core area dominated by the absolute nuclear family and the remaining periphery characterised by the stem family, should lead to defining the country as consisting of two VoC-types, a LME-like economy in the southeast and a CME-like economy in the remaining parts of the country. This is in line with earlier observations on general social, economic and political cleavages in Norwegian society (Øidne 1957; Rokkan 1967) and adds a theoretical explanation to earlier attempts to distinguish between two types of economic modernisation by industrialisation affecting various regions differently. The pervasive industrialisation of the Oslofjord-area with its distinct patterns of industrial towns and related hinterlands following an 'English' model, stood in sharp contrast to the organic industrialisation of the rural West and the sluggish industrialisation of other regions (Jøssang 2002; Wicken 1997, 2004).

8 VoC and Modes of Innovation

The general argument often presented is that different types of VoC support different modes of innovation. The LME economies favour radical innovation through mobility and rupture, while the CME economies favour incremental innovation through stability and continuation. Furthermore, the two economies are often linked to various modes of innovation as suggested by the dichotomisation between a DUI (doing, using interacting) and a STI (science, technology, innovation) mode. Radical innovations are thought to appear in a STI context where inventions and patents from scientific activity nourish the work of innovators. Incremental innovations are equally linked to the DUI context (Casper 2010).

However, this scheme needs some modification. The American type of innovation seems to follow it, but we also find that typical CME countries like Germany and Sweden have strong STI cultures known to foster both radical and incremental innovations. Countries often characterised as intermediate between the LME and CME poles like Denmark and Norway (Schneider and Paunescu 2012) are more DUI than STI oriented (Cooke 2016). Taking this discussion to the regional level, again for Norway, more nuances appear, but the model seems to support the case. Industrialisation based on radical innovations and geographical transformation of local communities through urbanisation has historically characterised the LME region centred on the Oslofjord region (Wicken 1997). The type of rural industrialisation found in some regions of the West, especially in Jæren, Nordfjord and Sunnmøre, with its incremental attitudes towards innovation and organic cohabitation with existing settlement structures and local cultures, tend to mirror the values of a stem family based CME society (Fløysand and Sjøholt 2007; Jacobsen and Lorentzen 2015; Jøssang 2002).

9 Two Types of CME-Economies?

CME economies are often presented as strongly vertically integrated, even though decision structures tend to involve employees more tightly than will be the case in the LME economies. This integrative trait contributes to distinguish German and Swedish companies from their American and British counterparts. This is further used as an argument for why workers and engineers play a more important role for incremental innovation within their companies. It is not happening because they are hired to perform innovation in the first place, but because their roles within their respective organisations are installed with authority (Gertler 2004; Thelen 2001). This does not imply that these societies necessarily adhere to standards of non-hierarchical organisations. In both countries, strong class hierarchies are found, which also affect the way business communities operate, not the least through corporate and family ownership. In both countries, political culture supports the verticality of the societal logic, that of stability and order, and channel democratic impetuses into formal structures of manageable representative participation.

Norway, though historically devoid of a native nobility, also had a distinct class structure where rural proprietaries and traders along with an upcoming stratum of industrialists in isolated company towns formed the top of the social and economic pyramid. This pattern especially prevailed along an axis from the interior East through Trøndelag and into Northern Norway, leaving especially the valleys and the mountain-areas of the interior East to economic stagnation (Wicken 1997). This pattern is in stark contrast to the vivid entrepreneurial activity often reported from the core areas of rural industrialisation in West Norway (Fløysand and Sjøholt 2007; Jøssang 2002; Wicken 1997). Even though both areas are characterised by the CME label and dominated by the stem family with its organic value systems highlighting family and place bound loyalty, the verticality of the social order is different. In a classical stem family society, verticality applies to all levels from the state through regional and local authorities and down to the family as the basic cell of the structure. In the rural West, this system is, with some exceptions, broken at the meso-level. In most local communities, there is simply no notable class-structure. Traditionally, farmers were free and independent, but hardly wealthy. They revered God, the state and paternal authority, but no economic or social matador ruled the ground at the local and regional levels. The breaking of the chain of verticality presents possibilities and challenges of a cognitive nature. The missing vertical link creates a representational vacuum, which is being filled by the community chieftain as an informal type of leadership (Høydal 1995; Knudsen 2015; Yttri 2015). The opportunities consist in free men being able to devote themselves to all kinds of entrepreneurial processes, economically as well as culturally and politically.

Although the rural West is a stronghold for the stem family and displays many traits of a CME economy, its verticality is defied by a social structure showing a far-driven, local equality. The problem resides in a three-generational, inequality-tolerant society being reproduced as extremely egalitarian. The mechanism at operation is easily explained. The hereditary system ordains that farms should be passed on undivided, meaning that the oldest son, recently also daughter, inherits the property. Thus, a given ownership structure is reproduced from one generation to the next. This means that where the social structure is marked by inequality this feature will be passed on through generations, but equally, where society is characterised by an egalitarian structure, this equality is also being reproduced. Paradoxically, then, an egalitarian economic and social structure is being maintained by a hereditary institution favouring inequality. Hence, a social structure appears which I earlier have labelled *hierarchical egalitarianism* (Knudsen 2015). By necessity this structure fosters the creation of chieftains to mend its lack of local and regional authority, but the chieftain is primarily a cultural construct and figure. His authority is that of an informal leader, close to the Weberian category of charismatic leadership. He is accorded the role by popular esteem and credibility, having almost no economic benefit from taking on the position. He will normally act as a leader for his life-time, after which the leadership will be passed on to the next suitable person (Yttri 2015).

Economic innovators also took on the role as chieftains in many areas. While industrial innovators and leaders could adopt roles as tycoons and company town magnates in other parts of the country, this role was not in the repertoire of the rural West. Here, they would have to act as chieftains performing in the business sector, continuing to live on equal footing with their fellow inhabitants, share-owners and workers, culturally as well as economically (Asheim and Grillitsch 2015; Fløysand and Sjøholt 2007; Jøssang 2002). The notion *community fields* has been coined to designate local arenas where the hierarchic egalitarian logic of mutually cross-fertilising practices of innovation apply (Fløysand and Sjøholt 2007). Low transaction barriers and a high level of trust, together with a historical tradition of widespread literacy and learning dating back to a regional adaption of Enlightenment impulses from the late eighteenth century on (Eide 2009), dispose for a remarkable absorptive capacity favouring an early type of triple helix-process to form and thrive. This practically oriented use of relevant knowledge yields comparatively higher economic returns from its favourable institutional set-up than what could be said about more technologically and academically endowed urban milieus such as Trondheim and Oslo (Strand and Leydesdorff 2013). Thus, a special form of modernisation *from within* occurs, meaning that the communities in question attain a high level of economic competitiveness while conserving their inherited social, cultural and physical structures. A small-scale rural or semi-urban form of modernisation stands out as an alternative to classic forms of large-scale urban settlement and locational choices. Following the categorisation by Isaksen and Karlsen (2012), the type of innovation encountered in these communities can either be labelled *strong DUI* or, by its ability to absorb and transform external learning to the local knowledge platform, *combined and complex innovation (CCI)*. However, more empirical research is needed to substantiate this conclusion. Summing up, I suggest a tentative model of innovation logic as presented in Fig. 4.

This alternative CME structure proves competitive also in coping with global economic changes. A comprehensive study of the industrial structure of the agricultural district of Jæren, stretching into the rural hinterland southwards from Stavanger, shows how the remarkable industrial growth and transformation of the area took its early nineteenth century offset in small smithies, often located on farms and operated by farmers who practised as blacksmiths. Their experience as farmers formed the basis for innovation in a steady stream of new and better farming and agricultural tools and machinery as the smithies were converted into workshops and factories, forming a late twentieth century globally competitive cluster in agricultural machinery. This industrial structure was complemented and supported by spinoffs into other industrial branches, making the region a hub for

Family type ↔ VoC type → Rationale for innovation → Innovation type
Stem family dominated ↔ CME type 1 → Incremental → DUI
Hierarchic egalitarianism dom. ↔ CME type 2 → Creative continuation → Strong DUI, CCI
Absolute nuclear family dominated ↔ LME → Radical/Creative disruption → STI

Fig. 4 A tentative model of hegemonic regional innovation logics

advanced mechanical and robotic technological activities combining practical learning with externally extracted formalised competencies (Jøssang 2002). As such, the structure was well equipped to meet the demands from the oil and gas industries entering this part of the country from the late 1960s; the practice-based knowledge structures were capable of discerning the immediate needs of their surroundings and transforming them into viable economic activities.

The merits of regions dominated by hierarchic egalitarianism are many, but their challenges should also be mentioned. As many of them are small in scale and with a weak urban structure, the threat of lock-in will always be felt simply from the lack of talent and of low institutional and occupational thickness. This feature is reinforced by the tendency of this social structure to refuse urbanism and to neglect the building of hierarchical, formal institutions. Its preferred institutional solution is to install lateral network structures, closer to a movement than to systemically aspiring and professionalised organisations. The county of Sogn og Fjordane, immediately north of Bergen, illustrates the case. Being the most rural in structure of all Norwegian counties, it has had an almost stagnate population for two centuries. Its innovative zeal has been invested in reactive cultural modernisation rather than in industrial revival. The county is marked by having an almost full adoption of the minority variety of written Norwegian, Nynorsk. Its school system is excellent, competing with the capital region of Oslo and Akershus in national scoring on the international PISA-tests (Programme for International Student Assessment). In fact, when controlling for the socio-economic profile of its population, Sogn og Fjordane may be said to have the best performing primary school system in the country (Knudsen 2015).

The cultural struggle of the rural West was, and still is, interlinked with its educational assets, a rurally based primary school system historically nourished by teachers, often cumulating in different social roles and acting as local chieftains. Their ideology characterised as locality-based, liberal-agrarian nationalism, was forged as an alternative programme for the nation-building process of the new nation. Two features should, however, be noted. First, the educational modernisation did not always spill over into economic modernisation after an initial period of agrarian modernisation faded out with the period between the world wars. The nexus between the cultural programme in place and its historical connections with agrarian and rural interests, often seems to have produced a situation of lock in, in which alternative paths to regional development became blocked. Second, the alternative nation-building programme coined and nurtured by the periphery claimed no national institutions, such as universities or theatres, to be erected in their core regions. The reason for this may be twofold: the institutional disposition of the hierarchic egalitarian ideology neglected formal institutions and the historical mistake in believing that the programme itself was strong enough to conquer the capital of Oslo and its adjacent regions harbouring differing values (Hoel 2009). This lack of impact from educational excellence and cultural modernisation on the economy is at odds with the mainstream belief that education and economic innovation per se are mutually supporting variables in local and regional contexts (Fritsch and Warwych 2014; Lorentzen 2007; Lundvall 1992). Hence, Sogn og Fjordane on the county level still figures as number one in education and as the definite laggard on the national innovation scoreboard (Knudsen 2015).

10 From Analysis to Policies

The analysis offered here actualises the problem of how to bring these insights onto the political agenda. In highlighting this problem, I once again stress the need for coupling policies to politics, as policies without legitimacy in politics are likely to have none or even negative impact. The first question is whether it is feasible to create policies which aim at the cultural prerequisites for innovation or not. The second question will be whether such policies will be judged as legitimate. Here, I disagree with Andrés Rodríguez-Pose (2013) who in a frequently cited article proposes seeing strategy steering institutions with an analogy to the way a bicycle's rear wheel is steered by its front wheel. This represents, I will maintain, a grave misunderstanding of the order of factors. Already common wisdom holds that 'structure eats strategy for breakfast', the point being that institutions only change slowly and then by the operation of the endogenous and exogenous dynamics into which they are woven. In this, political decisions and strategy processes mostly play meagre roles. A citation from Bloch (1993[1939]: 279) on the feudal interlude in European history may illustrate my point: '. . .it imparted its own colouring to what it received from the past, as if passing through a prism, and transmitted it to succeeding ages'.

Cultural forms found in Europe today replicate deep anthropological dispositions as suggested by Hofstede and Todd and confirmed by Duranton et al. (2009). This implies that these old, formative schemes are still operating and that new institutional forms, be they cultural, economic or political, are conditioned by their mechanisms. Returning to Weber, his take on religious schemes as pivotal factors to understanding cultural rationales should not be judged as obsolete. We see from the analysis of global data that religion, as a comprehensive cultural label, still has substantial explanatory power on various geographical levels (Norris and Inglehart 2004). But, as Todd (1990) maintains, Weber overlooked the anthropological patterns *conditioning* the religious divisions across Europe (Knudsen 2016). Hence in Todd's scheme, religion becomes an intervening variable and not an independent variable as with Weber. Nonetheless, both furnish cultural arguments which in the end can be used to substantiate the CME/LME-dichotomy.

Picking up Wicken's (2004) insistence on politics being differently performed and policies differently interpreted from one region to another within an otherwise, at least to foreigners, seemingly homogenous country, we find ourselves close to a point where academic analyses and applied research can fruitfully meet. Again, however, a problem close to the laïcist taboo on religion in present day politics arises: We can only exceptionally coin an economic policy for people from one region and a different one for people living in another region, by referring to their culturally inherited rationales as being different. I can think of just a few circumstances where this will apply, most saliently that of indigenous minorities' institutionalised traditions of land use and property rights. Otherwise, culturally caused economic cleavages will be *deculturalised* and socio-economically masked to fit the formal-pragmatic rationales of regional policies in a post-religious political climate, nationally as well as on the EU level. Culturally explained variations, cleavages and mismatches are translated to a different cognitive and rhetorical universe, where the problems to be addressed are assessed on a systemically legitimate formula, but where it otherwise is difficult to ascertain whether the logics behind the problems are being passed on or lost in translation.

Norway presents an instructive case, that of the rise and fall of regional policies. In a country where the capital area with its hinterland bears the marks of being an LME-economy while most of the periphery falls into the CME-category, it is striking that the regional policy mapping shows almost the same distribution. While most of the CME-area happens to be targeted by regional policy assistance schemes, the quasi-totality of the LME-area is left to compete without such public support (Meld. St. 18 2016–2017: 105). At the outset, this bifurcation was socio-economically argued as the immediate post WWII-situation first required special attention for rebuilding and the modernisation of Northern Norway and then, subsequently, the modernisation of the peripheries of Southern Norway (Hansen 1972). In a centre-periphery perspective, it may be almost tautological that regional policies are there for the outskirts. However, an alternative interpretation would be that CME-economies *by logic* require more public involvement than LME-economies, and that this also applies on a sub-national level.

Looking at the present map of the regional distribution of GDP in the country, it has two, or rather three, peaks: one in the LME centre of the capital, and two in the Western CME-region, one of them in the axis of Stavanger-Bergen, strongly related to the national hubs of the oil and gas economy, and the other in Møre og Romsdal, a county which has all the characteristics of a growth model based on hierarchical egalitarianism (Meld. St. 18 2016–2017: 34). Substantial parts of the national CME-realm have experienced a remarkable economic upturn in recent years. The common explanation to this phenomenon is generally given by referring to the effects of the oil and gas activities and of new marine industries, especially fish farming. Others explain it by reference to the ability of the CME economy, especially in its West Norwegian variety, to foster an institutional platform conducive to stimulate the innovation potentials stemming from its industries at hand

(Asheim and Grillitsch 2015; Strand and Leydesdorff 2013). In this perspective, theories of regional variations in cultural disposition will supplement or compete with more mainstream economic theories in explaining historical and contemporary patterns and practices of innovation.

11 Conclusion

Fundamentally, we still struggle to come to terms with many aspects of the socio-cultural geographies of innovation. This, it may be argued, can partly be explained by the complexity of the concept. What we know is that innovative practices seem to vary according to cultural context. In addition, we should reckon that contingent factors, possible to describe by referring to historical legacies and present practices, account for much of the readiness to innovate in a society at a given geographical scale. This line of reasoning has two important consequences, one for research and one for policy formation. The first is an urge to pursue more multi-paradigmatic research on regional innovation according more importance to cultural aspects. The second is an argument for policy devolution and contextualisation, meaning that culturally sensitive policies developed in and for a specific geographical context will have better chances of being relevant to meet regionally specific challenges and capabilities than policies imported from without or from above.

References

Albert, M. (1993). *Capitalism vs capitalism*. New York: Four Walls Eight Windows.

Amable, B. (2003). *The diversity of modern capitalism*. Oxford: Oxford University Press.

Asheim, B., & Grillitsch, M. (2015). Smart specialisation: Sources for new path development in a peripheral manufacturing region. In Ø. Strand, E. Nesset, & H. Yndestad (Eds.), *Fragmentering eller mobilisering. Regionalutvikling i Nordvest. Fjordantalogi* (pp. 87–113). Oslo: Forlag 1.

Bloch, M. (1993[1939]). *Feudal society 1. The growth of the ties of dependence*. London: Routledge.

Casper, S. (2010). The comparative institutional analysis of innovation: From industrial policy to the knowledge economy. In G. Morgan, J. L. Campbell, C. Crouch, O. K. Pedersen, & R. Whitley (Eds.), *The Oxford handbook of comparative institutional analysis* (pp. 335–362). Oxford: Oxford University Press.

Charles, N., Davies, C. A., & Harris, C. (2008). *Families in transition. Social change, family formation and kin relationship*. Bristol: Policy Press.

Coleman, J. (1964). *Introduction to mathematical sociology*. New York: The Free Press.

Colombo, S., & Regini, M. (2016). Territorial differences in the Italian 'social model'. *Regional Studies, 50*(1), 20–34.

Cooke, P. (2016). Nordic innovation models: Why is Norway different? *Norsk Geografisk Tidsskrift – Norwegian Journal of Geography, 70*(3), 190–201.

De Tocqueville, A. (2003 [1835-1840]). *Democracy in America and two essays on America*. London: Penguin.

Duranton, G., Rodríguez-Pose, A., & Sandall, R. (2009). Types and the persistence of regional disparities in Europe. *Economic Geography, 85*(1), 23–47.

Eide, E. S. (2009). Bønder og bøker - opplyst folkelighet omkring år 1800. *Nytt norsk tidsskrift, 26* (2), 141–150.

Fauve-Chamoux, A., & Ochiai, E. (Eds.). (2009). *The stem family in Eurasian perspective. Revisiting house societies 17th -20th centuries*. Bern: Peter Lang.

Flora, P., Kuhnle, S., & Urwin, D. (1999). *State formation, nation-building and mass politics in Europe: The theory of Stein Rokkan. Based on his collected works*. Oxford: Oxford University Press.

Florida, R. (2005). *Cities and the creative class*. New York: Routledge.

Fløysand, A., & Sjøholt, P. (2007). Rural development and embeddedness: The importance of human relations for industrial restructuring in marginal areas. *Sociologia Ruralis, 47*(3), 205–227.

Friel, D. (2005). Transfering a lean production concept from Germany to the United States: The impact of labor laws and training systems. *Academy of Management Executive, 19*(2), 50–58.

Fritsch, M., & Warwych, M. (2014). The long persistence of regional levels of entrepreneurship: Germany 1925-2005. *Regional Studies, 48*(6), 955–973.

Fukuyama, F. (2011). *The origins of political order*. London: Profile Books.

Gertler, M. S. (2004). *Manufacturing culture: The institutional geography of industrial practice*. Oxford: Oxford University Press.

Gertler, M. S. (2010). Rules of the game. The place of institutions in regional economic change. *Regional Studies, 44*(1), 1–15.

Greif, A. (2006). Family structure, institutions, and growth: The origins and implications of Western corporations. *American Economic Review, 96*(2), 308–312.

Grytten, O. H. (2013). The Protestant ethic and the spirit of capitalism: Entrepreneurship of the Norwegian Puritan leader Hans Nielsen Hauge. *Review of European Studies, 5*(1), 31–44.

Habermas, J. (2001). *The postnational constellation*. Cambridge: MIT Press.

Hall, P., & Soskice, D. (Eds.). (2001). *Varieties of capitalism. The institutional foundations for competitive advantage*. Oxford: Oxford University Press.

Hancké, B., Rhodes, M., & Thatcher, M. (2007). *Beyond varieties of capitalism: Conflict, contradictions, and complementarities in the European economy*. Oxford: Oxford University Press.

Hansen, J. C. (1972). Regional disparities in Norway with reference to marginality. *Transactions of the Institute of British Geographers, 57*, 15–30.

Hirschman, A. O. (1976). *The passion and the interest. Political arguments for capitalism before its triumph*. Princeton: Princeton University Press.

Hoel, O. L. (2009). *Målreising og modernisering i Noreg 1885-1940. Doktoravhandlingar ved NTNU 2009.208*. Trondheim: NTNU.

Hofstede, G. (1991). *Cultures and organizations. Software of the mind*. London: McGraw-Hill.

Høydal, R. (1995). *Nasjon – region – profesjon. Vestlandslæraren 1840-1940. KULT skriftserie nr. 45*. Oslo: Forskningsrådet.

Isaksen, A., & Karlsen, J. (2012). What is regional in regional clusters? The case of the globally oriented oil and gas cluster in Agder, Norway. *Industry and Innovation, 19*(3), 249–263.

Jacobsen, S.-E., & Lorentzen, T. (2015). Between bonding and bridging: Regional differences in innovative collaboration in Norway. *Norsk Geografisk Tidsskrift-Norwegian Journal of Geography, 69*(2), 80–89.

Jøssang, L. G. (2002). *Industrievntyret på Jæren. 1800-2000*. Oslo: Samlaget.

Knudsen, J. P. (2015). Education and social structure. In H. Chr, G. Johnsen, S. Torjesen, & R. Ennals (Eds.), *Higher education in a sustainable society. A case for mutual competence building* (pp. 29–50). Berlin: Springer.

Knudsen, J. P. (2016). Un cas *d'ecclesiolae in ecclesia* en Norvège à la lumière de la théorie culturelle d'Emmanuel Todd. *Social Compass, 63*(1), 57–75.

Knudsen, J. P., Normann, R. H., & Schulze-Krogh, A. C. (2017). *Smart specialization – Norwegian adoptations*. (Manuscript in review).

Laslett, P. (1965). *The world we have lost: England before the Industrial Age*. London: Methuen.

Lorentzen, M. (2007). Social capital and localised learning: Proximity and place in technological and institutional dynamics. *Urban Studies, 44*(4), 799–817.
Löfgren, O. (1974). Family and household among Scandinavian peasants: An exploratory essay. *Ethnologica Scandinavia. A Journal for Nordic Ethnology, 1974*, 17–52.
Lundvall, B.-Å. (1992). *National systems of innovation: Towards a theory of innovation and interactive learning*. London: Pinter Publishers.
Lundvall, B.-Å. (2002). *Innovation, growth and social cohesion. The Danish model*. Cheltenham: Edward Elgar.
Mamadouh, V. (1999). A political-cultural map of Europe. Family structures and the origins of differences between national political cultures in the European Union. *Geo Journal, 47*(3), 477–486.
Marangoni, G., & Solari, S. (2006). Flexible specialisation 20 years on: How the 'good' industrial districts in Italy have lost their momentum. *Competition and Change, 10*(1), 73–87.
Marshall, A. (1890). *Principles of economics*. London: Macmillan.
Meld. St. 18. (2016–2017). *Berekraftige byar og sterke distrikt*. Oslo: Ministry of Local Government and Modernisation.
Norris, P., & Inglehart, R. (2004). *Sacred and secular: Religion and politics worldwide*. New York: Cambridge University Press.
Normann, R. H., Johnsen, H. C. G., Knudsen, J. P., Vasström, M., & Johnsen, I. G. (2017). Emergence of regional leadership—A field approach. *Regional Studies, 51*(2), 173–284.
North, D. C. (1994). Economic performance through time. *American Economic Review, 84*(3), 359–368.
Øidne, G. (1957). Litt om motsetninga mellom Austlandet og Vestlandet. *Syn og Segn, 63*(3), 97–114.
Østerud, Ø. (Ed.). (2007). *Norway in transition: Transforming a stable democracy*. London: Routledge.
Piore, M. J., & Sabel, C. F. (1984). *The second industrial divide: Possibilities for prosperity*. New York: Basic Books.
Porter, M. E. (1990). *The competitive advantage of nations*. New York: The Free Press.
Porter, M. E. (2000). Attitudes, values, beliefs, and the microeconomics of propserity. In L. E. Harrison & S. P. Huntington (Eds.), *Culture matters: How values shape human progress* (pp. 14–28). New York: Basic Books.
Ptak, R. (2009). Neoliberalism in Germany: Revisiting the Ordoliberal foundations of the social market economy. In P. Mirowski & D. Plehwe (Eds.), *The road from Mont Pèlerin: The making of the neoliberal thought collective* (pp. 124–125). Cambridge: Harvard University Press.
Putnam, R. D. (2000). *Bowling alone*. New York: Touchstone Books.
Reher, D. S. (2004). Family ties in Western Europe. Persistent contrasts. In S. G. Dalla & G. A. Micheli (Eds.), *Strong family and low fertility: A paradox?* (pp. 45–76). Dordrecht: Kluwer.
Rodríguez-Pose, A. (2013). Do institutions matter for regional development? *Regional Studies, 47* (7), 1034–1047.
Rokkan, S. (1967). Geography, religion and social class: Cross-cutting cleavages in Norwegian politics. In S. M. Lipset & S. Rokkan (Eds.), *Party systems and voter alignments* (pp. 367–444). New York: The Free Press.
Sandberg, L. H. (1982). Ignorance, poverty and economic backwardness in the early stage of European industrialization. Variations on Alexander Gerschenkron's Grand Theme. *Journal of European Economic History, 11*(3), 675–697.
Sæther, A., & Eriksen, I. E. (2014). Ragnar Frisch and the Postwar Norwegian economy. *Econ Journal Watch, 11*(1), 46–80.
Schneider, M. R., & Paunescu, M. (2012). Changing varieties of capitalism and revealed comparative advantages from 1990 to 2005: A test of the Hall and Soskice claims. *Socio-Economic Review, 10* (4), 731–753.
Schröder, M., & Voelzkow, H. (2016). Varieties of regulation: How to combine sectoral, regional and national levels. *Regional Studies, 50*(1), 7–19.

Schultenover, D. G. (1999). An anthropological view of the modernist crisis. *Journal of Religion & Society, 1*(1), 1–37.

Schumpeter, J. A. (1934). *The theory of economic development: An inquiry into profits, capital, credit, interest, and business cycles*. Cambridge: Harvard University Press.

Strand, Ø., & Leydesdorff, L. (2013). Where is synergy indicated in the Norwegian innovation system. Triple-helix relations among technology, organization, and geography. *Technological Forecasting and Social Change, 80*(3), 471–484.

Teague, P. (1977). Lean production and the German model. *German Politics, 6*(2), 76–94.

Thelen, K. (2001). Varieties of labor politics in the developed democracies. In P. Hall & D. Soskice (Eds.), *Varieties of capitalism. The institutional foundations for competitive advantage* (pp. 71–103). Oxford: Oxford University Press.

Todd, E. (1987). *The causes of progress. culture, authority and change*. Oxford: Basic Blackwell.

Todd, E. (1990). *L'Invention de l'Europe*. Paris: Seuil.

Todd, E. (1998). *L'illusion économique. Essai sur la stagnation des sociétiés dévéloppées*. Paris: Gallimard.

Todd, E. (2011). *L'origine des systèmes familiaux. Tome 1: L'Eurasie*. Paris: Gallimard.

Weber, M. (1947 [1922]). *Gesammalte Aufsätze zur Religionssoziologie*. Tübingen: Mohr.

Wicken, O. (1997). Regionenes industrialisering – et historisk perspektiv. In A. Isaksen (Ed.), *Innovasjoner, næringsutvikling og regionalpolitikk* (pp. 80–111). Kristiansand: Høyskoleforlaget.

Wicken, O. (2004). Politikk som konkurranse mellom industrialiseringsformer. In P. Arbo & H. Gammelsæter (Eds.), *Innovasjonspolitikkens scenografi: Nye perspektiver på næringsutvikling* (pp. 50–65). Trondheim: Tapir.

Witt, M. A., & Redding, G. (2013). Asian business systems: Institutional comparison, clusters and implications for varieties of capitalism and business systems theory. *Socio-Economic Review, 11*(2), 265–300.

Yttri, G. (2015). Læraren som bygdehøvding. In G. Langfeldt (Ed.), *Skolens kvalitet skapes lokalt* (pp. 66–96). Bergen: Fagbokforlaget.

Zhang, J., & Peck, J. (2016). Variegated capitalism, Chinese style: Regional models, multi-scalar constructions. *Regional Studies, 50*(1), 52–78.

Institutional Agency and Path Creation

Institutional Path from Industrial to Knowledge City

Markku Sotarauta and Nina Suvinen

Abstract

This chapter argues for the need to focus more explicitly on institutions and the related agency to gain a better understanding of the relationship between micro and macro levels and thus of path creation. The core concepts related to path creation and institutional agency are investigated. The research question is: What are the main institutional strategies adopted by intentional actors, independently or in collaboration, in their efforts to boost institutional path creation and renewal? This question is scrutinized in the context of a knowledge-city development and use Tampere, Finland as a case in point. The analysis reveals that the early stages of new path creation can be explained by both institutional factors and/or the strong entrepreneurial agency It also highlights the crucial role of the institutional agency shaping the rules of the game and the playing field for industry-oriented efforts.

Keywords

Institution · Agency · Path creation · Tampere

1 Introduction

Regional development and related innovation-oriented studies have faced interesting challenges. On one hand, micro-level analyses do not usually provide much insight into structural changes. On the other hand, more structurally oriented studies tend to "read off" actors from national (or local/regional) institutional structures (Gertler 2010, 5). In this paper, we argue for the need to focus more explicitly on

M. Sotarauta (✉) · N. Suvinen
Faculty of Management, University of Tampere, Tampere, Finland
e-mail: markku.sotarauta@uta.fi; nina.suvinen@uta.fi

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_5

institutions and the related agency to gain a better understanding of the relationship between micro and macro levels and thus of path creation.

Many studies have shown how institutions mediate economic development and path creation in subtle but pervasive ways. Institutions frame many actors' choices and actions, as well as their interactions. Consequently, institutions frame the emergence of new industrial paths and are potential sources of lock in. More specific conceptualisations of institutional agency and related strategies are called for, as path creation is about (a) releasing the future potential underlying existing institutions and (b) institutionalising the released potential. Understanding institutional agency in the context of path creation is crucial because it aims to mould and is simultaneously affected by many kinds of history-informed social practices and routines.

Following the work of Dawley (2014, 92), who stresses the importance of moving beyond firm-centric accounts of path creation, we study "a wider array of actors and multi-scalar institutional contexts that mediate the emergence and development of growth paths". We also follow Isaksen's (2015) argument that the new regional industrial path development includes both renewal and creation. We extend his view beyond the growth of new activities and industries via regional branching (path renewal) and the growth of entirely new industries (path creation) to include *institutional* path creation. It would serve us well if we knew more about institutional strategies of local, national and international actors and learn more about how they influence one another in time. Sotarauta (2017) contends that these issues and the secrets of institutional path creation may be tackled best by adopting an actor-centric bottom-up view on institutions to complement the dominant top-down perspective. The main aspiration of an actor-oriented approach is to strengthen the ways that the concepts of institution and institutional agency can be used as analytical tools to investigate path creation, as well as the relationships between agency and institutions.

From these premises, we investigate the core concepts related to path creation and institutional agency. What are the main institutional strategies adopted by intentional actors, independently or in collaboration, in their efforts to boost institutional path creation and renewal? We scrutinise these questions in the context of a knowledge-city development and use Tampere, Finland as a case in point. We focus on the main institutional changes and the related agency, shedding light on how Tampere has been transformed from an industrial to a knowledge city. Carrillo et al. (2014) maintain that one of the key ingredients of any knowledge city constitutes superior quality, higher educational institutions that also undertake scientifically excellent quality and economically and socially relevant research. In this regard, we pay special attention to how Tampere has become a university town and how university–industry collaboration has become one of the defining features locally.

We continue our efforts to appreciate the ways that local actors work to construct local institutional arrangements, but we focus on institutional meta-strategies instead of following our earlier more detailed studies on agency, institutions and strategies. The case illustrates the conceptual discussion and suggests future avenues for research rather than providing conclusive empirical evidence for institutional agency and path creation. In line with Dawley's (2014) position, we believe that by dismantling and making sense of long processes of regional evolution and path creation, we would learn much about not only local and regional development but also the relationships between institutions and agency.

This paper presents a re-analysis of the extensive empirical data that has been collected for four independent research projects (see Kostiainen and Sotarauta 2003; Suvinen 2014; Sotarauta and Mustikkamäki 2015; Sotarauta and Heinonen 2016). The data is based on (a) secondary data, including online materials; relevant journals; dozens of related newspaper articles; policy documents from different levels of governance; various business, technology and other strategies related to the national, regional and local-level industries; funding decisions of external funding bodies, as well as meeting minutes and other official documents from critical junctions in time; and (b) a total of 77 interviews[1] with key actors.

2 Towards a Bottom-Up Approach to Institutional Change

2.1 Basic Tenets of Institutions

Institutions are habitually defined as recurrent patterns of behaviour (habits, conventions and routines) (Morgan 1997) and socially constructed rule systems or norms that produce routine-like behaviour (Jepperson 1991). North (1991) simplifies institutions as the rules of the game. Martin (2000) distinguishes between the institutional environment and institutional arrangements, defining the former as consisting of generic social conventions, rules and routines, which determine the informal incentives of innovation systems. Institutional arrangements shape specific institutional forms, defining the ways that political choices and policies are framed and how formal economic incentives are identified and enacted (Rafiqui 2009).

Scott (2001) further divides institutions by using three pillars—regulative, normative and cultural-cognitive. The regulative pillar underlines the rule settings and rewarding and sanctioning activities that control and constrain behaviour and hence influence future behaviour. The normative pillar comprises values and norms. It points out rules, introducing obligatory, prescriptive and evaluative dimensions of behaviour and highlighting factors that aim at preferred and/or desirable behaviour. It also includes standards on which existing values and norms are built (Scott 2001, 51–54). The cultural-cognitive pillar serves as a reminder of how external frameworks shape internal interpretation processes (Scott 2001, 57). Cognitive-cultural institutions frame the way that actors perceive, interpret and understand themselves, as well as their actions and positions in broader structures.

[1]We express our gratitude to Nina Mustikkamäki and Tuomo Heinonen, who conducted 52 interviews.

The kinds of institutional changes framing the journeys from an industrial to a knowledge city are sometimes approached as if institutional changes would be easily detected and explicitly initiated and directed by market-based entrepreneurs or policy makers. Of course, in the case of Tampere, it would be easy to list some of the critical incidents, such as the establishment of universities, a science park, some national and local development programmes, reorganisations of firms, changes in legislation affecting local development, and so on. These are undoubtedly crucial junctions in a long journey. Some of them are mentioned below, but the true nature of institutional path creation cannot be fully appreciated by analysing only the changes in formally defined top-down institutions. Nonetheless, in the course of the decades, the Finnish institutions regulating and setting normative expectations for science, technology and innovation (STI) were both transformed and fine-tuned with a top-down approach. Towards the 1990s, the institutional arrangements eventually changed to centre explicitly on innovation.

2.2 Path Dependency and Institutions

The regional studies community has shown a growing interest in how socioeconomic systems change over time. A series of studies using metaphors, ideas and models drawn from evolutionary sciences has emerged (e.g. Boschma and Martin 2010). Consequently, among many other concepts, path dependency has also become a household term in regional development studies, reflecting, for its part, the evolutionary turn (Djelic and Quack 2007; Martin 2010).

In path dependency, “events occurring at an earlier point in time will affect events occurring at a later point in time” (Djelic and Quack 2007, 161). Expressed slightly differently, path dependency explains a current state of affairs from its history (Boschma and Frenken 2006). In a stronger sense, “path dependency characterizes historical sequences in which contingent events set institutional patterns with deterministic properties into motion” (Djelic and Quack 2007, 161–162). Path dependency explains how existing institutions preserve what is already present and how economic restructuring may be slowed down because of this, as well as how the indigenous potential and creativity in regions may neither be fully developed nor exploited. As Martin (2000) reminds readers, institutions preserve social practices and routines; hence, they are the carriers of history, passing institutional ingredients into the future. Importantly, Martin (2010) argues that in its dominant lock-in oriented form, the path-dependence model affords a restrictive view on local and regional industrial evolution. He shows how it emphasises more continuity than change. Moreover, much remains to be done to fully understand how an industry emerges, how a new path is created, drawing on already existing resources in a region (Simmie 2012), or how new unrelated resources and capabilities can be constructed to support path creation (Boschma 2017).

Tampere is a city that has experienced several institutional transformations and has witnessed its share of lock-in situations. In the nineteenth century, it developed from a small village into Finland’s first large-scale industrial city. Over 100 years later, it belongs to the group of leading Finnish knowledge city-regions, with its 380,000 inhabitants. It is the second research and development (R&D) centre in the country, with a 13% share of national R&D spending in 2015 (public and private), the peak year being 2010, with a 16% share of R&D in Finland (Statistics Finland: PX-Web Database). Its transformation from an industrial to a knowledge city has not been a straightforward path from one era to another but a bumpy road with industrial restructurations and the unemployment rate occasionally rising above 20% or close to it.

Martin's (2010) canonical path-dependence model of spatial industrial evolution can be used to describe the industrial evolution in Tampere. The founding of the town in 1779 was a historical accident; its location between two lakes and the rapids flowing through it provided hydro power and hence an ideal site for industries. Moreover, the King of Sweden,[2] and later the Tsar of Russia, provided it with freedom of enterprise; thus, Tampere became established as a free industrial town (Rasila 1988, 379–398). It enjoyed similar kinds of privileges as only Eskilstuna did at that time, among all the Swedish towns; trade and industrial enterprise were unimpeded in these two towns. The industrial path began to emerge due to the "development of self-reinforcing autocatalytic processes of agglomeration economies" (Martin 2010, 5). Martin's model proposes that early path creation, stemming from a historical accident, is followed by a path-dependent lock-in, which is caused by getting bogged down in increasing returns (agglomeration economies). From the 1970s to the 1990s, Tampere was in many ways locked into its industrial heritage. External shocks hit it hard, including expanding industrial automation, the oil crisis in the 1970s, upheavals in Eastern Europe in the late 1980s and the consequent loss of export markets, as well as the severe recession of the early 1990s. The city struggled to bounce back, but it eventually did with considerable success.

Tampere's industrial paths consisted of three main developments (with several more specific sub-trajectories not discussed here). First, the earlier dominant textile industry faced difficulties and declined in the 1970s, and Tampere faced a 'life-cycle type trajectory', per Martin's model (2010, 10). Second, Tampere went through 'rejuvenation' (Martin 2010), as the engineering industry faced severe difficulties in the early 1990s but was able to renew itself and maintain its position by infusing new technology and services into its product portfolio. The third of the main economic trajectories was the rapid growth of the ICT cluster in the 1990s. Since the 2000s and the 2010s, it has faced Nokia's and Microsoft's reorganisation and is struggling to renew itself. For its part, it can be described as experiencing an 'ongoing change and mutation' (Martin 2010). Parkinson et al. (2012) conclude that the continuous reinvention of Tampere has been influenced by proactive local development policies, business sector activities and forward-looking, relatively young universities (Benneworth 2007). In this paper, we focus on the universities.

[2]Finland was a part of Sweden until 1809 and after that, an autonomous grand duchy of Russia until 1917.

2.3 Institutional Agency and Path Creation

Path creation is a highly complex process involving sequences and the accumulation of events over long periods of time. In line with Garud et al.'s (2010) argument, we emphasise the power of reflexive agency and cumulative processes of gradual change as forces in path creation. Garud and Karnøe (2001) highlight that instead of being given, initial conditions are constructed by actors; thus, various incidents shaping paths should not be approached as exogenous and manifesting something unpredictable, non-purposive and random but as emergent and serving as embedded contexts for agency. Garud and Karnøe's framework of path creation and hence of institutional change differs slightly from those that stress the political nature of path creation (Djelic and Quack 2007) or those that observe institutional change emerging due to entrepreneurial efforts of science and policy actors despite the lack of business entrepreneurs (Sotarauta and Mustikkamäki 2015). Djelic and Quack (2007) conclude, "different societal actors with different economic and political interests, normative orientations and social identities strive to shape the institutional rules used to govern the overall societal system or specific subsystems" and thus path creation. With this thinking, it follows that the many self-reinforcing mechanisms are rather strategically manipulated than simply given from the outside. Therefore, if the path-dependency literature highlights how lock-in happens through adherence to a path, the view opened by path creation states that lock-in situations are "provisional stabilizations within a broader structural process" but not permanent (Garud and Karnøe 2001).

Drawing on Emirbayer and Mische (1998), we define agency as an "action or intervention to produce a particular effect". Interestingly, they highlight both the path-dependent and the path-creative nature of agency by noting that it is informed by the past but performs a simultaneously channelling action towards the future. As such, agency is a temporally embedded process of social engagement, calling for a strong capacity to interpret past habits and future prospects (Emirbayer and Mische 1998). The complexity of actor constellations means that the paths are likely to develop emergent qualities, that is, characteristics not directly intended by any of the actors involved but stemming out in direct or indirect interaction with the multiplicity of them (Djelic and Quack 2007; Sotarauta 2016). Therefore, agency is best studied in its full complexity by situating it in the flow of time. The reason is that actors often amend their agentic tendencies. Their capacity to intervene is not static; the way that they make choices or push for transformation fluctuates in time due to changing situations and their own capacity in relation to such situations (Emirbayer and Mische 1998, 963).

We dissect institutional agency into two distinct but interrelated concepts—institutional entrepreneurship and institutional navigation. Institutional entrepreneurship refers to conscious efforts to pool and mobilise resources and capabilities to create and/or change institutions (Battilana et al. 2009; Sotarauta and Pulkkinen 2011). As Schumpeterian entrepreneurs, institutional entrepreneurs also grasp new opportunities and emerging combinations of knowledge and markets. Their major faculty is the will to accomplish something (Weik 2011, 470). Entrepreneurs' primary interest is to "map unknown terrain, to move where no-one dared venture before" (Weik 2011, 470–471). Entrepreneurs are not inventors who create new possibilities but aim at the practical execution of these. Entrepreneurs are thus involved in non-routine strategies, and in doing so, they encounter social resistance from those who want to defend the prevailing institutions (Weik 2011, 471).

Institutional navigation focuses on the ways that actors deal with mixed messages of many institutions and comply with them, all the time formulating and implementing their own strategies. Institutional navigation allows us to understand institutions and institutional manoeuvres through the experiences of actors who are not necessarily able to mould institutions but are aware of their effects and work to navigate through often conflicting institutional arrangements (Sotarauta 2017). In practice, the concepts of institutional entrepreneurship and navigation overlap and do not describe the static functions of actors but the forms of agency and how agential roles fluctuate in time.

3 Institutional Agency and Meta-Strategies: From Institutional Opportunism to Institutional Offensive

We broadly discuss institutional evolution in Tampere but select a few incidents that, according to many other analyses (e.g. Parkinson et al. 2012), illustrate well the nature of institutional changes in this specific case. As stated, we do not focus on industrial but on institutional path creation that provides the local playground and rules of the game for the prospective industrial path developments. Therefore, the phasing reflects institutional agency rather than changes in industrial trajectories, the aim being to specify a generic top-down description with the agency-oriented bottom-up observations.

The institutional influences shaping path creation are similar to tides, going back and forth. Webster's dictionary defines tide as "the alternate rising and falling of the sea [. . .] due to the attraction of the moon and [the] sun". It is also "a powerful surge of feeling or trend of events". Inspired by these definitions, institutional tide is perceived here as the alternate rising and falling of belief systems due to the attraction of models in global circulation, top-down institutions and local needs. The phases of institutional tides and the related agency discussed here are as follows:

- working against the institutional tide with an *opportunistic* institutional strategy,
- adapting to a turning institutional tide with an institutional *protection* strategy,
- going with the institutional tide and exploiting the innovation hype with an institutional *expansion* strategy and
- launching an institutional *offensive*.

The institutional strategies introduced here are not actual planned or deliberate strategies but long-term meta-strategies that can be identified in retrospect. Of course, meta-strategies paint an unnecessarily neat picture of institutions and path creation. In practice, they always include arrays of deliberate strategies of many actors and many kinds of incidents, as well as conflicts and moments of joy. Meta-strategies are used to illustrate the overarching development patterns that provide the many other strategies with a broader meaning and link to agency in the long run.

3.1 Working Against the Institutional Tide with Opportunistic Institutional Strategy

Universities are institutions in their own right. They frame local actions and choices of many actors in many ways, generate new opportunities and attract knowledge and insights from afar. The history of higher education and scientific research in Tampere is recent, dating back to the 1960s. From the late 1950s to the early 1980s, the Finnish higher education system grew rapidly by expanding spatially, and the government established new universities in different parts of Finland to secure equal opportunities to education and promote balanced economic development (Tirronen 2005). Instead of being a beneficiary of national-level decisions, Tampere had to rely on local agency, and it basically ended up usurping two universities from Helsinki. First, following colourful events and cunning ploys, the local actors successfully convinced the small private College of Social Sciences to relocate from Helsinki to Tampere in 1960 (see Seppälä 1998). In 1966, it was renamed the University of Tampere. As the local desire for higher education in engineering dated back to the 1850s, soon after acquiring the College of Social Sciences, the city government began to fulfil another institutional dream. In 1964, it established a committee to formulate a strategy to set up a technical university in the city (Wacklin 1995, 16). This ambition was supported by the local conviction about the need to generate new industrial fields. The institutional dream materialised in 1965 when a filial unit of the Helsinki University of Technology was established in Tampere. The rector and the board of the Helsinki University of Technology were in favour of it, but the professors and the Union of the Electrician Engineers did not support it (Wacklin 1995, 16–17). As planned in advance by the local actors, the filial unit was turned into an independent university of technology in 1972 (Ahonen 1993; Wacklin 1995, 53). Similar to every university in Finland, the two new Tampere-based universities became state universities in 1974 (Kaarninen 2000).

Usurping the two universities from Helsinki was not actually supported by the government; neither was it forestalled, although the process also met resistance. In a way, in the early days of its knowledge-city strategy (not explicitly defined as such yet), Tampere applied an approach that can retrospectively be labelled as institutional opportunism. Institutional opportunism is a strategy of knowledge-race coevolution, in which a weaker party taps into a stronger ecosystem and aims to exploit the latter to strengthen its own institutions. Tampere tapped into the strongest science concentration in Finland and quickly constructed a local institutional capacity for the future. As shown in retrospect, the universities have played a central role, not only in the attractiveness of the city but more specifically, in several industrial path developments, including the rapid growth of the ICT industry in the 1990s, upgrading of the engineering and the automation industries since the early 1990s and the emergence of medical technology and optoelectronics.

To highlight the cases in point, all these developments were supported by first, the two universities' efforts to profile themselves differently from the other Finnish universities by establishing future-oriented professorships starting in the 1960s. For example, the professorship in computer sciences established at the University of Tampere in 1965 was the first in the Nordic countries. The two universities also pioneered in other fields of study (Kaarninen 2000; Häikiö 2015). For its part, the strategy adopted by the universities paved the way for new fields of industry to emerge in the following decades. Second, the local-level understanding of especially enhancing the technological skills of the local labour force soon met the national-level policy to increase the overall number of university students in the country. The two Tampere-based universities started to grow rapidly.

Third, the early institutionalisation of the university–industry collaboration proved crucial for the subsequent industrial path creation. Since day one, Tampere University of Technology (TUT) has emphasised collaboration with industry and labelled itself as a university for industry (Häikiö 2015). However, in the early days, the institutional arrangements from above were not supportive at all, and close collaboration between universities and industries was not regarded as desirable. On the contrary, it was considered a threat to the purity of science, and the Ministry of Education issued a strict regulation against academic research services for companies (Häikiö 2015). The restrictive policy concerning collaboration with industries was locally deemed harmful; indeed, despite strong institutional pressure from above, TUT continued its collaboration with firms. As Hassi states, "if discrepancies of interpretation occurred with the Ministry, the interpretations were consistently made in the university" (1993, 381–382).

However, the question was about not only the unfavourable national institutional arrangements regulating university–industry collaboration but also the minimal structures supporting collaboration even until the mid-1980s. To some extent, the question also involved the lack of a structured dialogue among different institutional actors to overcome the implementation gaps (see Brömmelstroet and Schrijnen 2010). Interaction was quite largely based on (a) close personal-level contacts between professors and industry leaders, (b) an explicit conviction that strengthening local institutional capacity would be important for the future and that close collaboration in several technology fields was an imperative and (c) the cunning institutional navigation of local leaders to work against the will of the Ministry of Education without harming the university's future. Indeed, the city government's obstinacy was decisive in establishing two universities in town, and TUT's obstinacy was crucial in securing its role as a "university for industry".

In sum, regulative and normative top-down institutions regulated against university–industry collaboration, and Tampere was not in a position to receive a government-established university. The local leaders in Tampere were convinced of the need to have universities, not only for education and science but also for city and industrial development. Local cognitive-cultural institutions concerning higher educational institutions and collaboration between universities and industries somewhat conflicted with the national institutions, and proactive local agency proved crucial.

3.2 Adapting to a Turning Tide with an Institutional Protection Strategy

If the 1970s were characterised by strong top-down regulation and normative institutional pressure against university–industry interaction, in the 1980s, the institutional environment and thus institutional arrangements gradually began to become less hostile towards university–industry collaboration and to emphasise its significance. Suddenly, the still smallish science and innovation community in Tampere was well positioned to exploit the changing national institutions and gradually increasing RD funding. The opportunistic strategy was left behind, and institutional protection began.

In Tampere, as well as in some other Finnish city-regions, technology centres and technology-transfer agencies were founded, and more proactive local business development strategies were adopted in the 1980s (Linnamaa 2002; Männistö 2002; Pelkonen 2008). Normally, this kind of phase might be characterised using policy or organisational terms. However, from an institutional perspective, the question was about taking several steps forward in institutionalising university–industry interaction, in other words, protecting it against other ideas requiring public attention and funding. Since protection refers to efforts to preserve something, institutional protection is an elemental part of an institutionalisation process. Institutionalisation involves "a process of a new practice, activity, norm, belief, or some other institution, becoming an established part of an existing system, organization or culture" (Sotarauta and Mustikkamäki 2015, 343). There was no need to protect the two universities as such, as they had earned their places in the Finnish higher educational system, but it was necessary to establish new structures and mechanisms to secure a well-functioning but non-structured university–industry interaction and take steps forward. By institutionally protecting university–industry interaction, the aim was to attain a higher degree of resilience. Thus, such collectives of actors were also added in the local system, whose mission was to develop and protect new social practices.

Although in the 1980s, the national institutions became more permissive towards university–industry interaction, and local structures supporting it were constructed, the somewhat conflicting situation prevailed. For example, organisations under the state government (including universities) were not allowed to own any property, make commercial acts or establish specialised companies to perform certain functions. As the universities' hands were still somewhat tied, locally emerging support communities, often led by the local government, proved important. Many of the new mechanisms institutionalising university–industry collaboration was initiated by the local government in cooperation with other stakeholders and were based on extensive collaboration among firms, public-sector actors and higher educational institutions. Eventually, the new models have led to a situation where many of the Finnish universities have not been strategic in their own engagement efforts, as there is usually a network of actors around them, constructing collaborative models with and for them.

In sum, the tide was beginning to turn. Cognitive-cultural institutions supporting university–industry interaction, complemented by several regulative and normative ones, were constructed but were still in their early stages of development. Several institutional discrepancies remained, sending conflicting messages to local actors.

3.3 Exploiting the Innovation Hype with an Institutional Expansion Strategy

In the early 1990s, the institutional tide turned more comprehensively, and Finland became a star pupil in the global class of innovation students. The policy emphasis was laid on innovation; thus, university–industry interaction was also stressed. The policy focus shifted explicitly to global competitiveness, innovation systems and clusters; formal institutional arrangements began to be transformed and to expand accordingly. Indeed, Finland was among the few countries in the world that began to construct a new type of innovation and cluster-oriented policies already at that time. Lemola (2016) calls the 1990s a "golden decade" of the Finnish innovation policy but notes that the tide started to turn in the 1980s, and seeds of change were planted even earlier, also nationally. Prior to the economic recession of the early 1990s, Finnish public R&D policy focused primarily on individual enterprises and macro-economic factors rather than on the contexts of innovation (Romanainen 2001, 381). The new policy's meta-rationale was reflected on the idea of perceiving the innovation process and policies from a broad perspective, spanning from education and science to firms' innovative activities and commercialisation of technological innovations (Miettinen 2002).

In the expansive phase, the public policies related to STI increased at all levels of governance; all this was also enhanced by Finland joining the European Union in 1995. It is not possible to introduce all the institutional changes that aimed at boosting technology and innovation, but we illustrate the thinking of that time by using national and local development programmes as cases in point. They provided national and local contexts for increasing collaboration among the main parties and aimed to boost specialisation. Nationally, these included the Centre of Expertise Programme (1994–2013), Centres of Excellence for Science, Technology and Innovation (2006–2016/2017) and the Technology Programmes of Tekes. The programmes constructed a platform for ongoing dialogues among (a) national and local policy actors; (b) the public sector, firms and universities across the governance levels; and (c) the public sector, firms and universities at the local level. In a way, these were efforts to create focused and co-ordinated 'multi-scalar triple helix policies' to support clustered specialisation. The flagship programmes were tools in network management to cross the institutional divides. To complement the national programmes, the City of Tampere launched a series of local development programmes to further develop the strongholds of the local economy, provide platforms for collaboration and collective contemplations and continuously search for new directions. The local programmes focused on information society (2001–2005), biotechnology (2003–2009), creative economy (2006–2011) and open innovation (2012–2018).

Overall, Tampere was quick to exploit the more supportive national institutional arrangements for STI, as well as the continuously expanding R&D funding. The rapid growth of the Finnish ICT cluster was dominated by Nokia. Tampere became one of the hotspots of Nokia-led growth, along with the Helsinki and the Oulu city-regions. Indeed, R&D expenditure grew by 481% from 1995 to 2010 but has slowly declined since then (Table 1).

In addition to witnessing the rapid growth of the ICT cluster, in which the universities also played a central role, the expansive phase also saw the emergence of other specialised industrial paths. For example, a locally new industry—opto-electronics—emerged from one of the research groups of the Department of Physics of TUT. The key actors were able to institutionalise it and expand on the platforms constructed earlier. Eventually, an optoelectronics industry with several spin-off firms, a specialised intermediary organisation and related research activities became rooted in Tampere (Suvinen 2014). Another case in point is regenerative medicine (human spare parts industry); from its humble beginnings in the late 1990s, it has become one of the nationally acknowledged profile areas, with a joint research institute of the two universities and over 250 scientists. It represents a new field of science and a potential new industry that is an outcome of specialisation based on integrated institutions of the two universities and strong national support (see Sotarauta and Mustikkamäki 2015; Sotarauta et al. 2016). Moreover, the mechanical engineering and automation industry, often in collaboration with TUT, was able to upgrade its offerings and thus survive hard times.

If institutional opportunism and protection were essentially reinforced by individual actors and small active groups and were accelerated by their interaction, in the expansive phase, the question was not only about increasing volumes of resources but also institutionalising knowledge and innovation-oriented thinking more broadly in Tampere. Even though Tampere had built local institutions for science and innovation, renewed, protected and expanded them, even in the 1990s, the new thinking was not fully institutionalised in local policy spheres (Kostiainen and Sotarauta 2003). The strong perceptions and local collaboration patterns shaped by the industrial culture and traditions slowed down the institutional transition in the cognition from an industrial to a knowledge city, and the new perspectives were constantly confronted by the supporters of the old order. Nonetheless, step by step, the institutional changes initiated earlier started to pay off, manifested in several local economic development strategies and specialised development programmes. The new institutions crept in, and when the changes in the economy and the top-down institutions providing the country with normative directions moved to highlight STI, Tampere also began to gain a broader understanding of its own institutional strategies.

Table 1 The increase of R&D expenditure (€ million) in Finland and the city-regions of Helsinki, Tampere and Oulu, and the shares of the leading city-regions (Statistics Finland: PX-Web Database)

	1995		2000		2005		2010		2015	
City-regions	R&D exp.	Share (%)	R&D exp.	Share (%)	R&D exp.	Share (%)	R&D exp.	Share (%)	R&D exp.	Share (%)
Finland	2172	100	4423	100	5474	100	6971	100	6071	100
Helsinki	1027	47	1965	44	2275	42	2958	42	2842	47
Tampere	189	9	606	14	835	15	1099	16	758	12
Oulu	174	8	493	13	688	13	935	13	633	10
Turku	141	7	268	6	317	6	379	5	345	6
Others	641	29	1091	25	1360	25	1601	23	1493	25

Interestingly, despite top-down institutions becoming in favour of university–industry collaboration, some institutional conflicts have remained. While the university act explicitly maintains that the Finnish “universities must interact with the surrounding society” (MoE), interaction is not supported by the funding system that is used by the government to allocate funds from the state budget to universities. All the 13 indicators emphasise excellence in research and education, not engagement; therefore, increased tension exists between research excellence and various forms of engagement. Only time will tell whether strong university–industry interaction will prevail in Tampere or whether the strong funding related to regulative institutions will guide universities to focus increasingly on scientific excellence even though the normative institutions demand otherwise.

3.4 Launching an Institutional Offensive

After the expansive phase, Finland has moved to a no-growth era in its R&D. Both public and private R&D expenditure has been in decline since the 2010s. The innovation policy community in Finland seems to be reaching beyond the R&D-oriented, STI-dominated policy and is seeking to find inspiration from such concepts as the Doing, Using, Innovation (DUI) mode of innovation, innovation platform and innovation ecosystem. It is too early to assess where the policy thinking is heading, and what kind of institutional agency is in the making. In Tampere as well, the new approach revolves around innovation ecosystems and platforms; again, new ways to organise local development work are sought. At this point in time, it is difficult to know whether the question is about minor deviations or a somehow novel policy paradigm in the making.

From the institutional perspective, the most important of the latest institutional strategies is the prospective amalgamation of the University of Tampere, TUT and the Tampere University of Applied Sciences that is planned to take place in 2019, which would create a university with more than 35,000 students. The amalgamation of the most social science-oriented Finnish university with the most engineering-based one is a story of its own, especially when the forthcoming higher education concern crosses the strictly regulated gulf between research universities and polytechnics (universities of applied sciences). Our data does not cover the latest phase. Thus, we need to be content with acknowledging that the University of Tampere has made the initiative and has gained wide support from the government and the Ministry of Education and Culture, as well as local stakeholders. It should also be acknowledged that the amalgamation process in itself is a bumpy road with many kinds of incidents. At all events, the main objectives of the amalgamation are to provide students, scholars and scientists with new learning environments, as well as multidisciplinary platforms for producing new types of combinatorial knowledge. Of course, perhaps most importantly, the goal is to institutionally secure the national position as the second largest higher education, science, and innovation concentration in Finland. At least implicitly, another objective is to challenge the dominant position of the capital city. An institutional opportunist has launched an offensive.

4 Discussion

Market-related entrepreneurial agency is usually considered important in the early phases of industrial path creation. Relying on Mazzucato's (2014) study, we emphasise the need to acknowledge, identify and analyse the institutional influences that not only constrain but also make market-related entrepreneurial agency possible. In line with Holmen and Fosse's (2017) position, we argue that the early stages of new path creation can be explained by both institutional factors and/or the strong presence of entrepreneurial agency, as well as highlight the institutional agency shaping the rules of the game and the playing field for industry-oriented efforts. It is not only economic agency that shapes the emergence of new paths, but many kinds of agency are involved and needed (see also Dawley 2014). The main difficulty here lies in identifying the significance of the institutional agency of the past for the industrial path creation of the present. For example, the local actors in Tampere have been cultivating local institutions for STI since the 1950s. Thus, they have been engaged in simultaneous capacity building here and now and the cultivation of local conditions for serendipitous developments in the future. Many developments that appear to many observers as accidental or pure luck have in fact been influenced by institutional agency years or decades earlier.

We have used a broad brush to illustrate the institutional changes and the related agency in Tampere and to discuss how institutions are moulded over the long term and how the fruits of the institutional meta-strategies become visible much later. At this stage of conceptual development, the brush is so broad that the link between the concepts of meta-strategy and agency is not fully utilised and remains to be strengthened in forthcoming studies. Additionally, labelling a complex series of development phases and related incidents as comprising a shift from institutional opportunism to protection to expansion to offensive is an outright simplification of institutional evolution over decades. It contains several specific institutional and industrial trajectories and endless series of decisive incidents. As such, the case under scrutiny supports the view that institutional change is not straightforwardly Lewinian by nature [melt the old, change and freeze again (Lewin 1951)] but Confucian, that is, processional and as such, continuously equilibrium seeking (Weick and Quinn 1999). Inspired by our case analysis, as well as Streeck and Thelen's (2005) study, we suggest that new institutional arrangements creep into the old institutions. Continuous combinations of abrupt and incremental institutional changes are neither transformative (path creative) for nor reactive/adaptive to the protection of the past path but simultaneously both. Institutional agency operates in the nexus of the past, the present and the future, as well as many kinds of institutions. This type of approach seems to bring forward a fairly voluntaristic perspective on agency (see also Männistö 2002).

Especially in the early phases of new institutional developments, institutional entrepreneurship and the related navigation are often unplanned, highly personal and intuitive forms of agency (Ritvala and Kleymann 2012; Sotarauta and Mustikkamäki 2015). Actors simply do what they believe must be done without fully realising what might follow and what kinds of institutions they end up confronting, on one hand, and explicitly changing, on the other hand. When the time is right, it is possible to establish new organisations or carry out other institutional reforms that superficially appear new and fresh but have been boiling under the institutional surface for some time before emerging. It is possible to identify the core institutional entrepreneurs at different phases and detect master navigators, but it is just as important to acknowledge that they neither accomplished their ambitions alone nor quickly. In Tampere, several institutional entrepreneurs and navigators paved a way for both institutional expansion and offensive by shaping the local institutional arrangements by means of forging new structures, constructing a collective belief system, enriching the dialogue among the main players and renewing identities step by step. In a way, they were champions of creeping change. Actors collectively learnt new ways of thinking and constructed such new interpretations of themselves and the city that transformed cognitive-cultural institutions and in time, were also institutionalised regulatively and normatively that again shaped cognitive-cultural institutions. Reinterpretation is crucial because the institutional influence from the national level sanctions, one way or another, actions deviating from what is framed as suitable (Battilana et al. 2009), which, more often than not, leads to compliance, as local actors tend to bend to a wish, regulation or another institutional factor from above. However (as shown), in some cases, the local actors may successfully challenge the top-down influence and benefit from it later. Of course, it is always a risk to challenge institutional influence from above, but what institutional entrepreneurs do is to recognise opportunities and take risks.

The creeping nature of institutional change easily shadows all the institutional manoeuvres made earlier in time. The four meta-strategies—institutional opportunism, protection, expansion and offensive—comprise many kinds of influence tactics, encompassing coercion, networking, reinterpretation, belief formation, knowledge justification, professionalisation, lobbying, and so on. This kind of multidimensional and deviating behaviour is a challenging form of local agency and demands skilled institutional navigators who construct local institutions while navigating through the top-down influence without damaging prospects. Institutional path creation is indeed a political process. At all events, entrepreneurial activity is by necessity at the centre when institutions are consciously shaped for new paths to emerge. As the case of Tampere suggests, not only firms but several other types of actors can act entrepreneurially for path development. Additionally, any study on institutional agency requires openness to recognise the potentially unintended effects of complex social processes and thus the emergent qualities of institutional change processes.

5 Conclusions

This paper corroborates earlier studies showing institutional agency as a patchwork of action, as well as institutional entrepreneurship as a collective and processual form of agency (Drori and Landau 2011; Ritvala and Kleymann 2012; Sotarauta and Mustikkamäki 2015). It is collective as actors are both directly and indirectly dependent on one another's activities (also temporally). Often, they do not even perceive the interdependencies but simply build on what already exists without recognising the ways that institutions were moulded to allow a new phase to unfold. Institutional entrepreneurship and institutional navigation should not belong to the attributes of individual actors but be present in the relationships that connect actors in the emerging institutional path. We add to the earlier literature the notion of institutional navigation, that is, the ways that actors navigate through multilayered and conflicting sets of institutions. Organised institutional navigators not only comply with institutions, but when consciously aiming to find their way through them, they simultaneously end up promoting creeping change. Institutional navigation is a gentle form of institutional entrepreneurship.

In innovation studies, institutions are usually approached more instrumentally than by delving deep into the social structures of a given spatial entity. This may be the result of institutions being notoriously difficult to operationalise and the institutional theory still operating at an abstract level (Rodríguez-Pose 2013). Therefore, in regional innovation system studies, institutions are often specified by using predefined lists of institutions (Grillitsch 2016). Top-down institutions are relevant to have, but (as stressed throughout this paper) we might lose analytical power by focusing only on normative and regulative aspects of top-down policies, as well as cognitions prevailing at the national level. It might be impossible to fully appreciate the current position of Tampere, for example, without scrutinising local institutional strategies in relation to the top-down influences. It is believed here that to fully grasp the complex social-political-economic nature of path creation and the related institutionalisation, we need to reach beyond the top-down view on institutions and seeing only their national layer and find ways to study institutions in a bottom-up manner, through the local actors' intentions, strategies and preferences. As Sotarauta (2017, 589) points out, "if we focused solely on the top-down effect of institutions, we would neglect the diversity of actors and assume that they are all the same, while it is institutions that differ".

Acknowledgments With this piece of writing colleagues from Tampere, Finland wish to congratulate Björn on his birthday, and especially appreciate his longstanding contribution to the field and warm friendship. As a highly-cited scholar Björn is used to seeing his name in the list of references. As a token of appreciation, we decided not to cite Björn's work in this chapter, and thus provide him with a rare opportunity to see a scholarly piece without his name.

The authors are grateful to Kevin Morgan and Jon P. Knudsen for very constructive and useful pieces of advice.

References

Ahonen, P. (1993). *Tampereen teknillisen korkeakoulun synty* [The birth of Tampere University of Techonology]. In Tekniikan Tampere. Tampereen teknillinen seura.

Battilana, J., Leca, B., & Boxenbaum, E. (2009). How actors change institutions: Towards a theory of institutional entrepreneurship. *The Academy of Management Annals, 3*, 65–107.

Benneworth, P. (2007). *Leading innovation: Building effective regional coalitions for innovation*. Research report. London: Nesta.

Boschma, R. (2017). Relatedness as driver of regional diversification: A research agenda. *Regional Studies, 51*(3), 351–364.

Boschma, R., & Frenken, K. (2006). Why is economic geography not an evolutionary science? Towards an evolutionary economic geography. *Journal of Economic Geography, 6*, 273–303.

Boschma, R., & Martin, R. (2010). The aims and scope of evolutionary economic geography. In R. Boschma & R. Martin (Eds.), *The handbook of evolutionary economic geography* (pp. 3–39). Cheltenham: Edward Elgar.

Brömmelstroet, M. T., & Schrijnen, P. M. (2010). From planning support systems to mediated planning support: A structured dialogue to overcome the implementation gap. *Environment and Planning B: Planning Design, 37*(1), 3–20.

Carrillo, F. J., Yititcanlar, T., García, B., & Lönnqvist, A. (2014). *Knowledge and the city: Concepts, applications and trends of knowledge-based urban development*. Abingdon: Routledge.

Dawley, S. (2014). Creating new paths? Offshore wind, policy activism, and peripheral region development. *Economic Geography, 90*(1), 91–112.

Djelic, M.-L., & Quack, S. (2007). Overcoming path dependency: Path generation in open systems. *Theory and Society, 36*(2), 161–186.

Drori, I., & Landau, D. (2011). *Vision and change in institutional entrepreneurship*. New York: Berghahn Books.

Emirbayer, M., & Mische, A. (1998). What is agency? *The American Journal of Sociology, 103*(4), 962–1032.

Garud, R., & Karnøe, P. (2001). *Path dependence and creation*. London: Lawrence Erlbaum.

Garud, R., Kumaraswamy, A., & Karnøe, P. (2010). Path dependency or path creation? *Journal of Management Studies, 47*, 760–774.

Gertler, M. S. (2010). Rules of the game: The place of institutions in regional economic change. *Regional Studies, 44*(1), 1–15.

Grillitsch, M. (2016). Institutions, smart specialisation dynamics and policy. *Environment and Planning C: Politics and Space, 34*(1), 22–37.

Häikiö, M. (2015). *Tampereen teknillisen yliopiston historia 1965–2015* [History of the Tampere University of Technology 1965–2015]. Kirjokansi, 97, Helsinki: Suomalaisen Kirjallisuuden Seura.

Hassi, O. (1993). *Tampereen teknillinen korkeakoulu vuosina 1975–1992* [Tampere University of Technology in 1975–1992]. In Tekniikan Tampere. Tampereen teknillinen seura.

Holmen, A. K. T., & Fosse, J. K. (2017). Regional agency and constitution of new paths: A study of agency in early formation of new paths on the west coast of Norway. *European Planning Studies, 25*(3), 498–515.

Isaksen, A. (2015). Industrial development in thin regions: Trapped in path extension? *Journal of Economic Geography, 15*(3), 585–600. https://doi.org/10.1093/jeg/lbu026

Jepperson, R. L. (1991). Institutions, institutional effects, and institutionalism. In W. W. Powell & P. J. DiMaggio (Eds.), *The new institutionalism in organizational analysis*. Chicago: The University of Chicago Press.

Kaarninen, M. (2000). *Murros ja mielikuva. Tampereen yliopisto 1960–2000* [Period of transition and image: University of Tampere 1960–2000]. Tampere: Tampereen yliopisto & Vastapaino.

Kostiainen, J., & Sotarauta, M. (2003). Great leap or long march to knowledge economy: Institutions, actors and resources in the development of Tampere, Finland. *European Planning Studies, 10*(5), 415–438.

Lemola, T. (2016). *Finland: Building the base for telecom breakthrough*. A paper presented in "Industrial Policy for New Growth Areas and Entrepreneurial Ecosystems". Helsinki 28–29, November 2016.

Lewin, K. (1951). *Field theory in social sciences*. New York: Harper and Row.

Linnamaa, R. (2002). Development process of the ICT cluster in the Jyväskylä urban region. In M. Sotarauta, H. Bruun (Eds.), *Nordic perspectives on process-based regional development policy*. Nordregio report 2002:3, Stockholm.

Männistö, J. (2002). *Voluntaristinen alueellinen innovaatiojärjestelmä: Tapaustutkimus Oulun ict-klusterista* [A voluntaristic regional innovation system: The ICT cluster in the Oulu area]. Acta universitatis lappoensis 46. Rovaniemi.

Martin, R. (2000). Institutional approaches to economic geography. In T. Barnes & M. Sheppard (Eds.), *A companion to economic geography* (pp. 77–94). Oxford: Blackwell.

Martin, R. (2010). Roepke lecture in economic geography—rethinking regional path dependence: Beyond lock-in to evolution. *Economic Geography, 86*, 1–27.

Mazzucato, M. (2014). *The entrepreneurial state: Debunking public vs private sector myths*. London: Anthem Press.

Miettinen, R. (2002). *National innovation system: Scientific concept or political rhetoric*. Helsinki: Edita.

Morgan, K. (1997). The learning region: Institutions, innovation and regional renewal. *Regional Studies, 31*, 491–503.

North, D. C. (1991). *Institutions, institutional change and economic performance*. Cambridge: Cambridge University Press.

Parkinson, M., Meegan, R., Karecha, J., Evans, R., Jones, G., Sotarauta, M., et al. (2012). *Second tier cities in Europe: In an age of austerity why invest beyond the capitals?* Liverpool: Liverpool John Moores University.

Pelkonen, A. (2008). *The Finnish competition state and entrepreneurial policies in the Helsinki region*. Research reports no. 254, Helsinki University Print. University of Helsinki, Department of Sociology.

Rafiqui, P. (2009). Evolving economic landscapes: Why new institutional economics matters for economic geography. *Journal of Economic Geography, 9*(3), 329–353.

Rasila, V. (1988). *Markkinapaikasta tehdaskaupungiksi* [From market place to industrial city]. In Tampereen historia I. Tampereen kaupunki.

Ritvala, T. Y., & Kleymann, B. (2012). Scientists as midwives to cluster emergence: An institutional work framework. *Industry and Innovation, 19*, 477–497.

Rodríguez-Pose, A. (2013). Do institutions matter for regional development? *Regional Studies, 47* (7), 1034–1047.

Romanainen, J. (2001). The cluster approach in Finnish technology policy. In *Innovative clusters: Drivers of national innovation systems* (pp. 377–388). Paris: OECD.

Scott, W. R. (2001). *Institutions and organizations* (2nd ed.). Thousand Oaks: Sage.

Seppälä, R. (1998). *Hyökkäävä puolustaja. Maakunnan selviytymistaistelu ja Tampereen Kauppakamari 1918–1998* [Offensive defender: Regional fight for survival and Tampere Chamber of Commerce 1918–1998]. Otava, Helsinki.

Simmie, J. (2012). Path dependence and new technological path creation in the Danish wind power industry. *European Planning Studies, 20*, 753–772.

Sotarauta, M. (2016). *Leadership and the city: Power, strategy and networks in the making of knowledge cities*. Abingdon: Routledge.

Sotarauta, M. (2017). An actor-centric bottom-up view of institutions: Combinatorial knowledge dynamics through the eyes of institutional entrepreneurs and institutional navigators. *Environment and Planning C: Government and Policy, 35*(4), 584–599.

Sotarauta, M., & Heinonen, T. (2016). The Triple Helix model and the competence set: Human spare parts industry under scrutiny. *Triple Helix, 3*(8), 1–20.
Sotarauta, M., & Mustikkamäki, N. (2015). Institutional entrepreneurship, power, and knowledge in innovation systems: Institutionalization of regenerative medicine in Tampere, Finland. *Environment and Planning C: Government and Policy, 33*(2), 342–357.
Sotarauta, M., & Pulkkinen, R.-L. (2011). Institutional entrepreneurship for knowledge regions: In search of a fresh set of questions for regional innovation studies. *Environment and Planning C: Government and Policy, 29*, 96–112.
Sotarauta, M., Heinonen, T., Sorvisto, P., & Kolehmainen, J. (Eds.) (2016). *Innovation ecosystems, competencies and leadership: Human spare parts and venture finance ecosystems under scrutiny*. Tekes review 329/2016. Tekes, Helsinki.
Statistics Finland. *PX-Web Database*.
Streeck, W., & Thelen, K. (2005). Introduction: Institutional change in advanced political economies. In W. Streeck & K. Thelen (Eds.), *Beyond continuity: Institutional change in advanced political economies* (pp. 1–39). Oxford: Oxford University Press.
Suvinen, N. (2014). Individual actors building an innovation network. In R. Rutten, P. Benneworth, D. Irawati, & F. Boekema (Eds.), *The social dynamics of innovation networks* (pp. 140–156). Abingdon: Routledge.
Tirronen, J. (2005). *Modernin yliopistokoulutuksen lähtökohdat ja sivistyskäsitys*. Kuopion yliopiston julkaisuja E. Yhteiskuntatieteet 122. Kuopio.
Wacklin, M. (1995). *Lainahöyhenissä kohti teknopolista. Kronikka 30-vuotiaan TTKK:n vaiheista* [In borrowed plumes towards technopole: 30 years chronicle of Tampere University of Techology]. Tampereen teknillinen korkeakoulu.
Weick, K. E., & Quinn, R. E. (1999). Organizational change and development. *Annual Review of Psychology, 50*, 361–386.
Weik, E. (2011). Institutional entrepreneurship and agency. *Journal for the Theory of Social Behaviour, 41*(4), 466–481.

Part II

Empirical Cases of Regional Innovation System Development

Financial Organizations: An Overlooked Element in Regional Innovation Systems

Martin Gjelsvik and Michaela Trippl

Abstract

Financial organizations are a vital element in the regional innovation ecology. However, they are mostly absent in accounts of regional innovation systems. This chapter addresses this gap by exploring how different financial organizations contribute to economic renewal and new path development in four Norwegian regions. The study is guided by an evolutionary perspective on regional industrial development, invoking the concepts of path dependence and new path development. We investigate how financial organizations contribute to five different regional trajectories: path extension, path upgrading, path importation, path branching and new path creation. This chapter discusses the role of a differentiated set of financial organizations, including banks, venture capital, seed capital and wealthy individuals. Our study offers micro-level insights in the behavior of financial organizations to support various forms of path development. We find that banks primarily support path extension and path upgrading and to some degree path importation and branching. Venture capital has evolved from risk taking entities financing start-ups into private equity funds primarily engaging in buy-outs and restructuring of existing industries. Seed capital to fund new paths is scarce.

Keywords

Financial organizations · Regional innovation systems · Path development · Finance of innovation · Banks

M. Gjelsvik (✉)
International Research Institute of Stavanger (IRIS), Stavanger, Norway
e-mail: martin.gjelsvik@iris.no

M. Trippl
Department of Geography and Regional Research, University of Vienna, Vienna, Austria
e-mail: michaela.trippl@univie.ac.at

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_6

1 Introduction

Financial organizations constitute a core element in the regional innovation ecology. However, apart from a few exceptions (see, for instance, Cooke 2007) they are mostly absent in conceptual and empirical research on regional innovation systems. When financial organizations are dealt with, the focus of enquiries is often confined to the spatial distribution of venture capital (Sorensen and Stuart 2001; Martin et al. 2002, 2005), presumably because venture capital fosters change and new trajectories. Recently, another strand of research in economic geography has surfaced to study the geography of finance in itself (Dixon 2015), but without explicitly linking it to regional development and change.

Financial organizations may affect regional path development in several ways. Financial markets are found to play a decisive role in driving economic growth by supporting technological innovation (Neffke et al. 2011; Gjelsvik 2017). Financial organizations are supposed to transfer capital from stagnant industries to growth sectors, thus supporting those sectors that are driving regional growth. Growth rates vary between sectors and paths. Some may be in decline whilst others experience high growth with need for substantial financial support. The financial sector may take on a "demand-following role", i.e., financing the needs as defined by firms and industries. Financial organizations may also take a more active, "supply-leading role" by supporting technologies in which they have a strong belief. In that case, they identify opportunities for regional change or growth, and channel funds to entrepreneurs and firms that most likely have the capacity to turn those opportunities into innovative products, services and processes.

This chapter seeks to explore what kind of paths financial organizations mainly contribute to and how institutional configurations influence their activities. The paper proceeds as follows. The next section presents relevant theoretical perspectives and concepts of finance and regional innovation systems, respectively. We draw on evolutionary notions of path dependence and new path development and offer a nuanced perspective by considering different types of path development. Section 3 explains the research methods and data sources, and Sect. 4 introduces the four respective regions. Section 5 presents and discusses the results, highlighting the roles of financial organizations in path development. Section 6 provides insights into the institutional set-ups that affect the activities performed by financial organizations. Section 7 offers some conclusions and discusses policy implications emanating from our findings.

2 Theoretical Perspectives

Kerr and Nanda (2015) provide an updated overview of the literature on the finance of innovation. They refer to mainstream economics which assumes a frictionless world where all positive NPV (net present value) projects are financed and in which the sources of finance have no impact on the nature of innovations conducted by firms. However, R&D and innovation processes are characterized by features that impose frictions that lead to financial constraints. First, innovation processes are inherently uncertain, referring to Knight's (1921) discussion of the difference between real uncertainty and risk. Furthermore, agency problems exist. As a rule, the innovator knows more about the project than the financier. The output of the innovation process is highly uncertain, making it impossible to establish complete contracts (Aghion and Tirole 1994). Not only is the outcome uncertain, the potential profits are extremely skewed (Scherer and Harhoff 2000). These attributes of innovation and R&D investments have an important bearing on how different actors in the financial sector influence the degree of innovation in firms and the pace of regional renewal. Banks may experience big losses if the innovation fails, but they are generally not in a position to share the upside profits. Sharing the profit assumes equity stakes in the project, in which banks as a rule are not engaged. Banks (supplying debt financing) are hence more risk averse than organizations that take equity positions, such as venture and seed funds. The financial actors in a region (banks, venture funds, seed funds, business angels) take on different roles; consequently the *diversity* of the regional financial landscape is crucial for the regional innoation system. We therefore assume that banks focus on paths with a lower potential for risk, often associated with more familiar technologies that lead to path extension or path upgrading. Institutionally, venture and seed funds are better posistioned to take and monitor risks, and hence more suited to finance forms of path development that represent more radical breaks with the past.

Financial organizations differ in their capabilities to operate as selection devices both as a direct source of financial resources for more or less risky endeavors in firms, and as a "disciplining" influence on management behavior as they spell out "the rules of the game". It should be noted that financial organizations are permanently facing the dilemma between a prudent management of their funds (on behalf of their investors and depositors) and their capacity to take risk. Finance constitutes a crucial bridge between the present and the future, between experiences of what has proven to work in the past and the exploration of what might be possible in the future.

In a next step, we turn to theories of regional development. In evolutionary theory, history matters, which is expressed through the concept of path dependence (Arthur 1994). Path dependence is a ubiquitous phenomenon, which pertains to firms and institutions, as well as the regional level. The literature has documented many potential causes for path dependence from the micro level to system dynamics (in our case from the technology to the firm level and the regional innovation system level). Path dependence occurs when the current realization of socio-economic processes depends on previous states, even back to the initial conditions (Castaldi and Dosi 2014). There are several potential causes for path dependence. One source relates to the process of learning. When agents learn, their behavior depends on their memory of the past, i.e. on their prior experiences. The degree of path dependence may diminish when agents also change their "models" of the world, i.e. their very interpretative structures through which they process information. At a more aggregate level, organizations (such as providers of finance) and institutions such as laws, regulations, conventions and customs influence decisions and selection criteria at the individual level.

At the regional level, path dependence may result from a variety of sources (Martin and Sunley 2006). These may include localization and urbanization economies, technological lock-in, region-specific institutions, social norms and cultural traditions, sunk costs of local assets and infrastructure, etc. As new paths evolve, networks of producers, suppliers, research institutions and support organizations (in our case financial organizations) emerge that institutionalize specific paths of development.

Recent work in economic geography has shifted attention to new regional industrial path development and offers fine-grained typologies to capture various forms of regional economic evolution and change (Tödtling and Trippl 2013; Isaksen et al. 2016). One can draw a distinction between five types of regional industrial path development: path extension, path upgrading, path importation, path branching and new path creation.

Path extension refers to the continuation of an existing industrial path, driven by incremental innovation in existing industries along well-established technological trajectories. Path extension may be positive when an industry is being build up in a region. Firms benefit from economies of scale and scope. It may also be negative when an existing industry or product portfolio becomes "locked-in" to an outdated trajectory.

Path upgrading (sometimes also referred to as path modernization or renewal) refers to more fundamental intra-path changes, that is, transformation processes of established paths into a new direction. Such changes may lead to a renewal of existing paths based on the "injection" of the latest technologies or the implementation of organizational innovation.

Path importation means that established industries are transplanted to regions, in which they have not existed before. They are new to the region but not new to the world. Foreign direct investment might be an important mechanism, provided that incoming firms perform high value-added functions in the region and establish linkages to regional actors to enhance their embeddedness in the regional economy.

Path branching represents a more radical form of regional structural change. Branching implies that new paths grow out of existing industries and capabilities (Boschma and Frenken 2011) often fueled by related variety (Neffke et al. 2011; Boschma 2015). A core mechanism of such processes is the diversification of incumbent firms into new fields and sectors based on the redeployment of existing assets and capabilities. Branching, however, can also take place through the establishment of new firms based on competencies in existing industries. Firms may also diversify into a new industry based on unrelated variety (unrelated path diversification, see Grillitsch et al. 2017).

Finally, *new path creation* constitutes the most radical change, denoting the emergence of an entirely new industry based on new technological and organizational knowledge. Path creation may be the result of chance or historical accidents but more often it is related to pre-existing assets, resources or competencies in the region, such as an excellent scientific base (Tanner 2014) or the availability of highly skilled workers (Martin 2010).

Above we have outlined some general mechanisms behind various forms of path development. The degree of path dependence and the degree of structural change associated with emerging paths depend on the degree of newness of the selected innovations and firms. In addition to selections through product market competition, innovative efforts are shaped and selected by the criteria financial markets and organizations have implemented to allocate resources. A core question relates to the influence financial organizations may have on the paths taken or not taken. According to Dosi (1990), in a path dependent evolutionary system of technological change, firms have the capacity to search, make mistakes and sometimes obtain unexpected successes, and try to learn through such processes. Furthermore, product- and financial markets operate as selection devices among different technologies and firms, thus shaping regional industrial paths.

3 Research Methods

The study is based on in-depth interviews with 29 managers of financial organizations in four Norwegian regions. These interviews offer opportunities to study the micro foundations of regional industrial path development, as they reveal the selection criteria used by financial organizations to evaluate projects and firms that in turn form regional path development at a more aggregate level. We have taken interviews with managers from banks, venture funds and seed funds. Annual reports over the last 10 years comprise the other main data source. These reports reveal how different types of capital (bank lending, venture and seed capital) evolve over time. Banks represent by far the largest share of capital. We use distributions of business loan portfolios across industries as an indicator of what kind of paths are supported by banks. For commercial banks, regional loan distributions are not available, so we use their national data.

Three of the regions (Kristiansand, Stavanger and Bergen) are located in the south of Norway, whereas the fourth one, Finnmark, is situated in the northernmost part of the country. In an international comparison, all these regions are small. They are very important in a national context, however, as the three southern regions host strong and growing industries, mainly based on natural, local resources like oil and gas, hydropower and fish farming. However, these regions have been severely hit by the fall in oil prices since 2014. These regions and their innovation systems are also characterized by thicker organizational and institutional structures (Zukauskaite et al. 2017) when compared to Finnmark. The latter has far fewer financial organizations and a less diversified financial sector. Overall, the four regions offer opportunities for drawing comparisons between both similar and different regional innovation systems.

4 Regional Endowments of Financial Organizations

Industries associated with the ocean and energy dominate the four regions. The further development of these industries depends on highly productive and innovative firms, due to the Norwegian high-cost regime. The markets are typically associated with the sea: offshore oil and gas, sea transport, fish farming, fisheries, marine and fiord tourism, construction of ships and oil installations, and related suppliers. The energy economy includes hydro and wind power, petroleum exploration and exploitation, and energy intensive sectors like aluminum production and other process industries. In recent years, new industries, unrelated to the natural resources, have emerged in the fields of IT, new media and health care. The regions thus share many features, but the mix and volume of these industries differ. The regions also vary in terms of populations size (Bergen: 516,000 inhabitants; Stavanger: 470,000; Kristiansand: 182,000; and Finnmark 75,000).[1] The industrial capacity and productivity of the respective regions is best captured by the regional GDP per employee (Stavanger 755,000 NOK, Kristiansand 737,000 NOK, Bergen 720,000 NOK, and Finnmark 613,000 NOK).

4.1 Bergen

Bergen is competing with Stavanger to be the number two financial center behind the capital city of Oslo. The banks in Bergen has a strong history from shipping. Shipping amounts to 17% (DNB) and 19.8% (Nordea) of the total corporate lending of the leading banks operating in the region. DNB commands a market share of 40%. Smaller players are Nordea, Sparebanken Vest, Handelsbanken, Sparebank1 SR-BANK, Fana Sparebank and Danske Bank. DNB, Nordea and partly SR-Bank compete for the business of larger firms; the local savings banks prioritize smaller businesses. DNB Bergen hosts the bank's national competence center in fisheries and fish farming. In sum, the banks have 2800 employees and assets under management amount to NOK 353 billion.

Six seed and private equity companies[2] are present in Bergen with 40 employees and NOK 12.9 billion under management. Sarsia Seed AS invests in early phase technology companies within the energy/cleantech and biotechnology/life science sectors. Furthermore, the equity firm Argentum is headquartered in Bergen. According to their website, the firm specializes in energy-focused private equity funds, and is wholly owned by the Government, but run on a commercial basis. Argentum currently has NOK 17 billion under management, whereof two thirds are managed on behalf of the Norwegian Government and one third on behalf of private investors.

[1]The province is taken as a proxy for the respective regions (2016).

[2]Report on "Finansbyen Bergen" from Bergen Chamber of Commerce and Industry, 2013.

4.2 Stavanger

Stavanger hosts Sparebank1 SR-Bank. It is no coincidence that SR-Bank is the market leader in Stavanger. The bank is physically located all over the region. Several smaller, but not insignificant, savings banks are also present. DNB has also a strong presence. Other commercial banks include Nordea, Danske Bank, and Handelsbanken. In sum, the banks have 1725 employees, and assets under management amount to NOK 315 billion.[3] Seven seed and private equity companies are present with 83 employees and NOK 52 billion under management.[4] Stavanger furthermore hosts two internationally acclaimed private equity firms, Energy Ventures and HitecVision. Their portfolios are concentrated on the upstream offshore oil and gas industry. Since inception, they have made close to 200 investments in technology companies whose products and services bring significant innovation to the energy value chain. From initial investment to exit, the venture firms are active owners and partner with portfolio companies to ensure the effective use of capital and talent. The region also hosts Procom Venture, a Norwegian based early stage venture capital company with NOK 340 million under management. Its focus is on companies in the petroleum, clean energy and industrial biotechnology sectors. The largest private investors own assets of NOK 51 billion.

4.3 Kristiansand

Kristiansand enjoys the presence of the same four commercial banks as Bergen and Stavanger. Furthermore, a (recently merged) savings bank and a large number of small savings banks are operating in the region.

Nordea is market leader, followed by DNB and Sparebanken Sør. Over the past 10 years, Sparebank1 SR-Bank has made inroads, whereas Danske Bank and Handelsbanken both have a weaker position than their equivalents in Stavanger and Bergen. Smaller craft and industry firms lean towards the savings banks, because of loyalty and demand for uncomplicated services. DNB and Nordea are dominant in the extensive oil and gas equipment cluster. All banks are heavily involved in business properties. One reason among others is that wealthy local industrialists and investors favor investments in property, so it is not without conflicts to reduce the banks' engagement. The smaller savings banks play a minor role in industrial development. The region hosts a few small seed/venture companies, funded by private investors or the utility company. It is telling that a seed fund with 30 investors recently closed, unable to raise fresh money. The management has turned to the corporate market for mergers and acquisitions.

---

[3]Report on "Finansnæringen i Stavanger-regionen", Stavanger Chamber of Commerce, 2014.

[4]IRIS report 200315 on "Finansnæringen i Stavanger-regionen", 2016.

Historically, the region has a strong reputation in shipping and more recently in oil and gas, which in turn has created wealthy families. With two conspicuous exceptions, these fortunes are invested in property or financial assets.

4.4 Finnmark

Finnmark hosts only three banks, Sparebank1 Nord-Norge, DNB and Nordea. The latter operates its business customers in Finnmark from outside the region (Tromsø). SNN and DNB hold about the same market shares; the former has more local branches. There is practically no venture or seed capital, and the number of bank branches is decreasing. Financial organizations are far less present in Finnmark than in the other regions, both in types and numbers.

Most mineral firms are customers in DNB, but the emerging oil and gas sector is fully financed on arrival. A venture capital fund financed by the region's utility company invested in a greenfield local oil company. However, this has thus far been an unsuccessful endeavor. KapNord, an equity firm based in Bodø (i.e., outside the region), has some investments in Finnmark. The banks and some private wealth are the only sources of capital. SNN is a merger between all former independent savings banks. Around 40–45% of their commercial loans is related to property, followed by construction and machine ventures.

Fish farming is a big industry in Finnmark. Three international corporations have now acquired all prior independent and locally owned installations. Financial settlements in these companies are centralized to their head offices outside of Finnmark, and their huge profits are transferred to the main office. Local banks are used for minor activities such as leasing and daily money transfer. DNB Finnmark may access competence from DNB's specialists located in Oslo (energy) and Bergen (fisheries, fish farming).

Family capital is few and far between. Traditionally, Finnmark is a capital-poor county (the entire region was burnt down at the end of World War II) with no tradition of inherited family fortunes like in Bergen and Kristiansand. A handful of families have grossly profited from sales of fish farming installations ("salmon millionaires"), and some construction firms enjoy considerable profits. Compared to other regions, these fortunes are small. "*If they do reinvest in industry, they do it in the industry they know*". "*Too much of the salmon profit has ended up as bank deposits. Supporting good ideas from the neighbors is a distant thought. They prefer investing in financial assets.*"

To summarize, Finnmark stands out with a smaller and less diversified financial sector. The three southern regions share more similarities. They all host a diversity of banks. However, we also find interesting and crucial differences. Kristiansand lacks venture and seed capital firms that are supposed to take more risk than the banks. Stavanger has two significant and successful venture capital firms, both dedicated to the oil and gas sector. Bergen hosts a broader diversity of venture and seed funds, which reach beyond the existing oil and gas sector.

5 Financial Actors and Different Forms of Regional Industrial Path Development

This section offers an analysis of the financial sector and how its actors influence various types of (new) industrial path development.

5.1 Commercial and Saving Banks

Both commercial and savings banks[5] are physically present in the four regions. The commercial banks Nordea, Danske Bank and Handelsbanken (all foreign owned) and DNB are present in three of the regions. Finnmark hosts DNB and Nordea (operated remotely from Tromsø). The four regions also benefit from the presence of four regional savings banks, where three regions (except Finnmark) host their respective headquarters.

DNB is the largest bank in Norway, in which the state holds a 34% ownership stake. The bank commands a strong international position in shipping, energy, fisheries and fish farming, and has a strong position in the oil and gas sector. Danske Bank, based on the former Fokus Bank is headquartered in Copenhagen. Handelsbanken is owned by Svenska Handelsbanken, with its head office in Stockholm. Nordea is a Nordic financial services group, headquartered in Stockholm. Nordea Norway is headquartered in Oslo, and the Norwegian presence is based on the former Kreditkassen. Nordea and DNB are world leading on syndicating loans to offshore oil and gas, and shipping.

These four commercial banks have a strong international presence, a comparative advantage in relation to firms with international ambitions. Furthermore, they have a markets division that handles a broad range of investment banking products and services including currencies, equities, debt capital markets, and corporate finance. They supply advisory services and internationally acknowledged economic research and analysis. These functions serve large, capital-intensive start-ups, mergers and acquisitions or existing companies with extensive projects. This expertise is mainly located in Oslo, but the regional branches tap into that expertise for both funding and provision of advice in transactions. As a rule, transactions (mergers and acquisitions) take place within a given industry, thus leading to path extension and path upgrading. These banks may also spur path importation as they may link foreign firms to regional actors and thus enhance their embeddedness in the regional economy. We also identify some examples of banks financing path branching (and sometimes unrelated path diversification) as incumbent firms diversify into new industries. We are not able to detect any regional differences in this respect, except for Finnmark with its scarcity of banks.

[5]As the result of the liberalization of the financial markets in the 1980s, savings banks and commercial banks operate very similarly. Like in Germany and Austria Norwegian savings banks play a major role in the economy.

The international presence is a competitive advantage for the commercial banks, as most regionally based industries (particularly shipping, fish farming, and oil and gas) are internationally oriented. For instance, the regionally based oil and gas related supply industry is no longer entirely dependent on the activities in the North Sea, as they have a global market for their technologies. Overall, the presence of these banks facilitates expansion abroad and thus strengthens their regional core in Norway. Often this supports path upgrading, as international expansion may require new organizational processes and facilitate learning and access to new knowledge from international partners.

Some banks offer seminars and advice on how to set up a new company, how to recruit a competent board, how to establish shareholders' agreements etc. One bank has introduced the concept of a "start-up pilot" that assists entrepreneurs to establish routines and access public funding: "*Our task is not limited to funding, we contribute with knowledge to firms in order for them to access capital from relevant sources*". If a customer approaches the bank with an idea, they usually recommend Innovation Norway, the public support agency, which provides funding, expertise and networks. Most banks refrain from funding start-ups, but some banks co-fund together with Innovation Norway: "*There are projects we would not have participated in without Innovation Norway. It is of mutual interest. Innovation Norway relies on the bank's evaluations. They think that when the bank dared to be involved, we may as well*". For small firms banks are active advisors: "*Just a handful of our firms have their own finance managers. The bank is financial director in 90% of our customers both in the nascent and mature phases*." These roles performed by banks are most prevalent in Finnmark. With the modest presence of financial institutions, firms rely more on the public mechanisms for funding.

Finnmark displays an example of a potential *path importation*. The oil and gas sector has extended to northern Norway, having been located in the southern and western parts of the country for a generation. There was an enormous boom in connection with the Snow-white field. The local construction industry was heavily engaged. So far, a local supply industry as witnessed in the three other regions, have not surfaced. The oil and gas industry has moved in with technology developed in the mature industry in southern Norway. Finnmark lacks engineering expertise, since the education system prioritized education in public services. Small firms cannot cope with quality standards in the oil industry. Documentation of their qualifications and experience is required. This represents a change in the rules of the game: "*A handshake used to suffice; now insensitive players have entered the field*".

Banks are not homogeneous, they differ in their strategies and attitudes towards risk-taking, and, consequently, towards more radical forms of new path development. A conservative bank describes its policies as follows: "*We finance growth in existing firms rather than start-ups, companies with customers and proven technology. We pass a person with a promising technology, and we are not competent to link him to the public innovation system. When entering new markets or novel technology, the risk exposure increases. Without a large equity base, we don't participate*". Size matters, too. The largest banks obviously command a more encompassing knowledge base than the smaller ones. Internal specialization enables them to get involved in all industries, including industries that undergo radical changes at high speed. The volume of assets under management and the qualifications and skills of employees working in the bank sector go hand in hand. Larger, internationally oriented enterprises have more complex financial needs, and banks wanting to serve them need to learn and upgrade their skills correspondingly. In this respect, Bergen seems to have the upper hand as the host of DNB's national competence center in shipping, fisheries and fish farming.

New paths may evolve when an existing industry goes into decline because of shrinking markets or outdated technology or business models. As indicated above, at least three of the regions have experienced substantial growth in recent decades: "*Smaller firms have been proud to deliver to some of the major firms in the oil and gas cluster, being less attentive to the other long-time profitable customers. When this motor halts, you discover too late that you have lost these alternative opportunities*". However, there is a strong belief that existing firms will transform when changing context conditions force them to do so. When the cell-phone maker and major employer Ericsson closed their doors in 2013, a public/private consortium was established, and 90% of the redundant engineers stayed in the region. The consortium provided capacity, competence and economic means to develop ideas into commercial products and services. An investor provided NOK 30 million to incubator and research activities. A path new for the region was created: "*The disappearance of Ericsson created the platform for the ICT industry in the region*". On the other hand, when an incubator was established to serve entrepreneurs in the prosperous NODE cluster, it had only minor impact: "*But they showed no interest in incubation or change. Engineers delivering on orders will not have interruptions*". In the three southern regions, modern technologies and seeds may evolve into new industries related to green technology, renewable energy, material technology, subsea operations, remote operations, biotech and health care.

The knowledge level in banks is an important selection mechanism in itself. Emerging new industries (path branching, unrelated path diversification or new path creation) are hard to understand. Even larger banks struggle to understand novel business models, and thus try to avoid the risks involved. Banks may support diversification into new paths when the new venture is a spin-off from an incumbent firm. In such cases, the firm may offer the bank corollary in the existing business, thus reducing the bank's risk.

The financial industry makes a distinction between loans to commercial real estate development and other industrial sectors. The first is regarded as less dynamic, and is evaluated by banks based on the quality of the collateral offered. In contrast, other industries are evaluated on the expected future cash flow, the so-called turnover based industries. Based on that distinction, a high share of loans to commercial real estate is an indicator of a low risk appetite (Fig. 1).

In the whole bank sector, commercial real estate loans represent the largest share of total loans. This implies, ceteris paribus, a drawback for firms in the region and the potential for a varied industrial structure. DNB stands out with the consistently lowest share of less than 30%. As a corollary, their loan portfolio displays a greater

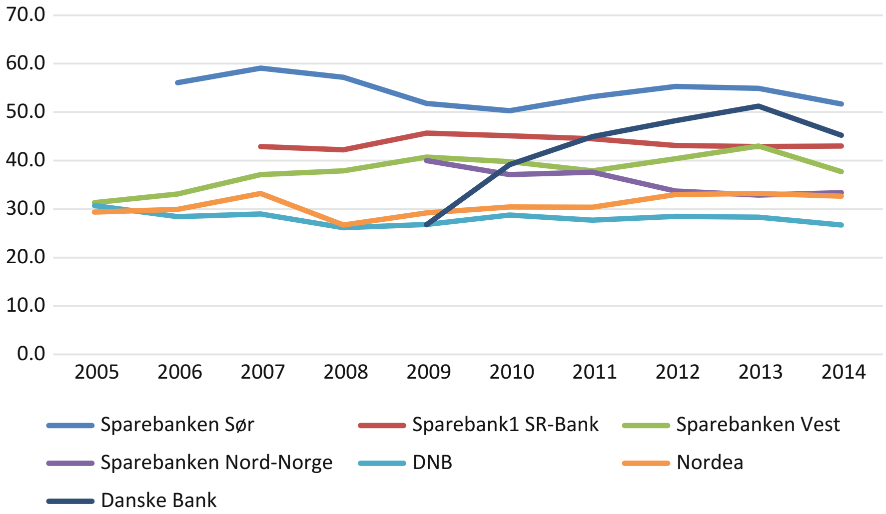

Fig. 1 Share of total corporate loans to commercial real estate

variety, with shipping (17%), services (11%) and industry (11%). Nordea's share of real estate is also below 1/3, indicating that the commercial banks share a different pattern than the savings banks. Danske bank is the exception to the rule, where the share of real estate has increased considerably since the financial crisis.[6] In absolute terms, loans to real estate constitute a steady amount, but the total assets under management have dwindled. Sparebanken Sør, headquartered in Kristiansand, stands out as a very conservative bank by this measure. More than half of the commercial loans are allocated to real estate. In general, this pattern of the banks' loan portfolio contributes to a cementation of existing regional paths. DNB, and to some degree Nordea, stand out with a more diversified loan portfolio, indicating a larger capacity to support alternatives to path extension. DNB has the strongest presence in Bergen, which enjoys a more diversified industrial structure than Stavanger and Kristiansand.

Supporting firms and industries that alter the existing paths require a long-term commitment from funding sources. Some informants argue that Norwegian banks, especially when headquartered in the respective regions, may be more trusted than foreign owned banks. It is argued that foreign banks, when they run into problems elsewhere, have fewer incentives to prioritize Norwegian regions. Representatives from the foreign bank discard this argument. The financial crisis in 2008 offers a "real world" experiment in this respect. Figure 2 indicates what happened.

[6]Handelsbanken does not publish the allocation of loans between industries. On request, the bank reports that commercial real estate constitutes by far the largest share.

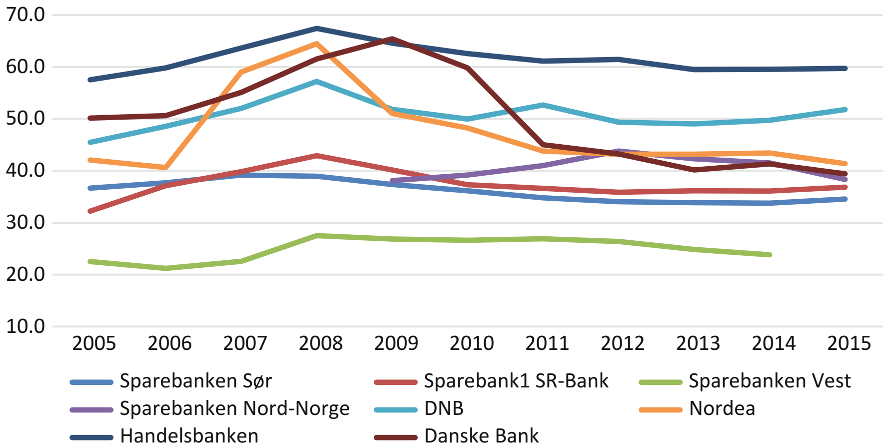

Fig. 2 Business loans as share of total loans

We note that business loans dipped significantly in foreign owned Danske Bank and Nordea in the wake of the financial crisis. The savings banks and DNB display a more consistent behavior.

5.2 Seed Funds

Seed money may be provided by seed funds, but may also be obtained through friends and family funding,[7] angel funding, or crowdfunding. The size of the investment from seed funds tends to be moderate. In many cases, 25,000–75,000 Euro will suffice in the earliest phase, before public funding may become relevant or new investors are invited in.

Investors make their decision to fund a project based on the perceived strength of the idea and the capabilities, skills and experiences of the founders. There are some seed funds in all four regions; presently they play minor roles as some of them have lost money (Finnmark and Kristiansand), or new investments are hard to find in the aftermath of the financial crisis. Because of the high risks involved, the state participates in several seed funds, often on a 50–50 basis with private capital. The banks may invest in the funds, but not in equity investments in individual firms.

As explicated above, only Bergen and Stavanger enjoy the presence of seed funds. These funds may support path branching, unrelated path diversification or path creation. They seem to focus on energy/cleantech and biotechnology/life science sectors, in Stavanger also in modernization and renewal of the oil and gas sector.

[7] A popular term is "fools, friends and family."

5.3 Venture Funds

Venture capital is independently managed dedicated pools of capital that focus on equity and equity-linked investments in privately held high-growth companies (Lerner 2009). The largest pool of venture capital comes in form of private limited partnerships (Gladstone and Gladstone 2002). These partnerships are companies that source their funds from pension funds, insurance companies, large foundations and wealthy individuals. When a new fund is established, the passive investors are committed typically for an 8-year period. Payments are called in parallel with the funds' investments. The implication is that investors' money may be paid in periods of recession and slumps.

The managers of these partnerships are general partners and the investors are limited partners with a passive role. The managers are professional investors. They identify and select those ventures that have the greatest potential for success and they provide management expertise and access to resources other than financial ones. They are expected to have better capabilities than banks to select profitable investments, to keenly monitor and follow up their investments, supply relevant knowledge for increased value creation, and manage risks associated with the investments (Manigart and Sapienza 2000). However, it is important to note that there is no commonly agreed definition of venture capital. The classic definition refers to long-term equity invested in high-risk ventures, especially new companies or new technologies, that offer large potential capital gains to compensate for the high risk involved (Martin et al. 2002). Venture capital associations, like the Norwegian Venture Capital & Private Equity Association in this case, include relatively short-term investment in business expansions and management buy-outs.

As argued above, information asymmetries between entrepreneurs and financiers can make funding of new ventures difficult. Entrepreneurs may possess information that potential external investors are deprived of. Generally, venture funds are better positioned to mitigate these risks than banks through proximity and social ties, direct and indirect, to promote the flow of "private" knowledge between the entrepreneur and the venture capitalist. Generally, the supply of venture capital is not evenly distributed across regions (Martin et al. 2002), which is also the case in this study. The most vital ones are located in Bergen and Stavanger. The latter hosts two successful venture capital companies both specialized in the oil and gas sector, the dominant industry in that region. Several of the managers had extensive industry experience before joining the venture firm. They thus possess "insider" knowledge about the industry and its managers, network connections, and social ties to many of its actors. This mitigates the potential downside of asymmetric information. However, the two dominating venture funds in Stavanger are dedicated to the oil and gas industry, thus contributing to path extension and upgrading. The venture funds in Bergen seem to be more diversified.

Venture funds have evolved into equity funds, and typically take temporary ownership in existing firms in order to restructure them to increase profits. They may also take equity stakes in start-ups in established industries. Our interviewees unite in the view that this type of organization has become less inclined to take risk over the past 10 years. Since the economic downturn, it has been difficult to achieve exits at a satisfactory price, hence the funds have been unable to deliver the expected return to the investors. This is one of the reasons why venture funds are less willing to take risks.

6 Institutional Configurations

In this section our focus is on institutions (both informal and formal ones) defined as the rules of the game (North 1990). They fundamentally shape and constrain "mental models", preferences and behavioral patterns. Institutions serve as platforms and sources of path dependent opportunities for social learning (Nelson and Sampat 2001) and account for important aspects of the macro-foundations of micro behaviors. We find that the behavior of both individual and institutional investors is strongly influenced by the norms and culture in the respective regions. The following statement by one of our interview partners is telling in this respect: In the Kristiansand region, "*private investors engage in silence and keep shut, because they fear failure more than the taste of success*".

Based on the modest presence of financial actors, Finnmark may be characterized as a thin regional innovation system: "*It is a new phenomenon from the past ten years that local individuals have made substantial profits in Finnmark. But there is no culture to invest with each other. We are modest on our own behalf, and have too low ambitions related to dividends from our own capital. The profit ambitions are too low. There's no tradition to see the value in companies. People from western Norway have been successful, they have industrialized and invested, they have been engaged in building something*".

This is further elaborated for the important fisheries along the coast: "*The fishermen in western Norway have had distinct strategies for their fleets. In northern Norway, they have operated at sea, made substantial profits, followed by partying. Discarded vessels from western Norway have ended up in northern Norway. We have never been at the frontier of technology. Operating costs have been high because of lacking investments*."

In Stavanger, investors often invest together to share knowledge and risks. In contrast to Finnmark, there is a tradition of pulling together. Networks are strong, and most wealth is created by the present generation. Some investors team up to do investments in emerging firms, indicating that equity investing is both a financial and a social endeavor. Owner-managers of existing industrial companies often organize their financial ambitions in investments firms. These investors are experienced and prepared to engage in repeated equity emissions to realize sizeable projects or start-ups. On the other hand, the mood in northern Norway is described as follows: "*Entrepreneurs that succeed do not let in others. They are certainly not obsessed by growth, do not prioritize growth, they are afraid about competition and losing their competitive edge. They prefer organic growth, even if they have access to external finance*".

Values and informal rules are different among the regions, which have obvious bearing on path development: "*In the Kristiansand region people cultivate failures, a cultivation of being unsuccessful. The leading regional newspaper in Stavanger displays a positive attitude to the region, which we never experience with our regional paper. There's a strong and persistent rivalry between the towns in the region, much worse than in Stavanger*". The rivalry between Kristiansand and Arendal probably postponed the merger between the two savings banks in the respective towns for several decades. Distinct cultures were also on display when the two local commercial banks merged. An observer close to the event explains: "*Privatbanken was the bank for the religious, Sørlandsbanken for the non-religious. What a merger! It took ten years to weld them together*". A manager new to the region echoes the influence of religion: *"My first impression of Kristiansand when I moved from Bergen was a red Volvo station wagon with the sign "Hello God" in the rear window. We have many free churches and congregations in this region with many business managers as members. Contrary to Bergen and Stavanger, the links between religious organizations and business are strong"*.

There may also be differences between Stavanger and Bergen. A number of interviewees have noted that family fortunes in Bergen are several generations old; often from shipping or commercial real estate; compared to the more recent wealth generation in Stavanger. "*My gut feeling is that the wealthy persons in Stavanger still have the entrepreneurial spirit, and have not yet developed into the more conservative second or third generation.*" The perceived risk in the two regions may be different. The oil and gas sector in Stavanger, now 40 years old, has by and large been a continuous success. Until recently, investors have not experienced substantial risk. The history of shipping is very different, especially in a 2–3 generation perspective. Shipping has been volatile, and many fortunes have been lost.

Formal regulations, particularly the Basel II and Advanced IRB (internal ratings-based approach), strongly influence the behavior of the larger banks. The scoring system associated with Advanced IRB is based on the banks' expectations of future cash flows of projects and investments. For smaller banks, the familiar requirements to collateral are more decisive. This distinction has motivated non-IRB banks to fund the property and construction industry. Over the years, these regulations have greatly influenced the micro behavior of banks. The radical change in risk appetite and behavior is described as follows: *"Back in the 1980s we were allowed to lose 1% of assets under management, this is a mirage today. Everything has been tightened sincerely up since the Norwegian bank crisis at the end of the 1980s and again after the recent global financial crisis."*

7 Conclusions

The effectiveness of a regional innovation system is enhanced by a diversified financial sector. Banks, venture funds, seed funds and private wealth are governed by different rules and institutional set-ups, implying different capabilities to take risk. Seed and venture funds have a more hands-on attitude to their investments and are set up to manage risks in the various stages of a project or firm's development. In contrast to banks, venture and seed funds take equity shares. They may thus reap the (sometimes substantial) profits of a new venture. A diversified financial sector tends to assist regions to diversify and spur renewal. The region's capability to *realize* the economic potential of possible paths is associated with a diversified and competent financial sector.

There are some dilemmas, however. Both formal and informal institutions seem to discourage banks from risk taking. Formal regulations such as the Basel II and Advanced IRB, strongly influence the behavior of the banks. According to Kay (2015), these European regulations focus on the efficient functioning of the market, "market integrity", rather than the interests of market users like companies. The risk management system associated with IRB is based on the banks' expectations of future cash flows of projects and investments. Evaluations of future cash flows are relatively straightforward in established industries, with proven technology and trustful managers. Both knowledge and incentive structures point in the direction of path extension. Path extension is also documented by the fact that property lending makes up the largest share of the commercial lending in the banks, typically 30–50%. Property requires more capital than other industries and is the main post on the banks' balance sheet. The implication is that the selection mechanisms in banks mainly work to uphold regional path extension, and to some degree path upgrading. Larger banks also facilitate path importation by financing international endeavors.

Moreover, the banks presently experience a disincentive to take a regional development role. Banks are required to build up their equity (core capital) within a couple of years. These requirements are tied to their risk adjusted credit exposure. Lower risk and more moderate growth of loans to businesses ease the requirements. The management of the banks needs to find a balance between their regional role and how they aim to satisfy the requirements for increased solidity.

Generally, innovation in established companies is funded through their running cash flows, sometimes by establishing a new single purpose company, sometimes branching into related or unrelated industries. As we recall, path branching is exemplified by firms diversifying into related activities by redeploying their core technologies and expertise. When the bank trusts both the technology and the technical and managerial expertise of the firm, the risk level is perceived as moderate. The firms need to convince the banks that new and profitable markets actually exist. This path is exemplified by oil and gas companies diversifying into renewables, in particular the onshore and offshore wind sectors. Wind power has proven to be very effective with stable production in these regions. In northern Norway summer tourism evolves into to all-year tourism with winter tourism as the most vibrant activity: northern light, ice hotels and dog sleds. Land-based tourism has diversified into maritime activities. In the dominating industries (i.e. in oil and gas and fish farming), a related, substantial supply industry has emerged.

Our study has several policy implications. For the regions in this study, further path extension alone is not a viable option. The financial sector needs to support new path development. Banks need to upgrade the knowledge of their employees to get a better understanding of the business models in emergent industries, enabling them to sense and appreciate the risks involved. The government should initiate early phase funds or tax incentives for entrepreneurs willing to take risks. Actors in the financial sector would help firms and regional development by taking various bridging roles. Banks may help fledgling firms by collaborating with Innovation Norway and other public agencies.

Banks or venture funds should engage more with seed funds to enable entrepreneurs to scale up their business faster, so when a great idea is being sold, competent capital can bring it across to more conservative investors.

References

Aghion, P., & Tirole, J. (1994). The management of innovation. *The Quarterly Journal of Economics, 109*(4), 1185–1209.

Arthur, W. B. (1994). *Increasing returns and path dependence in the economy*. Ann Arbor: University of Michigan Press.

Boschma, R. (2015). Towards an evolutionary perspective on regional resilience. *Regional Studies, 49*(5), 733–751.

Boschma, R., & Frenken, K. (2011). Technological relatedness and regional branching. Beyond territory. In H. Bathelt, M. Feldman, & D. F. Kogler (Eds.), *Dynamic geographies of knowledge greation, diffusion and innovation* (pp. 64–81). London: Routledge.

Castaldi, C., & Dosi, G. (2014). The grip of history and the scope for nevelty: Some results and open questions on path dependence. *LEM Working Paper Series*. Pisa, Italy: Sant'Anna School of Advanced Studies.

Cooke, P. (2007). Regional innovation, entrepreneurship and talent systems. *International Journal of Entrepreneurship and Innovation Management, 7*(2/3/4/5), 117–139.

Dixon, A. D. (2015). *The new geography of capitalism*. Oxford: Oxford University Press.

Dosi, G. (1990). Finance, innovation and industrial change. *Journal of Economic Behavior and Organization, 13*, 299–319.

Gjelsvik, M. (2017). Economic transformations of regions: The role of banks. *Strategic Change, 26*(1), 35–51.

Gladstone, D., & Gladstone, L. (2002). *Venture capital handbook*. London: Financial Times Prentice Hall.

Grillitsch, M., & Asheim, B., & Trippl, M. (2017). *Unrelated knowledge combinations: Unexplored potential for regional industrial path development*. CIRCLE Working Paper 2017/10. CIRCLE, Lund: Lund University.

Isaksen, A., Tödtling, F., & Trippl, M. (2016). *Innovation policies for regional structural change: Combining actor-based and system-based strategies*. SRE-Discussion 2016/05. Vienna: Vienna University of Economics and Business.

Kay, J. (2015). *Other people's money: Masters of the universe or servants of the people?* London: Profile Books.

Kerr, W. R., & Nanda, R. (2015). Financing innovation. *Annual Review of Financial Economics, 7*, 445–462.

Knight, F. H. (1921). *Risk, uncertainty and profit*. New York: Houghton Miffin Company.

Lerner, J. (2009). *Boulevard of broken dreams: Why public efforts to boost entrepreneurship and venture capital has failed – and what to do about it*. Princeton, NJ: Princeton University Press.

Manigart, S., & Sapienza, H. J. (2000). Venture capital and growth. In D. Sexton & H. Landstrom (Eds.), *The Blackwell handbook of entrepreneurship* (pp. 240–258). Cambridge: Blackwell.

Martin, R. (2010). Roepke lecture in economic geography – rethinking regional path dependence: Beyond lock-in to evolution. *Economic Geography, 86*(1), 1–27.
Martin, R., Sunley, P., & Turner, D. (2002). Taking risks in regions: The geographical anatomy of Europe's emerging venture capital market. *Journal of Economic Geography, 2*, 121–150.
Martin, R., Berndt, C., Klagge, B., & Sunley, P. (2005). Spatial proximity effects and regional equity gaps in the venture capital market: Evidence from Germany and the United Kingdom. *Environment and Planning A, 37*, 1207–1231.
Martin, R., & Sunley, P. (2006). Path dependence and regional economic evolution. *Journal of Economic Geography, 6*(4), 395–437.
Neffke, F., Henning, M., & Boschma, R. (2011). How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. *Economic Geography, 87*(3), 237–265.
Nelson, R. R., & Sampat, B. (2001). Making sense of institutions as a factor shaping economic performance. *Journal of Economic Behavior and Organization, 44*, 31–54.
North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge: Cambridge University Press.
Scherer, F. M., & Harhoff, D. (2000). Technology policy for a world of skew-distributed outcomes. *Research Policy, 29*(4), 559–566.
Sorensen, O., & Stuart, T. (2001). Syndication networks and the spatial distribution of venture capital investments. *American Journal of Sociology, 106*, 1546–1588.
Tanner, A. N. (2014). Regional branching reconsidered: Emergence of the fuels cell industry in European regions. *Economic Geography, 90*(4), 403–427.
Tödtling, F., & Trippl, M. (2013). Transformation of regional innovation systems: From old legacies to new development paths. In P. Cooke (Ed.), *Reframing regional development* (pp. 297–317). London: Routledge.
Zukauskaite, E., Trippl, M., & Plechero, M. (2017). Institutional thickness revisited. *Economic Geography, 93*, 325–345. https://doi.org/10.1080/00130095.2017.1331703

Regional Innovation Systems and Global Flows of Knowledge

Roman Martin, Heidi Wiig Aslesen, Markus Grillitsch, and Sverre J. Herstad

Abstract
The literature on regional innovation systems emphasizes the role of the region as locus for interactive learning and knowledge exchange, stressing the importance of (geographical) proximity for innovation. Even though the importance of extra-regional knowledge is widely acknowledged, there has been only little emphasis on the particular role and the nature of global knowledge flows. The aim of this chapter is to explore the differentiated nature of global knowledge flows in regional innovation systems. We provide an overview of the different ways firms can gain access to global knowledge sources. Identified knowledge sourcing channels include international R&D collaborations, foreign direct investments, personally embedded relationships, international mobility of skilled labour, virtual communities and online platforms, and the participation in temporary clusters such as fairs, exhibitions, and conferences. Depending on regional innovation system preconditions, firms use and combine different

R. Martin (✉)
School of Business, Economics and Law, University of Gothenburg, Gothenburg, Sweden
e-mail: roman.martin@handels.gu.se

H.W. Aslesen
BI Norwegian Business School, Oslo, Norway
e-mail: heidi.w.aslesen@bi.no

M. Grillitsch
Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE), Lund University, Lund, Sweden

Department of Human Geography, Lund University, Lund, Sweden
e-mail: markus.grillitsch@keg.lu.se

S.J. Herstad
Inland Norway University of Applied Sciences, Lillehammer, Norway
e-mail: sverre.herstad@hil.no

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_7

knowledge sourcing channels to access global knowledge. Firms in organisationally thick and diversified regional innovation systems have a geographical advantage in accessing knowledge globally, but even firms in peripheral areas can exchange knowledge worldwide, due to improved means of transport and communication at distance. Furthermore, not only multinational companies that are dominated by analytical or synthetic knowledge bases, but even small and medium sized enterprises in symbolic industries are often deeply involved in global knowledge sourcing activities. We illustrate our arguments with interview data collected among New Media firms in southern Sweden and in the Oslo Region in Norway.

Keywords
Regional innovation systems · Globalisation of innovation · Knowledge sourcing · New media

1 Introduction: From Local to Global Knowledge

In the literature on regional innovation systems (RIS), innovation is typically seen as localised process and the region as the main arena where innovation and knowledge creation takes place (Moulaert and Sekia 2003; Asheim and Gertler 2005). Innovation is understood as the result of knowledge exchange between various actors, and as dependent on relations between firms and their external environment. Companies interact with other organisations to access new knowledge and other innovation-related resources. Relevant RIS organisations include other firms, but also universities and research institutes conducting R&D and education, as well as governmental agencies proving various forms of policy support. Moreover, the innovation behaviour of firms is influenced by a common regional institutional framework, understood as the formal legal rules and the informal social norms that govern individual behaviour and social interactions (North 1990; Gertler 2010). Consequently, the RIS literature sees innovation as the outcome of exchanges and interdependencies between various organisations, governed by a common institutional framework that is linked to the geographical context in which innovation takes place (Cooke et al. 1998; Asheim and Gertler 2005; Cooke et al. 2004).

Spatial and other types of proximity facilitate the exchange of knowledge and foster mutual learning, and consequently, intraregional interactions play a key role for innovation. However not all interactions take place in geographical proximity, and knowledge exchange may well cross regional and national boundaries (Asheim and Isaksen 2002; Chaminade and Vang 2008; Trippl et al. 2009). In fact, some scholars argue that it is actually the global exchange of knowledge that provide the most novel ideas and that lead to most radical innovation (Chaminade et al. 2016; Fitjar and Rodríguez-Pose 2012). Even though the importance of extra-regional knowledge is acknowledged in the RIS literature (e.g. Maskell et al. 2006; Trippl et al. 2017), little emphasis is placed on the particular nature of global knowledge flows for different firms and in different regions.

The aim of this chapter is to explore the differentiated nature of global knowledge flows and to discuss in which ways firms can access them. First, we review the RIS literature with a focus on the role of global knowledge sourcing[1] for innovation. Recent contributions argue that different types of RIS differ in their propensity to access knowledge globally, arguing that firms in thick and metropolitan regions have better access to international knowledge, while firms in thin and peripheral regions are less exposed to global expertise (Trippl et al. 2017). Furthermore, the RIS literature argues that firms in industries with different knowledge base vary in their likelihood to source knowledge globally, stressing that analytical industries deal with knowledge that is codifiable and easy to transfer over time and distance, whereas synthetic and in particular symbolic industries tend to exchange knowledge in highly localized networks (Martin and Moodysson 2013). In this chapter, we seek to extend the literature by providing insights into different ways how firms can gain access to global knowledge flows, focussing on small and medium sized enterprises (SMEs) and early start-up companies in thick and diversified RIS. We illustrate our arguments with interview data collected among New Media firms in southern Sweden and in the Oslo Region in Norway. We conclude that all firms can benefit from being embedded in global knowledge networks, and depending on RIS and knowledge-base preconditions, they use and combine different knowledge sourcing channels.

2 Differentiated RIS and Global Knowledge Flows

The RIS approach underlines the role of embeddedness of local actors in a web of interdependencies and a shared social and institutional context that facilitate learning and innovation. Nevertheless, RIS are also conceptualized as open systems in which extra-regional linkages play an important role. This has to do with the fact that regional economies are not self-sufficient and that relevant knowledge is created constantly in other parts of the world (Asheim et al. 2015).

Trippl et al. (2017) discuss the role of global knowledge links for new path development in different types of RIS. The authors argue that regions differ in their needs, attractiveness, and absorption capacity for accessing extra-regional knowledge. Building on advances in internationalisation theory, Herstad (2017) argues that regions differ in the incentives and resources they provide to local firms in support of internationalisation.

Organisationally thick and diversified RIS typically exhibit several features that explain a high level of attractiveness and absorption capacity. At the same time, the need for global knowledge links may be smaller than for other regions. A high level

[1]With the term ‘global’, we refer to knowledge that is available at and sourced over long geographical distance. This typically excludes regional and national, but includes international knowledge sourcing. However, not all cases of international knowledge sourcing would qualify as global (e.g. cross-border collaboration between neighbouring regions).

of diverse sets of knowledge and skills and capable actors involved in both knowledge exploration and exploitation imply high capacities to identify and appropriate external knowledge. These characteristics, but also the symbolic value of metropolitan regions and their easy accessibility due to advanced communication and transport infrastructures explain the attractiveness for external actors to establish linkages with thick and diversified RIS. But then again, due to the diversity and quality of competences and resources available regionally, metropolitan areas may need global knowledge links to a lesser extent than other types of RIS.

Actors in organizationally thin, peripheral RIS depend to a high degree on extra-regional knowledge linkages in order to innovate and maintain a competitive advantage. The lack of knowledge and skills explains the high need for global knowledge sources in the periphery (Grillitsch and Nilsson 2015; Chaminade and Plechero 2015). However, this implies also limited attractiveness and local resources in support of internationalisation (Herstad and Ebersberger 2015), and low levels of absorptive capacity. It can thus be argued that in peripheral regions innovation-based competitive advantages (in contrast to cost-based comparative advantages) can only be achieved by enhancing the competencies of regional actors while at the same time facilitating their access to global knowledge sources.

The relative need, attractiveness, and absorption capacity differs also for (old) industrial regions, i.e. regions that are specialized in a relatively narrow and typically traditional industry (Hassink 2005; Cooke 1995; Tödtling and Trippl 2004). Such regions are often well embedded in global production networks (Henderson et al. 2002; Coe et al. 2004; Chaminade and Vang 2008), implying that actors have a relative high absorptive capacity and attractiveness to establish and generate value from global knowledge linkages within the same area of specialization. This supports incremental innovations in terms of improvement of products and processes. However, due to cognitive myopia (Maskell and Malmberg 2007) and different forms of lock-in (Grabher 1993; Hassink 2010), actors in such regions have a relatively low capability to identify, absorb, and attract knowledge in unrelated fields. This becomes a problem when the respective industry matures or declines thus requiring more radical change. Finally, specialised regions are faced with the challenge that the local economy has limited capacity to absorb spillovers and transform them into impetuses for innovation outside current strongholds.

Table 1 provides an overview of the theoretical arguments made above (see also Trippl et al. 2017 for an elaboration on the role of non-local knowledge for regional industrial change).

3 Knowledge Bases and the Geography of Knowledge Flows

In addition to the characteristics of the RIS in which they are located, the propensity of firms to engage into global knowledge exchange also differs with regard to the type of knowledge applied and exchanged in the course of innovation (e.g. Laestadius 1998; Moodysson 2007; Gertler 2008; Asheim et al. 2011). Three

Table 1 RIS types and global flows of knowledge

	Organizationally thick and diversified RIS	Organizationally thick and specialized RIS	Organizationally thin RIS
NEED for extra-regional knowledge	LOW (well-endowed with endogenous knowledge sources)	HIGH (extra-regional knowledge is key to overcome lock-in and to strengthen existing specialization)	HIGH (need to compensate for weak local knowledge endowment)
SUPPORT for (endogenous) extra-regional knowledge sourcing	HIGH (point of convergence in international networks and labor mobility flows)	HIGH (for the specialized industrial sectors) LOW (for industrial sectors not part of initial specialization)	LOW (limited international contact points and experiences with international operations)
ATTRACTIVENESS for (exogenous) extra-regional knowledge	HIGH (attractive for external actors to create linkages with metropolitan areas)	LOW (overall low due to lacking diversity and attractiveness in particular for international talent) HIGH (for the specialized industrial sectors which will attract relevant skills and knowledge)	LOW (low accessibility and attractiveness)
ABSORPTION CAPACITY for extra-regional knowledge	HIGH (diverse local knowledge base and capable public and private sector actors)	HIGH absorption capacity for *related* knowledge LOW capability to absorb *unrelated* knowledge	LOW (lack of local skills and relative homogenous knowledge bases)

Source: own draft inspired by Trippl et al. (2017) and Herstad and Ebersberger (2015)

types of knowledge bases are distinguished in the RIS literature, namely analytical, synthetic and symbolic, that differ in various respects such as the rationale for knowledge creation, the development and use of knowledge, the actors involved and the role of spatial proximity in the innovation process (Asheim et al. 2011).

Amongst other, the knowledge base distinction has been applied to study industry specific differences in the geography of knowledge flows. Existing studies reveal clear differences between industries when it comes to the global reach and the actors involved in knowledge exchange (Plum and Hassink 2011; Martin and Moodysson 2013; Martin 2013; Herstad et al. 2014). In analytical industries, innovation involves strongly codified and universally valid knowledge, which is relatively easy to transfer over time and distance. Analytical knowledge is not bound to a particular geographical area, which opens up possibilities for global knowledge exchange. Consequently, firms source and exchange knowledge in globally configured epistemic communities and with highly specialised knowledge providers in different parts of the world. Important knowledge providing organisations include universities and other public and private research organisations. In synthetic industries, innovation relies on the application of existing knowledge in new ways, often taking the form of concrete problem solving and interactive learning with customers and suppliers. More than in other industries, fruitful cooperation and knowledge exchange requires trust and reciprocity that needs to be earned through repeated interactions and face-to-face meetings. Relatively little collaboration takes place over long distance, while national or regional networks prevail. Innovation in symbolic industries is even more governed by the local context, and firms collaborate with a number of altering partners in close geographical proximity. Companies change their cooperation partners frequently. They are tied together for the short period of an innovation project before they switch to other projects and other collaboration partners. The importance of cultural knowledge and project-based innovation implies that knowledge exchange in symbolic industries takes place primarily within localized networks (Plum and Hassink 2014; Manniche and Larsen 2013) (Table 2).

Table 2 Knowledge bases and global knowledge flows

	Analytical	Synthetic	Symbolic
Actors involved in innovation	Collaboration between research units, universities, R&D centres	Interactive learning with customers and suppliers	Experimentation in studios, flexible project teams
Knowledge types	Strong codified knowledge, highly abstract, know why	Partially codified knowledge, strong tacit component, know how	Importance of cultural knowledge, sign values; know who
Context specificity of knowledge	Meaning relatively constant between places	Meaning varies between places	Meaning highly variable between place, class and gender
Dominant geography of knowledge flows	Highly global	Primarily national/regional	Highly regional/ local
Global network linkages	Extensive R&D contracting & collaboration possible due to codifiability of knowledge	Selective R&D contracting & collaboration; stronger search, communication and absorptive capacity constraints due to tacitness and complexity of knowledge	Events & internet platforms Interpersonal networks

Source: own draft inspired by Asheim and Gertler (2005), Martin and Moodysson (2013)

While these finding on the geography of knowledge flows generally hold true on an industry level, micro-level studies stress that there exists strong heterogeneity between firms in the same industry (Srholec and Verspagen 2012). Firms in one industry may rely on different competencies and specialise into different activities (see, for instance, Pina and Tether 2016: on knowledge intensive business services). In fact, combinations of knowledge bases can occur at the level of the industry and at the level of firms. This argument has been advanced in recent works on knowledge base combinations (Manniche et al. 2016; Grillitsch et al. 2016), indicating that innovations are often the result of diverse knowledge inputs that are acquired from various sources and combined in the innovation process.

From the discussion above follows that firms located in different RIS and belonging to different industries also differ in their likelihood to engage into global knowledge network. While firms in science-based industries located in peripheral RIS would have the strongest need to engage into global knowledge network (for instance, the space industry located in Kiruna/Northern Sweden), firms in symbolic industries located and thick and diversified RIS are already well served by locally available knowledge (for instance, New Media in Malmö/Southern Sweden). In the following, we go beyond the argument that particular knowledge sourcing geographies prevail in different industries and regions. Instead, we show by using the cases of New Media in southern Sweden and in Oslo, that even firms that are best served by local knowledge (i.e. firms in symbolic industries and located in thick and diversified RIS) access global flows of knowledge, by using a range of different knowledge sourcing channels. The research question we address in this chapter is the following:

> Through which mechanisms do firms in symbolic industries located and thick and diversified RIS source knowledge globally?

4 Firms and Global Knowledge Sourcing Mechanisms

Research in the tradition of international business (Fernhaber et al. 2008; Johanson and Vahlne 2009) provides a number of indications on how firms may access knowledge globally. Typically, much attention has been devoted to foreign direct investments (FDI) and the question of whether technology and knowledge transfers within multinational enterprises (MNEs) are associated with spillovers into the region (Fosfuri et al. 2001; Balsvik 2011; Henderson 2007; Belderbos et al. 2008; Görg and Strobl 2005; Görg and Greenway 2004). Recently, it has been acknowledged that globalisation of innovation is not confined to MNEs and FDI, and more attention has been paid to other types of knowledge linkages. For instance, outsourcing of R&D to foreign partners may provide the basis for learning at home (D'Agostino et al. 2012) and for stronger, more committed international linkages to form at later stages (Maskell et al. 2007). Of particular importance among these is innovation *collaboration* (Herstad and Ebersberger 2015).

Collaborative linkages involves committed two-way exchanges of knowledge between independent organisations located in different countries that as such have the capacity to transfer complex, tacit knowledge (Ebersberger and Herstad 2011; Torre 2008). Some authors therefore consider collaborative ties a defining characteristic of 'global innovation networks' (GINs) (Herstad et al. 2014).

Until recently, research in the RIS tradition expressed concerns that global innovation networks would decouple firms from the local collaboration networks on which local knowledge dynamics where assumed to depend. This has now shifted to an emphasis on the importance of external learning interfaces for regions to avoid lock-in. Moreover, the knowledge dynamics of locations are now to a lesser extent assumed to depend on the collaborative linkages, than associated with informal relationships and labour market mobility (e.g. Cotic-Svetina et al. 2008). In line with that, the focus of investigation has been broadened. First, from attention specifically to technology transfer and the governance implications of inward FDI (Brown 2000; Asheim and Herstad 2005), to research on knowledge transfers within and around multinationals more generally (Meyer et al. 2011; Bellak 2004). Second, from attention predominantly to the role of FDI in the globalisation of innovation, to a strong interest in innovation collaboration as means by which firms that are not multinationals establish linkages to actors, regions and networks abroad. This broadening include, third, a call for research to look beyond the realm of formal business networks (Rutten and Boekema 2012), and consider how informal relationships and processes beyond the direct control of the firm (i.e. 'untraded interdependencies') influences their knowledge bases, search spaces, organisational routines and thus innovation capacities (Coviello and Munro 1997; Solheim and Fitjar 2016).

Such informal relationships can be of various nature. *Labour mobility* is one important mechanism for firms to acquire knowledge. International mobility often provides novel competencies that are particularly valuable for innovation in firms and regions (Saxenian 2006; Williams et al. 2004). Studies have shown that companies value international labour mobility as a means of fostering cultural diversity and redistributing international expertise across their branches (Williams 2007; Williams et al. 2004). Moreover, *temporal professional gatherings* are seen as important for creating global knowledge linkages. This was emphasized already by Maskell et al. (2006), who coined the term 'temporary clusters', and by Torre (2008), who argues that they create 'temporary geographical proximity', which allows for knowledge transmission between actors who are usually located at distance. Furthermore, it has been recognized that firms acquire knowledge globally through *online platforms and virtual communities,* comprising internet fora such as social networking sites, blogs, listservers, and shared interest sites (Miller et al. 2009; Grabher and Ibert 2014; Aslesen and Sardo 2016). Online communities can span over large distance, and typical gather around a certain interest field or technology. Examples for virtual communities can be found amongst others in the healthcare sector, where medical practitioners use online platforms to share common concerns and problems and thereby increase their medical knowledge and their confidence in their ability to provide health care (Sims 2018). According to Aslesen and Sardo (2016), the virtual dimension in the creation and support of knowledge linkages on a global scale requires more attention, even though scholars have recently started to examine the geography of virtual spaces (Rallet and Torre 2009). Further, *personally embedded networks* can be enablers for inter-organizational knowledge exchange, when skilled employees exchange ideas across organizational boundaries or seek help from former colleagues and other associates that they met in the course of their professional carriers. Often, inter-organizational collaboration in form of strategic alliances or R&D collaborations are mediated through inter-personal relations between managers or research staff. Such knowledge transfer mechanisms demands that complementarities between different formal and informal mechanisms are accounted for, as they influence one another through dynamic complementarities that also influence their combined effects on the innovation capacities of firms (Ebersberger and Herstad 2011; van Beers and Zand 2014).

Common to these perspectives is that they, implicitly or explicitly, conceptualize global innovation network linkages as interlinked with local economy characteristics, and draws attention to the symbiotic relationship between the global and the local. On the one hand, local institutional and industrial conditions attract or deter (different types of) inward FDI, and provide firms with incentives for tapping global knowledge flows that may or may not be backed by local resources in its support (O'Farrell et al. 1996; Herstad and Ebersberger 2015; Ebersberger et al. 2014). Such include privileged local contact points to global networks, due to the presence of 'gatekeepers' (Graf 2010) and favourable positions in international labour mobility flows (e.g. Oettl and Agrawal 2008). On the other hand, they influence the capacity of regions to absorb the resources that local firms access globally (Meyer and Sinani 2009; Boschma and Iammarino 2009), and transform them into impetuses for innovation-based growth.

5 Introduction to the Cases: The Media Industries in Southern Sweden and Oslo

In the following, we will turn to the question how firms in the New Media industry in southern Sweden and the Oslo Region acquire knowledge globally.

The New Media industry covers a range of activities related to the generation of media content and the development and use of media technology (Cooke 2002; Martin and Moodysson 2011). New Media is part of the creative and cultural industries, in which symbolic knowledge plays a central role, but firms also rely on synthetic knowledge to develop technological solutions to display and distribute media content (Martin and Rypestøl 2017). Innovation is typically organized in short-term projects involving a range of different collaboration partners, often in close geographical proximity (Grabher 2002; Cooke 2002). The flexible and project-based nature of innovation as well as the context specificity of symbolic knowledge implies that New Media companies have a strong tendency to cluster geographically, which could also be observed in the two case studies analysed in this chapter.

Both regions, southern Sweden and Oslo, can be regarded as thick and diversified RIS. As the capital of Norway, Oslo is the centre of the national media industry with major TV, radio and publishing companies having their headquarters in the region. The media industry further covers a very large share of small- and medium-sized firms that develop media-related technologies and provide creative media content partly to the national media outlets. In southern Sweden, the media industry is a rapidly growing sector and comprises today of approximately 360 SMEs, as well as a dedicated RIS support structure. The support structure includes a cluster initiative (Media Evolution, ME), a large business park (Media Evolution City, MEC and business incubator (Malmö Incubator MINC) that supports new start-ups in the industry, as well as a study programme and a research centre on New Media at the local university (Malmö University).

The empirical analysis is based on document studies and in-depth interviews with firm representatives. In total, 34 firms were interviewed, 16 firms in southern Sweden and 18 firms in Oslo. The firm population was identified on the basis of business statistics and sectoral codes (parts of NACE 58–63 and 73–74). Contact was made with RIS support organizations to identify companies that are innovative and maintain global knowledge linkages. The sample of interviewed firms was constructed to represent a large variation with respect to different subsectors and firm sizes (from 5 to 250 employees). The interviews were conducted between January and July 2016 and lasted between 60 and 90 min. The interviews were transcribed and analysed with regards to the nature of global knowledge sourcing.

6 Empirical Analysis: How Firms Gain Access to Global Knowledge Sources

Despite the prevalence of local knowledge exchange that is typical for firms in symbolic industries and in thick and diversified RIS, all interviewed firms use a number of mechanisms to access knowledge globally. Based on a review of the literature and the interview material, we identify seven key mechanisms that are used to access global knowledge (See Table 3).

One of the most important knowledge souring mechanisms used by the firms are *online platforms and virtual communities*. In online communities, new and often economically useful knowledge is generated through interaction between users and producers and despite an absence of co-location and geographical proximity. Grabher and Ibert (2014) demonstrate that knowledge practices in online communities can achieve quite demanding collective goals in a wide range of domains, including business areas such as furniture, photography, ICT and drug development. They can generate substantial value for the involved actors, ranging from collective knowledge creation and innovation to power, influence and prestige that arise from engagement with these communities (Agarwal et al. 2008). By creating organizational proximity, virtual spaces have the ability to compensate for a lack of geographical proximity for interactive learning. Romano et al. (2001) go so far as to talk of “virtual clusters”, in cases where customers, suppliers, distributors and business providers are linked in

Table 3 Knowledge sourcing channels in the media industry and their spaces

Knowledge sourcing channel	Frequency	Traded/ untraded	Space
Virtual communities and online platforms	Frequent	Untraded	Global
Temporary professional gatherings	Frequent	Untraded	Global, partly local
Personally embedded networks	Frequent	Untraded	Local, partly global
Mobility of skilled labour	Frequent	Untraded	Local, few global
R&D collaborations	Rare	Traded	Local, few global
Foreign direct investments (FDI)	Rare	Traded	Global
Hierarchies	Rare	Traded/ untraded	Global

Source: own draft

digital networks, through which they collaborate, compete and exchange knowledge with one another. In virtual clusters, tacit and codified knowledge are created and exchanged through diverse media channels, with “sharing” as main governance mechanism (Romano et al. 2001).

The importance of digital platforms and online communities has also become apparent in the interviews as all interviewed firms connect to the internet and access new ideas through virtual communities. This includes in particular technology forums that are used to search for solutions for practical problems that occur in the innovation process by actively taking part in online groups and engage into interactive problem solving, often with technology developers and users. Frequently mentioned example are software development platforms that are specialised on mobile operating systems (in particular Android or iOS). Companies interact on these platforms to find solutions to technological problems related to the display and distribution of media content on different media devices (e.g. displaying media content on mobile phones, tablet computers and TV sets). Rather than being confined to the region, these technologically-centred online communities have a global reach.

> This [conference] is more for inspiration, rather than to get the. . .the real knowledge. Basically, the real knowledge they’re gonna find online. (Firm representative, southern Sweden)

A second important knowledge sourcing channel are *temporary professional gatherings*, including conferences, conventions and trade fairs (Maskell et al. 2006; Bathelt et al. 2014; Torre 2008; Comunian 2016; Rallet and Torre 2009; Power and Jansson 2008). Such gatherings are used by firms to exhibit their latest and most advanced new products and services, which are then examined and evaluated by peers and competitors, as well as by customers and suppliers. Firms undertake considerable investments in terms of time and money to participate in these events, in order to identify the latest market developments and trends and to advance their own innovation strategies. Temporary clusters serve as a forum for information exchange concerning latest market trends, experiences and requirements for future products and services and gives insights that triggers new discussions and ideas at the firm level (Maskell et al. 2006). Some say that what is played out at the conference scene itself is not what is most important; it is to meet the right people. During a trade fair, firms establish social relations with their customers and attempt to attract new customers to market their products, and of course to monitor competitors. As many of those temporary professional gathering take place cyclically (Power and Jansson 2008), often annually, firms intensify their inter-organisatonal relations through recurring interactions over time, which may well lead to long-term and trustful relationships with partners over large geographical distance.

Among the interviewed media firms, the participation in conferences and trade fair is a common mechanism to meet global partners and acquire knowledge internationally. Depending on their size and their financial scope, the interviewed firms send representatives and qualified employees to professional gatherings in other parts of the word (e.g. Game Developer Conference GDC in San Francisco, CeBIT in Hanover, CrossMedia in London, South by Southwest in Texas, WAN-IFRA conferences), to present their products and to network with other firms, suppliers and customers. Additionally, employees are sent to conferences and fairs that are organized on local or national scale. Participation at local conferences is often less costly and allows to meet up with local partners, customers and decision makers. A yearly summit for game developers in the Nordic countries (Nordic Game Conference in Malmö) as well an annual media conference (The Conference in Malmö), hosted by the local cluster support organisation, are frequently mentioned temporary gathering events. These events are important platforms for local companies to exchange ideas with other local firms, but also to link up to multinational ICT companies, media publishers or potential customers nationally and internationally.

> We go to conferences. It's a good way to get inspiration. (. . .) It's a good way to get an international input. We have sent people to New York and to Amsterdam and to Norway and here in Malmö, to 'The Conference'. (Firm representative, southern Sweden)

Personally embedded networks are a third key mechanism for firms to access knowledge globally. The term refers to interactions between individuals in different firms, who know each other personally and interact beyond official work duties (Grabher and Ibert 2006; Huber 2011). Such networks can be informal, but they may also overlap with formalized relations, as long as they involve personal acquaintance and knowledge exchange beyond formal job roles (Huber 2013). Thus, discussions with strangers (e.g. at conferences or trade fairs) or interactions on virtual platforms would not qualify as personal relationship. Previous collaborations and face-to-face interactions lead to the formation of personal relationships that can be drawn upon in later stages, even in absence of geographical proximity. Huber (2012, 2013) shows that in science-based industries such as ICT, important forms of knowledge exchange occur through personal networks between skilled employees. They are particularly important to acquire business knowledge, that is, when senior managers interact with fellow managers to keep up-to-date on latest developments in their professional domain. Personal networks are argued to be particularly important for creative and cultural industries, where innovation is organized in short-term projects with changing collaboration partners (Grabher and Ibert 2006; Grabher 2002). Garmann Johnsen (2011) shows that in symbolic industries, knowledge is often exchanged in a dynamic interplay between formal project collaboration and informal social networking. Even though the regional level plays a vital role for collaboration in symbolic industries, networks are not limited to spatial proximity, but can span over long distances (Vang and Chaminade 2007; van Egeraat et al. 2013).

Among the interviewed media firms, personal relations play a central role for the acquisition of new knowledge. Even though personal relationships are often situated within the same regional or national context, important relations also span over national boundaries. Many of the interviewed companies are young and small, and the entrepreneur's personal network is vital to the success of the firm. Personal relations as a source to access knowledge are perceived especially important for these small firms with less financial resources. Personal relations of the entrepreneur and key staff members, very often created during school and college education, play a key role in different respects: First, entrepreneurial activities of former class mates or co-workers often serve as role model and source of inspiration to start a venture. Second, personal relations are often used to draw upon when complementary skills and knowledge are needed for the development of a new product or service. Within their personal networks, the entrepreneurs ask for managerial or technical advice, which they receive informally, based on trust and reciprocity. And third, personal networks are used to acquire knowledge about global markets and business opportunities. Personal contacts to entrepreneurs with experience in other, global markets (in particular in Silicon Valley, USA) have been frequently mentioned by the interviewed firms as important stimulus for innovation and product development:

> I am getting free knowledge, about digital platforms, that even the biggest Norwegian companies would dream of. That's the informal kind of buildup. (Firm representative, Oslo)

A fourth key mechanism to acquire knowledge is *labour mobility*, that is, the movement of skilled personnel between organizations (Williams et al. 2004; Saxenian 2006; Trippl 2013). As important types of knowledge are tacit and embodied into people, hiring skilled labour is a natural way for firms to source new knowledge for innovation. Studies that deal with the impact of labour flows on firm performance show that the skills of newly recruited employees should be related, but not too similar to the existing knowledge base of a firm (Boschma et al. 2009; Herstad et al. 2015). Asheim and Hansen (2009) show that skilled labour that draws on symbolic knowledge (e.g. artists, designers, writers) value the quality of place higher than skilled labour that draw on analytical knowledge (e.g. physicists, mathematicians, life-science professionals) or synthetic knowledge (e.g. engineers, technicians), who mostly move to places with strong and diversified regional economies. Alfken (2015) shows that job conditions outweigh the importance of amenity-related factors even for skilled labour in symbolic industries. Inter-regional mobility is typical for creative labour in an early career phase, while geographical mobility decreases in later phases of career development.

The interviewed firms report that recruiting is a key mechanism for getting new knowledge. Being located in a thick and diversified RIS is important in order to attract talent from abroad, which has been emphasized by the firms in Oslo. Some of the companies were in need for specific computer skills which was hard to find locally and even nationally, therefore recruiting international labors. However, most of the New Media industry is characterised by high local labour mobility, as many of the employees are on short-term contracts and further, that some employees are more driven by the specific project they would like to work on than by which company they are hired by. The high local mobility rate (also among leaders) suggests sector transparency (e.g. Herstad and Ebersberger 2014), and one interviewee meant that the tight network in the sector was a barrier for innovation, a kind of lock-in of a certain mind-set. This suggests a dilemma in symbolic industries between the need to hire people able to adapt innovations to local context, and that of triggering newness from outside. While international orientation and cultural diversity among the staff is considered as important for innovativeness of the firms, staff with different cultural background is usually hired locally, rather than internationally, due to the project-based nature of the industry:

> One of our value words is 'diversity'. I think it's really important that you come from another culture and that you have another way of looking at the problem. . .but we are getting challenged all the time, it is a really rapid movement and changing a lot. (Firm representative, southern Sweden)

Only few companies report of formal international *R&D collaborations*. Some have research collaborations with local and national higher education organizations, very few report of such collaboration internationally. Those that do are characterized by more synthetic knowledge bases, including media-related programming and software development. Formal development contracts with clients are of importance, but most of these clients are local. In the case of Oslo, several of the companies within production of films, video or TV- and radio programmes have been bought up by MNEs through *Foreign Direct Investments (FDI)* and as such become part of large global entities. Most of these mergers are due to well run production companies with accumulated and specific local knowledge. In both regions, there are examples of firms establishing subsidiaries in other countries in order to be near to their customers. This holds in particular for the larger firms in the sample. Such inward and outward investments lays the ground for intra-firm networks or *hierarchies* that can function as mechanisms for global knowledge flows (Lui and Liefner 2016; Aslesen et al. 2017). Intra-firm networks are important mechanisms for knowledge flows, which are strengthened by organisational proximity through common identity and language (Boschma 2005; Aguiléra et al. 2012). One of the Oslo-based companies reported that almost 40% of knowledge sourcing came from within the MNC. Knowledge is exchanged through meetings during the year where all subsidiaries, often representing 15–20 countries, meet up to share ideas, formats and views on trends. Having Scandinavian sub-groups that meet more frequently to share ideas and trends seems of particular importance due to similarity in markets and the potential of developing products that can work in all these countries. Scandinavia is also seen as a context where new ideas more easily will be tried out:

> . . .we get a development culture that regenerates. So it’s a high quality on innovation in the territory (firm representative, Oslo)

7 Conclusions: Understanding the Global Dimension of RIS

The RIS literature acknowledges the importance of global knowledge sources and the open nature of regional systems, but few studies go beyond this and systematically analyse the nature of global knowledge flows. This chapter contributes to filling this void conceptually and empirically. Conceptually, the paper draws on the RIS and knowledge base approaches in order to conceptualise the regional and industrial context of global knowledge flows. Regions differ in their needs, attractiveness, support, and absorption capacity for global knowledge, which further depends on the prevailing knowledge base of the industries located in the respective regions. According to this conceptual framework, local knowledge is most relevant for firms in symbolic industries (importance of tacit knowledge and cultural embeddedness) located in diverse metropolitan areas (thick and diverse RIS). Empirically, we investigate what role global knowledge plays for and how it is acquired by firms well served with local knowledge. We find that even such firms actively use a variety of mechanisms to source knowledge globally; a finding that underlines the importance of developing a better understanding about the *global dimension of RIS*.

We study firms in the New Media industry, that is, firms anchored in a symbolic knowledge base, located in southern Sweden and Oslo, Norway, two thick and diversified RIS. The study provides evidence that such firms frequently source knowledge globally using informal mechanisms. This includes virtual communities and online platforms, temporary professional gatherings, and personally embedded networks. Furthermore, recruitment of skilled labour is an important albeit less frequent mechanism for global knowledge sourcing. Notwithstanding some recent literature foregrounding informal mechanisms to source knowledge globally (Grabher and Ibert 2014; Comunian 2016; Bathelt et al. 2014), the bulk of literature focusses on R&D collaborations and FDI. Hence, our study raises a question as regards the relative importance of informal, low-cost versus formal, high-cost mechanisms to source knowledge globally. Informal, low-cost mechanisms are used much more frequently than formal, high-cost mechanisms, and they are clearly important. However, it could be the case that informal, low-cost mechanisms do not provide a competitive advantage as they are available to all firms in the New Media industry. This is often the case for virtual communities and online platforms even though limited access based on invitation is possible and used. Access to temporary professional gatherings varies by type, trade fairs are open to everybody while certain workshop and activities may be based on invitations. This leads to personally embedded networks, which are by definition not ubiquitous and depend on previous social interactions. Therefore, we conclude that it is conceivable that informal, low-cost mechanisms to source global knowledge give raise to competitive advantage and should be investigated in more depth.

Furthermore, our study raises the question of how local and global knowledge sourcing relate to each other. In the literature, the argument has been made that local and global knowledge are complementary, that strong local knowledge facilitates the sourcing of global knowledge, which in turn strengthens the local knowledge base. Bathelt et al. (2004) present this as symbiosis between local buzz and global pipelines (however, ignoring informal mechanisms of global knowledge sourcing). Camagni (1995) argues that "external energy", meaning knowledge from extra-regional sources, adds momentum to an innovative milieu. Belussi and Sedita (2012) argue that it is the combination of local and distant as well as emergent and deliberate knowledge structures that enhances the competitiveness of industrial districts. On the other hand, recent studies suggest that firms potentially are able to compensate for a lack of local knowledge with sourcing knowledge at other geographical scales (Fitjar and Rodríguez-Pose 2011; Tödtling et al. 2012; Grillitsch and Nilsson 2015). It remains unclear to what extent local knowledge shapes the access to and possibilities to absorb global knowledge and what conditions this relationship. As an entry to this question, the knowledge base approach has documented different spatial patterns of knowledge networks depending on the type of knowledge industries use (Tödtling and Grillitsch 2014; Martin 2013). Equally it may relate to the mode of innovation (Jensen et al. 2007), as well as institutional factors that foster or constrain knowledge flows over distance. This ties in to the question of the relative importance of local versus global knowledge. Following the frequently observed absence of input-output relationships in clusters, it has been widely postulated that the effect of collocation lies in the possibilities to acquire new knowledge, learn and become innovative (Maskell 2001; Malmberg and Maskell 2006; Storper 1995). Depending on the relative importance of local knowledge and the role that global knowledge can play in innovation processes of firms, these knowledge-based explanations of spatial clustering may also need to be revised.

Acknowledgements This research has been generously supported by the Marianne and Markus Wallenberg Foundation, grant number 2012.0194.

References

Agarwal, R., Gupta, A. K., & Kraut, R. (2008). Editorial overview—The interplay between digital and social networks. *Information Systems Research, 19*, 243–252.

Aguiléra, A., Lethiais, V., & Rallet, A. (2012). Spatial and non-spatial proximities in inter-firm relations: An empirical analysis. *Industry and Innovation, 19*, 187–202.

Alfken, C. (2015). Ich will nicht nach Berlin! – Life course analysis of inter-regional migration behaviour of people from the field of design and advertising. *Environment and Planning A, 47*, 2187–2203.

Asheim, B. T., & Gertler, M. S. (2005). The geography of innovation: Regional innovation systems. In J. Fagerberg, D. C. Mowery, & R. R. Nelson (Eds.), *The Oxford handbook of innovation* (pp. 291–317). Oxford: Oxford University Press.

Asheim, B. T., & Hansen, H. K. (2009). Knowledge bases, talents, and contexts: On the usefulness of the creative class approach in Sweden. *Economic Geography, 85*(4), 425–442.

Asheim, B. T., & Herstad, S. (2009). Regional innovation systems, varieties of capitalisms and non-local relations: Challenges from the globalising economy. In R. A. Boschma & R. C. Kloosterman (Eds.), *Learning from clusters: A critical asessment for an economic-geographical perspective*. Dordrecth: Springer.

Asheim, B. T., & Herstad, S. (2005). Regional innovation systems, varieties of capitalisms and non-local relations: Challenges from the globalising economy. In R. A. Boschma & R. C. Kloosterman (Eds.), *Learning from clusters: A critical asessment for an economic-geographical perspective*. Dordrecth: Springer.

Asheim, B. T., & Isaksen, A. (2002). Regional innovation systems: The integration of local 'sticky' and global 'ubiquitous' knowledge. *The Journal of Technology Transfer, 27*, 77–86.

Asheim, B. T., Boschma, R., & Cooke, P. (2011). Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies, 45*, 893–904.

Asheim, B., Grillitsch, M., & Trippl, M. (2015). Regional innovation systems: Past – presence – future. *Papers in innovation studies* 2015/36.

Aslesen, H. W., & Sardo, S. (2016). Dynamic knowledge linkages and extended innovation. *AAG Annual Meeting 2016,* San Francisco.

Aslesen, H. W., Hydle, K. M., & Wallevik, K. (2017). Extra-regional linkages through MNCs in organizationally thick and specialized RISs: A source of new path development? *European Planning Studies, 25*, 443–461.

Balsvik, R. (2011). Is labor mobility a channel for spillovers from multinationals? Evidence from Norwegian manufacturing. *Review of Economics and Statistics, 93*, 285–297.

Bathelt, H., Malmberg, A., & Maskell, P. (2004). Clusters and knowledge: Local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography, 28*, 31–56.

Bathelt, H., Golfetto, F., & Rinallo, D. (2014). Temporary markets and temporary clusters. In H. Bathelt, F. Golfetto, & D. Rinallo (Eds.), *Trade shows in the globalizing knowledge economy* (pp. 40–55). Oxford: Oxford University Press.

Belderbos, R., Lykogianni, E., & Veugelers, R. (2008). Strategic R&D location by multinational firms: Spillovers, technology sourcing, and competition. *Journal of Economics & Management Strategy, 17*, 759–779.

Bellak, C. (2004). How domestic and foreign firms differ and why does it matter? *Journal of Economic Surveys, 18*, 483–514.

Belussi, F., & Sedita, S. R. (2012). Industrial districts as open learning systems: Combining emergent and deliberate knowledge structures. *Regional Studies, 46*, 165–184.

Boschma, R. (2005). Proximity and innovation: A critical assessment. *Regional Studies, 39*, 61–74.

Boschma, R., & Iammarino, S. (2009). Related variety, trade linkages, and regional growth in Italy. *Economic Geography, 85*, 289–311.

Boschma, R., Eriksson, R., & Lindgren, U. (2009). How does labour mobility affect the performance of plants? The importance of relatedness and geographical proximity. *Journal of Economic Geography, 9*, 169–190.

Brown, R. (2000). Clusters, supply chains and local embeddedness in Fyrstad. *European Urban and Regional Studies, 7*, 291–305.

Camagni, R. (1995). The concept of *innovative milieu* and its relevance for public policies in European lagging regions. *Papers in Regional Science, 74*, 317–340.

Chaminade, C., & Plechero, M. (2015). Do regions make a difference? Regional innovation systems and global innovation networks in the ICT industry. *European Planning Studies, 23*, 215–237.

Chaminade, C., & Vang, J. (2008). Globalisation of knowledge production and regional innovation policy: Supporting specialized hubs in the Bangalore software industry. *Research Policy, 37*, 1684–1696.

Chaminade, C., De Fuentes, C., Harirchi, G., & Plechero, M. (2016). The geography and structure of global innovation networks: Global scope and regional embeddedness. In R. Shearmur, C. Carrincazeaux, & D. Doloreux (Eds.), *Handbook on the geographies of innovation* (pp. 307–381). Cheltenham: Edward Elgar.

Coe, N. M., Hess, M., Yeung, H W.-c., et al. (2004). 'Globalizing' regional development: A global production networks perspective. *Transactions of the Institute of British Geographers, 29*, 468–484.

Comunian, R. (2016). Temporary clusters and communities of practice in the creative economy: Festivals as temporary knowledge networks. *Space and Culture, 20*, 329–343.

Cooke, P. (1995). *The rise of the Rustbelt: Revitalizing older industrial regions*. London: UCL Press.

Cooke, P. (2002). New media and new economy cluster dynamics. In L. A. Lievrouw & S. Livingstone (Eds.), *Handbook of new media: Social shaping and social consequences of ICTs* (pp. 287–303). London: SAGE.

Cooke, P., Uranga, M. G., & Etxebarria, G. (1998). Regional systems of innovation: An evolutionary perspective. *Environment and Planning A, 30*, 1563–1584.

Cooke, P., Heidenreich, M., & Braczyk, H.-J. (2004). *Regional innovation systems: The role of governance in a globalized world* (2nd ed.). New York: Routledge.

Cotic-Svetina, A., Jaklic, M., & Prodan, I. (2008). Does collective learning in clusters contribute to innovation? *Science and Public Policy, 35*, 335–345.

Coviello, N. E., & Munro, H. J. (1997). Network relationships and the internationalization process of small software firms. *International Business Review, 6*, 361–386.

D'Agostino, L. M., Laursen, K., & Santangelo, G. D. (2012). The impact of R&D offshoring on the home knowledge production of OECD investing regions. *Journal of Economic Geography, 13*, 145–175.

Ebersberger, B., & Herstad, S. (2011). Product innovation and the complementarities of external interfaces. *European Management Review, 8*, 117–135.

Ebersberger, B., Herstad, S., & Koller, C. (2014). Does the composition of regional knowledge bases influence extra-regional collaboration for innovation? *Applied Economic Letters, 21*, 201–204.

Fernhaber, S. A., Gilbert, B. A., & McDougall, P. P. (2008). International entrepreneurship and geographic location: An empirical examination of new venture internationalization. *Journal of international Business Studies, 39*, 267–290.

Fitjar, R. D., & Rodríguez-Pose, A. (2011). When local interaction does not suffice: Sources of firm innovation in urban Norway. *Environment and Planning. A, 43*, 1248–1267.

Fitjar, R. D., & Rodríguez-Pose, A. (2012). Firm collaboration and modes of innovation in Norway. *Research Policy, 42*, 128–138.

Fosfuri, A., Motta, M., & Ronde, T. (2001). Foreign direct investment and spillovers through workers' mobility. *Journal of International Economics, 51*, 204–222.

Garmann Johnsen, I. H. (2011). Formal project organization and informal social networks: Regional advantages in the emergent animation industry in Oslo, Norway. *European Planning Studies, 19*, 1165–1181.

Gertler, M. S. (2008). Buzz without being there? Communities of practice in context. In A. Amin & J. Roberts (Eds.), *Community, economic creativity, and organization* (pp. 203–226). Oxford: Oxford University Press.

Gertler, M. S. (2010). Rules of the game: The place of institutions in regional economic change. *Regional Studies, 44*, 1–15.

Görg, H., & Greenway, D. (2004). Much ado about nothing? Do domestic firms really benefit from foreign direct investment? *The World Bank Research Observer, 19*, 171–197.

Görg, H., & Strobl, E. (2005). Spillovers from foreign firms through worker mobility: An empirical investigation. *Scandinavian Journal of Economics, 107*, 693–710.

Grabher, G. (1993). The weakness of strong ties; the lock-in of regional development in the Ruhr area. In G. Grabher (Ed.), *The embedded firm: On the socioeconomics of industrial networks* (pp. 255–277). London: Routledge.

Grabher, G. (2002). The project ecology of advertising: Tasks, talents and teams. *Regional Studies, 36*, 245–262.

Grabher, G., & Ibert, O. (2006). Bad company? The ambiguity of personal knowledge networks. *Journal of Economic Geography, 6*, 251–271.

Grabher, G., & Ibert, O. (2014). Distance as asset? Knowledge collaboration in hybrid virtual communities. *Journal of Economic Geography, 14*, 97–123.

Graf, H. (2010). Gatekeepers in regional networks of innovators. *Camb J Econ, 35*, 173–198.

Grillitsch, M., & Nilsson, M. (2015). Innovation in peripheral regions: Do collaborations compensate for a lack of local knowledge spillovers? *The Annals of Regional Science, 54*, 299–321.

Grillitsch, M., Martin, R., & Srholec, M. (2016). Knowledge base combinations and innovation performance in Swedish regions. *Economic Geography, 93*(5), 458–479. https://doi.org/10.1080/00130095.2016.1154442

Hassink, R. (2005). How to unlock regional economies from path dependency? From learning region to learning cluster. *European Planning Studies, 13*, 521–535.

Hassink, R. (2010). Locked in decline? On the role of regional lock-ins in old industrial areas. In R. Boschma & R. Martin (Eds.), *The handbook of evolutionary economic geography* (pp. 450–468). Cheltenham: Edward Elgar.

Henderson, J. V. (2007). Understanding knowledge spillovers. *Regional Science and Urban Economics, 37*, 497–508.

Henderson, J., Dicken, P., Hess, M., et al. (2002). Global production networks and the analysis of economic development. *Review of International Political Economy, 9*, 436–464.

Herstad, S. J. (2017). Innovation strategy choices in the urban economy. *Urban Studies, 8*. https://doi.org/10.1177/0042098017692941

Herstad, S., & Ebersberger, B. (2014). Urban agglomerations, knowledge intensive services and innovation activity: Establishing the core connections. *Entrepreneurship & Regional Development, 26*, 211–233.

Herstad, S., & Ebersberger, B. (2015). On the link between urban location and the involvement of knowledge intensive business services in collaboration networks. *Regional Studies, 49*, 1160–1175.

Herstad, S., Aslesen, H. W., & Ebersberger, B. (2014). On industrial knowledge bases, commercial opportunities and global innovation network linkages. *Research Policy, 43*, 495–504.

Herstad, S. J., Sandven, T., & Ebersberger, B. (2015). Recruitment, knowledge integration and modes of innovation. *Research Policy, 44*, 138–153.

Huber, F. (2011). On the role and interrelationship of spatial, social and cognitive proximity: Personal knowledge relationships of R&D workers in the Cambridge information technology cluster. *Regional Studies, 46*, 1169–1182.

Huber, F. (2012). On the sociospatial dynamics of personal knowledge networks: Formation, maintenance, and knowledge interactions. *Environment and Planning A, 44*, 356–376.

Huber, F. (2013). Knowledge-sourcing of R&D workers in different job positions: Contextualising external personal knowledge networks. *Research Policy, 42*, 167–179.

Jensen, M. B., Johnson, B., Lorenz, E., et al. (2007). Forms of knowledge and modes of innovation. *Research Policy, 36*, 680–693.

Johanson, J., & Vahlne, J. E. (2009). The Uppsala internationalization process model revisited: From liability of foreigness to liability of outsidership. *Journal of international Business Studies, 40*, 1411–1431.

Laestadius, S. (1998). Technology level, knowledge formation and industrial competence in paper manufacturing. In G. Eliasson & C. Green (Eds.), *The micro foundations of economic growth* (pp. 212–226). Ann Arbour: University of Michigan Press.

Lui, J., & Liefner, I. (2016). The joint influencing mechanism of proximities and knowledge base on multinational companies' global innovation networks. *Papers in Innovation Studies* 2016/4.

Malmberg, A., & Maskell, P. (2006). Localized learning revisited. *Growth and Change, 37*, 1–18.

Manniche, J., & Larsen, K. T. (2013). Experience staging and symbolic knowledge: The case of Bornholm culinary products. *European Urban and Regional Studies, 20*, 401–416.

Manniche, J., Moodysson, J., & Testa, S. (2016). Combinatorial knowledge bases: An integrative and dynamic approach to innovation studies. *Economic Geography, 93*(5), 480–499. https://doi.org/10.1080/00130095.2016.1205948

Martin, R. (2013). Differentiated knowledge bases and the nature of innovation networks. *European Planning Studies, 21*, 1418–1436.

Martin, R., & Moodysson, J. (2011). Innovation in symbolic industries: The geography and organization of knowledge sourcing. *European Planning Studies, 19*, 1183–1203.

Martin, R., & Rypestøl, J. O. (2017). Linking content and technology: On the geography of innovation networks in the Bergen media cluster. *Industry and Innovation*, 1–24. https://doi.org/10.1080/13662716.2017.1343132

Martin, R., & Moodysson, J. (2013). Comparing knowledge bases: On the geography and organization of knowledge sourcing in the regional innovation system of Scania, Sweden. *European Urban and Regional Studies, 20*, 170–187.

Maskell, P. (2001). Towards a knowledge-based theory of the geographical cluster. *Industrial and Corporate Change, 10*, 921–943.

Maskell, P., & Malmberg, A. (2007). Myopia, knowledge development and cluster evolution. *Journal of Economic Geography, 7*, 603–618.

Maskell, P., Bathelt, H., & Malmberg, A. (2006). Building global knowledge pipelines: The role of temporary clusters. *European Planning Studies, 14*, 997–1013.

Maskell, P., Pedersen, T., Petersen, B., et al. (2007). Learning paths to offshore outsourcing: From cost reduction to knowledge seeking. *Industry and Innovation, 14*, 239–257.

Meyer, K., & Sinani, E. (2009). Where and when does foreign direct investment generate positive spillovers? A meta analysis. *Journal of International Business Studies, 40*, 1075–1094.

Meyer, K., Mudambi, R., & Narula, R. (2011). Multinational enterprises and local contexts: The opportunities and challenges of multiple embeddedness. *Journal of Management Studies, 48*, 235–252.

Miller, K. D., Fabian, F., & Lin, S.-J. (2009). Strategies for online communities. *Strategic Management Journal, 30*, 305–322.

Moodysson, J. (2007). *Sites and modes of knowledge creation: On the spatial organization of biotechnology innovation*. Lund: Lund University Press.

Moulaert, F., & Sekia, F. (2003). Territorial innovation models: A critical survey. *Regional Studies, 37*, 289–302.

North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge: Cambridge University Press.

O'Farrell, P. N., Zheng, J., & Wood, P. A. (1996). Internationalization of business services: An interregional analysis. *Regional Studies, 30*, 101–118.

Oettl, A., & Agrawal, A. (2008). International labor mobility and knowledge flow externalities. *Journal of International Business Studies, 39*, 1242–1260.

Pina, K., & Tether, B. S. (2016). Towards understanding variety in knowledge intensive business services by distinguishing their knowledge bases. *Research Policy, 45*, 401–413.

Plum, O., & Hassink, R. (2011). Comparing knowledge networking in different knowledge bases in Germany. *Papers in Regional Science, 90*, 355–371.
Plum, O., & Hassink, R. (2014). Knowledge bases, innovativeness and competitiveness in creative industries: The case of Hamburg's video game developers. *Regional Studies, Regional Science, 1*, 248–268.
Power, D., & Jansson, J. (2008). Cyclical clusters in global circuits: Overlapping spaces in furniture trade fairs. *Economic Geography, 84*, 423–448.
Rallet, A., & Torre, A. (2009). Temporary geographical proximity for business and work coordination: When, how and where? *55. Annual North American Meetings of the Regional Science Association International*. New York, USA. http://prodinra.inra.fr/record/191090
Romano, A., Passiante, G., & Elia, V. (2001). New sources of clustering in the digital economy. *Journal of Small Business and Enterprise Development, 8*, 19–27.
Rutten, R., & Boekema, F. (2012). From learning region to learning in a socio-spatial context. *Regional Studies, 46*, 981–992.
Saxenian, A. (2006). *The new argonauts: Regional advantage in a global economy*. Cambridge, MA: Harvard University Press.
Sims, J. M. (2018). Communities of practice: Telemedicine and online medical communities. *Technological Forecasting and Social Change, 126*(Supplement C), 53–63.
Solheim, M. C. W., & Fitjar, R. D. (2016). Foreign workers are associated with innovation, but why? International networks as a mechanism. *International Regional Science Review*. https://doi.org/10.1177/0160017615626217
Srholec, M., & Verspagen, B. (2012). The Voyage of the Beagle into innovation: Explorations on heterogeneity, selection, and sectors. *Industrial and Corporate Change, 21*, 1221–1253.
Storper, M. (1995). The resurgence of regional economies, ten years later: The region as a nexus of untraded interdependencies. *European Urban and Regional Studies, 2*, 191–221.
Tödtling, F., & Grillitsch, M. (2014). Types of innovation, competencies of firms, and external knowledge sourcing—findings from selected sectors and regions of Europe. *Journal of the Knowledge Economy, 5*, 330–356.
Tödtling, F., & Trippl, M. (2004). Like phoenix from the ashes? The renewal of clusters in old industrial areas. *Urban studies, 41*, 1175–1195.
Tödtling, F., Grillitsch, M., & Höglinger, C. (2012). Knowledge sourcing and innovation in Austrian ICT companies—How does geography matter? *Industry and Innovation, 19*, 327–348.
Torre, A. (2008). On the role played by temporary geographical proximity in knowledge transmission. *Regional Studies, 42*, 869–889.
Trippl, M. (2013). Scientific mobility and knowledge transfer at the interregional and intraregional level. *Regional Studies, 47*, 1653–1667.
Trippl, M., Tödtling, F., & Lengauer, L. (2009). Knowledge sourcing beyond buzz and Pipelines: Evidence from the Vienna software sector. *Economic Geography, 85*, 443–462.
Trippl, M., Grillitsch, M., & Isaksen, A. (2017). Exogenous sources of regional industrial change. *Progress in Human Geography, 3*. https://doi.org/10.1177/0309132517700982
van Beers, C., & Zand, F. (2014). R&D cooperation, partner diversity, and innovation performance: An empirical analysis. *Journal of Product Innovation Management, 31*, 292–312.
van Egeraat, C., O'Riain, S., & Kerr, A. (2013). Social and spatial structures of innovation in the Irish animation industry. *European Planning Studies, 21*, 1437–1455.
Vang, J., & Chaminade, C. (2007). Cultural clusters, global–local linkages and spillovers: Theoretical and empirical insights from an exploratory study of Toronto's film cluster. *Industry and Innovation, 14*, 401–420.
Williams, A. M. (2007). International labour migration and tacit knowledge transactions: A multi-level perspective. *Global Networks, 7*, 29–50.
Williams, A. M., Baláž, V., & Wallace, C. (2004). International labour mobility and uneven regional development in Europe: Human capital, knowledge and entrepreneurship. *European Urban and Regional Studies, 11*, 27–46.

Knowledge Bases and Relatedness: A Study of Labour Mobility in Norwegian Regions

Rune Dahl Fitjar and Bram Timmermans

Abstract

Two ideas have emerged as central in evolutionary economic geography in recent years: First, innovation is often the result of meetings between related ideas, and regions are therefore best served by hosting a variety of related industries. Second, innovation often comes from the combination of different knowledge bases. However, there have been few attempts at linking these approaches in empirical studies. This paper connects the dots by examining relatedness among industries with similar and different knowledge bases in specific regional contexts. We focus on regions expected to have different types of innovation systems, from the organisationally thick and diversified RIS of large cities through the more specialised RIS in intermediate cities to the organisationally thin RIS found in small rural regions. The analysis finds that industries with different knowledge bases are related in various regional settings, with combinatorial knowledge base industries having a central role in many regions. However, there are also cases of potential lock-in, where relatedness is mainly found among regions with the same knowledge base.

Keywords

Relatedness · Knowledge bases · Regional systems of innovation · Labour mobility

R.D. Fitjar (✉)
University of Stavanger, Stavanger, Norway
e-mail: rune.d.fitjar@uis.no

B. Timmermans
Norwegian School of Economics, Bergen, Norway

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_8

1 Introduction

At the time of writing, Bjørn Asheim's most cited paper is his chapter with Meric Gertler in the 2005 *Oxford Handbook of Innovation*, where they introduced the concept of knowledge bases into the geography of innovation literature.[1] They distinguish between industries relying respectively on an analytical and a synthetic knowledge base. A third knowledge base—symbolic—was introduced in subsequent work (Asheim et al. 2007). Analytical knowledge is oriented towards understanding and explaining the world, and innovation requires creating new knowledge. Synthetic knowledge is oriented towards problem-solving and mainly relies on novel applications and combinations of existing knowledge. Symbolic knowledge is oriented towards sense-making and creation of cultural meaning (Asheim et al. 2007: 661). The concept of knowledge bases has been central in much of Asheim's work in the subsequent years (e.g. Asheim and Coenen 2005, 2006; Moodysson et al. 2008; Asheim and Hansen 2009; Asheim et al. 2011, 2016; Liu et al. 2013).

A core idea in recent work on knowledge bases is that different knowledge bases can be usefully combined. For instance, Asheim et al. (2016: 9) note that "upgrading can take place through unrelated knowledge base combinations leading to new related industries". Tödtling and Grillitsch (2015) show that firms relying on a combination of different knowledge bases outperform those that are more narrowly based on one type of knowledge. Grillitsch et al. (2016: 1) further develop this argument to the regional scale, arguing that "firms benefit most from being located in a region with a balanced mix of all three knowledge bases".

The idea of combining different knowledge bases to create new combinations shares key similarities with another dominant idea in economic geography during the last 10 years: the concept of relatedness and the associated literature on related variety. The relatedness literature argues that due to cognitive proximity, knowledge flows and subsequent knowledge combinations occur more frequently across industries that share some basic similarities than across more unrelated industries. However, too much similarity can also hamper the potential for learning (Nooteboom 2000; Frenken et al. 2007; Boschma and Iammarino 2009). Thus, being located in a region with related variety—i.e. with many different, but related, industries—is thought to be beneficial for innovation (Tavassoli and Carbonara 2014; van den Berge and Weterings 2014; Castaldi et al. 2015).

The link between related variety and knowledge bases was already drawn in the so-called ABC paper by Asheim, Boschma and Cooke (2011), forming the basis of the concept "Constructing Regional Advantage". The idea here is that effectiveness of regional policy can improve when taking into account "related variety, which is defined on the basis of shared and complementary knowledge bases and competences" (Asheim et al. 2011: 901). A recent paper by Sedita et al. (2017) combine these concepts in an empirical analysis by interacting relatedness and

[1]The concept was seemingly first used by Asheim and Mariussen (2003) in a report which is no longer in the public sphere (cited in Manniche et al. 2016).

knowledge base specialisation measures at the regional level. However, few studies have empirically combined the two concepts in the sense of examining the extent to which industries with different knowledge bases are actually related in a regional economic context. Combining knowledge bases with industry relatedness allows us to identify the levels of industrial diversity of regions, how these industries are connected, and what the connecting forces of these industries are. As such, it provides us with another approach to understand the different configurations of regional innovation systems as proposed by Isaksen and Trippl (2016), who made a distinction between organizationally thick and diversified RIS, organizationally thick and specialized RIS, and organizationally thin RIS.

In this study, we conduct such an analysis in the context of Norway. We develop a measure of the knowledge bases of different Norwegian industries based on the educational background of their workers. Furthermore, we analyse the relatedness across these industries using labour mobility flows, building on the concept of skill relatedness and the method developed in Neffke and Henning (2013) and Neffke et al. (2017), as applied to Norway by Fitjar and Timmermans (2016). Finally, we examine the composition of industries in a selection of Norwegian regions, focusing on their knowledge bases and the skill relatedness across different industries.

2 Knowledge Bases, Relatedness and Regional Innovation: Review of the Literature

2.1 Knowledge Bases

The concept of knowledge bases was introduced to highlight the very different ways in which innovation processes unfold in different industries. Departing from Laestadius' (1998) distinction between analytical and synthetic knowledge, Asheim and Gertler (2005) describe industrial settings where these two different types of knowledge differ in their relative importance and discuss the characteristics of innovation processes in such settings. Analytical knowledge prevails in science-based industries, where innovation comes from basic and applied research. In industries where this is important, such as biotechnology or information technology, innovation will often be the result of new knowledge about the world. In-house R&D and links to knowledge-producing institutions, such as universities, is therefore essential. In this case, knowledge is often codified and can be transferred over long distances. Nonetheless, firms relying on analytical knowledge tend to locate in close proximity to universities due to the importance of absorptive capacity in decoding the new knowledge developed by basic research. Asheim and Gertler (2005: 298) note the importance of the local "buzz" of such places in sustaining both localised knowledge circulation (Storper and Venables 2004) and labour market opportunities for the creative talent, which this absorptive capacity depends on (Florida 2002).

In industries relying on synthetic knowledge, new applications or combinations of existing knowledge are more important for innovation than the development of completely new knowledge as such. Innovation often occurs as the result of problem-solving, when new solutions are developed in response to problems faced by the firm or posed by customers. These solutions are often not found in R&D, but in well-established knowledge that is applied to new settings. If the innovation process involves formal research, this tends to be mainly in the form of applied research. New knowledge is typically created through processes of trial and error, experimentation, and practical experience. Tacit knowledge therefore tends to be more important in industries with a synthetic knowledge base (Asheim and Gertler 2005).

While the original theory distinguished between these two knowledge bases only, Asheim et al. (2007) added a third: symbolic knowledge. This refers to industries in which aesthetic attributes, symbols, images and narratives are important—in short, the symbolic or sign value of the product. The cultural and creative industries are typical examples of this. In these industries, constant innovation is imperative as products more often compete on attractiveness and novelty than on practical utility (Fitjar and Jøsendal 2016). The knowledge involved is interpretative rather than informational. It also tends to be highly sensitive to local norms, habits and understandings, and therefore highly tacit. This cultural embeddedness of industries with a symbolic knowledge base entails that they will rely on knowledge sources in close geographical proximity, which share the same interpretative schemes (Martin and Moodysson 2011, 2013). However, validation of such interpretations at global nodes of excellence can also be highly important in these industries, underscoring the complex interplay between global and local knowledge also in symbolic industries (Rekers 2016).

A recent strand of research on knowledge bases has focused on its role in regional path development. Asheim et al. (2011) develop the notion of "constructing regional advantage" in which regional innovation policy should be based on an understanding of the dominant knowledge bases of the region's industries and their associated modes of innovation. Manniche (2012) argues for an integrative approach, where knowledge exchange across different knowledge bases is actively targeted. Following this idea, Asheim et al. (2016) argue that new path development could emerge from combinations of related and unrelated knowledge bases. These perspectives support the idea that fostering less developed knowledge bases in the region could be beneficial for new path development. However, other contributions seem to argue more strongly for policies attuned to the existing knowledge bases in the region. Isaksen and Trippl (2016) talk of analytical and synthetic routes to new path development, showing how new industrial paths in two regions were created by the inflow mainly of one type of knowledge. Martin and Trippl (2014) present a typology of innovation policies for analytical, synthetic and symbolic industries, arguing that policy should provide appropriate support depending on the knowledge bases of regional industries. However, they also note that "this does not imply that regional innovation policies should promote one single knowledge base" (Martin and Trippl 2014: 30).

2.2 Relatedness

The interest in new path development puts the knowledge base literature in close contact with the literature on related variety, industrial relatedness and, specifically, with the concept of regional branching. Frenken and Boschma (2007) introduced the idea of economic development as a process of diversification through evolutionary branching from the existing regional economic structure. In this perspective, diversification—or new path development—occurs through the recombination of existing technologically related industries in the region to create new industries (Boschma and Frenken 2011). The opportunities for such recombinations depend on the number of related industries present in the region, leading to an interest in measuring and analysing related variety at the regional level (Frenken et al. 2007).

Various studies have demonstrated that higher levels of related variety, due to knowledge spillovers, is conducive to regional employment growth (Frenken et al. 2007; Boschma and Iammarino 2009; Boschma et al. 2013, van Oort et al. 2015). An important question, however, is how relatedness across industries is defined, operationalised, and identified. While theoretical perspectives on relatedness between industries typically draw on the idea of cognitive proximity, i.e. similarities in the ways of thinking (Nooteboom 2000; Boschma 2005), the operationalisation of related variety has traditionally relied on the industrial classification hierarchy.

More recently, researchers started to measure revealed relatedness, which refers to *observed* commonalities of industries based on co-occurrence of activities, similarities in resource use, or connectedness based on trade and human capital flows (Neffke and Henning 2013; Essletzbichler 2015). When co-occurrences, similarities in the use of resources and/or higher levels of connectedness are consistent over a longer period of time, these industries, some of which might appear very different on the surface, may be assumed to rely on similar types of knowledge, skills and technologies. Contrary to measures of related variety, revealed relatedness allows relatedness across industry classes and identifies a more diverse set of related industry pairs. As highlighted by Fitjar and Timmermans (2016), these measures are also better equipped for smaller regions, where the limited number of industries cause related variety measures to underestimate relatedness.

The measures of revealed relatedness have had predictive power in several settings. First, they predict the emergence of new and the decline of incumbent industries. This process of regional branching has been empirically demonstrated on data from Sweden (Neffke et al. 2012), Spain (Boschma et al. 2013) and the United States (Essletzbichler 2015). Consequently, new path development often takes the form of path renewal (Isaksen 2015). Second, regions with higher levels of relatedness can better fend off decline; in other words, they are more resilient to economic shocks (Boschma 2015; Diodato and Weterings 2014). This resilience can be attributed to the ability of related industries to absorb the loss of jobs, as the skills of laid-off workers are valued in related industries. Third, mobility patterns between related industries allow for more efficient knowledge transfers and thus higher levels of innovative performance and productivity growth (Timmermans and Boschma 2014).

2.3 Putting the Two Together

The literatures on related variety and knowledge bases were integrated in the "constructing regional advantage" policy approach (Asheim et al. 2011), and most of the papers on new path development from the knowledge base perspective have built on the relatedness literature (although not the other way around). However, the two perspectives have rarely been integrated in empirical analyses. Sedita et al. (2017) represent an exception. In an analysis of resilience in Italian regions, they explicitly examine the interaction between knowledge bases and related variety in Italian regions, demonstrating that related variety has a positive effect on employment growth. Employment growth is stronger in regions with a large share of synthetic and symbolic (but not analytic) knowledge base industries. Furthermore, there is a significant interaction between related variety and the share of symbolic knowledge base industries, suggesting that symbolic industries are particularly dependent on the existence of related industries in the region.

However, an analysis of related variety and knowledge base intensity at the regional level does not reveal whether regional industries are related to other industries within the same knowledge base or across different knowledge bases. Thus, the potential for "unrelated knowledge base combinations leading to new related industries" (Asheim et al. 2016: 9) remains unknown. Knowledge base approaches that rely on worker level characteristics (Asheim and Hansen 2009; Martin 2012; Grillitsch et al. 2016) can be usefully combined with measures of revealed relatedness based on labour mobility patterns between industries (Boschma et al. 2013; Neffke and Henning 2013; Timmermans and Boschma 2014; Fitjar and Timmermans 2016). This allows not only the characterisation of industries based on the extent to which the skills of workers can be classified as analytical, synthetic or symbolic, but also provides indications of how these industries are linked through labour mobility.

We combine the knowledge base and relatedness perspectives by developing relatedness networks showing the knowledge bases of regional industries. This is helpful in examining whether regional industries are mainly related to other industries with the same knowledge base, or whether there is also significant levels of skill relatedness across different knowledge bases.

This approach allows us to identify: (i) how a particular industry is characterized in terms of (multiple) knowledge bases; (ii) how these industries are related based on labour mobility patterns of workers; and (iii) how the composition of knowledge bases and the level of relatedness differ across regions. The latter provides a supplementary approach to Isaksen and Trippl (2016) and Trippl et al.'s (2017) conceptualisation of different regional innovation systems and their associated system failures:

- Organizationally thick and diversified RIS, which are endowed with a variety of industries with different knowledge bases, but which potentially suffer from fragmentation.
- Organizationally thick and specialized RIS, with a more specialized industry structure often relying on similar knowledge bases, running the risk of lock-in.
- Organizationally thin RIS, with few industries and therefore limited opportunities for regional knowledge combinations.

These regions differ in terms of industrial composition, the opportunity for combining different knowledge bases and subsequently the potential for new path development. The approach in this chapter would help to identify whether regions fall in any of the above-mentioned categories, going beyond region size to examine their specific knowledge base and relatedness characteristics in classifying regions.

3 Measuring Knowledge Bases and Relatedness

The study builds on individual and firm register data from Statistics Norway. Two main registers are used: The register-based employment statistics (regsys) for the years 2008–2011, and the Norwegian educational database (NUDB) up to 2012. We focus on employees with higher education and examine the composition of regions and industries in terms of employees educated in different fields, as well as the labour mobility flows of workers with different educational backgrounds.

3.1 Identifying Knowledge Bases

In order to identify the knowledge bases of different industries, we examine the composition of their workforce in terms of the educational background of employees. This differs from previous large-scale quantitative studies of knowledge bases, which have tended to identify them on the basis of industry codes (Aslesen and Freel 2012), search behaviour as reported in the CIS survey (Herstad et al. 2014; Sedita et al. 2017) or composition of occupations (Asheim and Hansen 2009; Martin 2012; Grillitsch et al. 2016). A shortcoming of the first two approaches is that they tend to classify industries uniquely into one knowledge base, either directly from industry codes or empirically based on which information sources are used the most in innovation processes. An important idea in the knowledge base literature is that firms and industries can usefully combine and integrate different knowledge bases (Manniche 2012). It is therefore preferable to apply measures that allow industries to have more than one knowledge base.

The definition of knowledge bases applied here builds on the knowledge base classification of occupations by Grillitsch et al. (2016). As we do not have access to occupational data, we rely on data on the educational backgrounds of workers. While this might not perfectly reflect the functions performed by each individual worker, we expect that industries relying on a particular type of knowledge would be more inclined to recruit workers educated within this knowledge base. Another issue is that skills of workers without higher education, such as vocationally trained workers, are not considered. However, this might also make it easier to identify industries with particularly high knowledge needs within specific knowledge bases, which require workers educated at a higher level.

For each worker, we consider their highest completed education and, aligned with Grillitsch et al.'s (2016) occupational classification, classify them into analytical, synthetic or symbolic fields. In all cases, we only consider workers who hold at least a bachelor degree in the relevant field. Subsequently, we calculate the share of workers in each industry holding a degree in an analytical, synthetic or symbolic discipline as a measure of the intensity of this knowledge base in the industry.

A worker has an analytical education when he or she has a degree in biology, physics/chemistry, mathematics/statistics, geosciences, and pharmacology, as well as those with PhD degrees in IT/computer technology. Synthetic education includes degrees in electrical/mechanical/machine engineering, construction, manufacturing/development, as well as Bachelor or Master degrees in IT/computer technology. Symbolic education covers literature/library studies, historical/philosophical studies, music/dance/drama, arts, media/communication, and architecture.

In total, the educational database lists 786,413 unique individuals with a tertiary level of education by 2012. Among these, 30,072 (3.8%) hold a degree in an analytical discipline, 104,112 (13.2%) in a synthetic discipline, and 46,487 (5.9%) in a symbolic discipline. The majority, 77%, hold degrees in disciplines that cannot be classified into one of the three knowledge bases, e.g. in social sciences, health and social work, languages, etc. The share of analytical and synthetic education is higher in the private sector. In total, 26.4% of workers in the Norwegian private sector (472,318 workers) held a tertiary level of education in 2011. Of these, 4.1% held degrees in analytical disciplines, 16.9% in synthetic disciplines, and 5.8% in symbolic disciplines.

There is large variation across industries in the share of workers with analytic, synthetic and symbolic educational backgrounds. Considering industries at the NACE four-digit level, 17.0% of industries have no workers with analytical education, 8.4% have no workers with synthetic education, and 17.5% have no workers with symbolic education. At the opposite end of the scale, 22.8% of workers in the most analytic-intensive industry have such degrees, whereas 37.8% of workers in the most synthetic-intensive industry have synthetic education, and 46.5% of workers in the most symbolic-intensive industry have symbolic education. Considering all types of education, only two industries employ no university-educated workers, while 89.6% of workers have a university degree in the most education-intensive industry.

Figure 1 shows scatter plots of the 537 NACE four-digit industries considered in this analysis, indicating the share of workers with analytical, synthetic and symbolic education in each industry. The plots are weighted by the number of employees in each industry. Most industries tend to follow the axis of the figure—i.e. they employ few workers within any knowledge base, or they specialise in

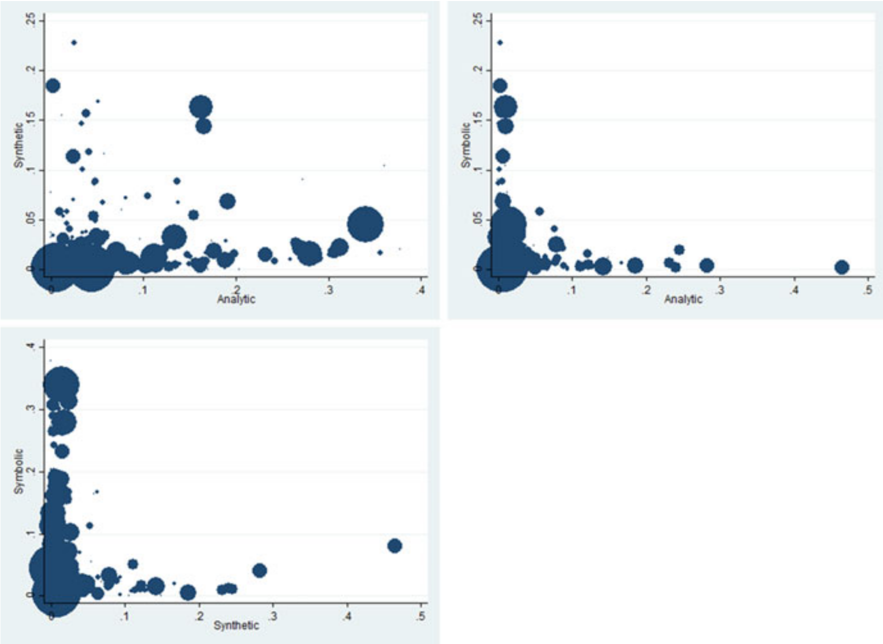

Fig. 1 Industries by share of workers with education in relevant knowledge base

one knowledge base only. However, the plot for analytical and synthetic also includes some industries with a substantial share of both analytical and synthetic workers. This suggests that the combination of these two knowledge bases is common, supporting the intuition that industries can usefully combine different knowledge bases (Manniche 2012).

We further define industries as being characterised by a particular knowledge base if it is within the top quartile of industries by the share of employees educated within disciplines belonging to this knowledge base. For analytical industries, this equates to industries in which more than 1.16% of workers are educated in analytical disciplines. For synthetic industries, the cut-off is 4.10%, and for symbolic industries, it is 1.30%. Some industries fall within the top quartile of more than one knowledge base. Table 1 shows the frequency distribution of industries within each possible combination of the three knowledge bases. In total, 44.3% of industries are not in the top quartile of any knowledge base and are therefore not classified into any particular knowledge base. The remaining industries are classified into one or, in some cases, several knowledge bases.

Table 1 Knowledge base of Norwegian industries, frequency distribution

	Number of industries	Share of industries (%)
No knowledge base	238	44.32
Analytical	56	10.43
Synthetic	63	11.73
Symbolic	90	16.76
Analytical and synthetic	46	8.57
Analytical and symbolic	19	3.54
Synthetic and symbolic	12	2.23
All knowledge bases	13	2.42
Total	537	100.00

3.2 Identifying Relatedness

To identify the relatedness of different industries (on the NACE four-digit level), we follow the approach as described in Fitjar and Timmermans (2016). However, in this case, we limit the study to consider mobility of educated workers only. Consequently, the skill relatedness measure is estimated on the subset of 465,000–485,000 educated workers employed in the private sector between 2008 and 2011, focusing on the 14% of workers that change workplace from one year to the next. Based on the above-mentioned criteria, and following the methodology introduced by Neffke et al. (2017) to measure relatedness, we identify 2714 industry pairs—13.5% of all possible pairs—that are skill related among tertiary educated workers.

We repeat the analysis on the three subsets of workers educated in analytic, synthetic, and symbolic disciplines, respectively. The idea here is to examine whether industries are mainly related because they build on the same skills within one particular knowledge base, or whether they are related across several knowledge bases—i.e. mobility between them tends to be high for workers with different knowledge bases. Table 2 shows the bivariate correlations between the three networks, conducted on an integrated network including all dyads that are connected in at least one of the knowledge bases. This network contains 273 unique industries that are connected to at least one other industry in one of the three relatedness matrices. The analyses show a weak positive and statistically significant (at the 95% level based on 500 QAP permutations) correlation between all three networks, indicating that industries that are related for workers in one knowledge base tend only to a marginally larger extent also to be related for workers in the other knowledge bases. This suggests that industries should not necessarily be seen as related for all types of workers—in many cases, they are related mainly within one specific knowledge base, even if there is some overlap.

Table 2 Bivariate network correlations across the three networks

	Synthetic	Symbolic
Analytical	.14	.12
Synthetic		.19

3.3 Identifying Regions

The definition of regions builds on economic regions as defined by Statistics Norway (2000). We merge economic regions that are part of the same labour market, following Gundersen and Juvkam's (2013) classification of Norwegian municipalities into labour market regions based on commuting patterns. This leaves a population of 78 regions. For the precise definition of these, see Fitjar and Timmermans (2016).

Regions differ in the composition of knowledge bases, as well as in the degree to which regional industries are related (on the latter, see Fitjar and Timmermans 2016). Table 3 shows the five regions with the highest and lowest shares of workers with educational backgrounds within each knowledge base.

The four largest city regions—Oslo, Bergen, Stavanger, and Trondheim—feature prominently at the top. Each list includes three of the large city regions within the top five by the highest share of employees educated within each knowledge base. Some smaller regions also have high shares of particular types of workers. For analytical knowledge, the peripheral region of Sunndalsøra ranks second only to much larger Stavanger, while the medium-sized city region Skien ranks fourth. Both are highly industrial regions: Sunndalsøra is based around aluminium production, and Skien also specialises in this along with other heavy industry. Notably, Stavanger employs a larger share of workers educated in analytical disciplines than any other region, while not making it into the top five in any of the other two knowledge bases.

Relative to its size, Kongsberg has far more synthetic workers than any other region. Its share of synthetic workers is more than double that of the second-placed region, Trondheim. Kongsberg is a high-tech industrial region with strong specialisations in defence and maritime industries. The other smaller region in the top five, Ulsteinvik, is also a high-tech industrial region, specialising in maritime industries. Among the large city regions, Trondheim notably has a higher share of synthetic workers than the other large cities.

The capital region, Oslo, has the highest share of workers educated in symbolic knowledge base disciplines. However, it is followed by much smaller Lillehammer. Another small region, Ørsta, is also among the top five. Both these smaller regions host strong symbolic knowledge educational institutions—the Norwegian film academy in Lillehammer and the journalism school in Ørsta (Volda).

Table 3 Knowledge bases in Norwegian regions, share of private sector employment

	Analytical	%	N	Synthetic	%	N	Symbolic	%	N
1	Stavanger	2.01	135,053	Kongsberg	14.02	14,562	Oslo	2.73	509,499
2	Sunndalsøra	1.74	3222	Trondheim	6.98	92,319	Lillehammer	2.40	12,608
3	Bergen	1.57	150,062	Oslo	5.59	509,499	Bergen	1.92	150062
4	Skien	1.45	37,970	Bergen	4.97	150,062	Ørsta	1.80	5676
5	Trondheim	1.43	92,319	Ulsteinvik	4.97	10,755	Trondheim	1.70	92139
	. . .			. . .			. . .		
74	Hadeland	.23	7381	Brønnøysund	1.34	3444	Setesdal	.34	2332
75	Oppdal	.21	3161	Frøya	1.23	3247	Lyngdal	.34	5849
76	Brekstad	.20	4025	Valdres	1.19	6208	Sandnessjøen	.31	4456
77	Vadsø	.18	3924	Nord-Gudbr.	1.14	6207	Brekstad	.27	4025
78	Risør	.08	2386	Rørvik	1.07	3379	Rørvik	.27	3379

4 Knowledge Bases and Relatedness in Norwegian Regions

We analyse the regional industrial landscape of selected regions, focusing on the knowledge bases of the industries present in the region and the relatedness between them. Building on Isaksen and Trippl (2016), we examine regions expected to have different types of RIS: Large cities, where organisationally thick and diversified RIS with a wide variety of knowledge bases are expected; intermediate cities, expected to have organisationally thick and specialised RIS, with industries mainly in the same knowledge base; and organisationally thin RIS, with a limited number of industries and weak knowledge bases. For each type of region, we include three different regions: One with a strong endowment of analytical knowledge base workers, one with a high share of synthetic, and one with a high share of symbolic knowledge share workers.

4.1 Large Cities

Large cities are typically characterised by organisationally thick and diversified RIS. This is reflected in the presence of the largest cities among those with the highest shares of workers within all three knowledge bases. For analytical and synthetic knowledge, all four large cities are among the six regions with the highest shares of workers educated within that knowledge base. For symbolic knowledge, three are in the top five, while Stavanger ranks only 15th. These cities still have somewhat different knowledge base profiles, and three different regions are at the top among the large cities for the three different knowledge bases: Stavanger for analytical knowledge base, Trondheim for synthetic and Oslo for symbolic knowledge.

Figure 2 shows the relatedness maps for these three cities, based on the mobility of all educated workers. In this and subsequent figures, the colours of nodes show the dominant knowledge base in the relevant industry. Red nodes denote analytical industries, green nodes denote synthetic industries, and blue nodes denote symbolic industries. Industries that combine more than one knowledge base (i.e. in the top quartile of at least two knowledge bases) are shown in black, while industries with no knowledge base (i.e. not in the top quartile of any knowledge base) are shown in yellow. The edges show relatedness ties across two industries. The nodes are weighted by the number of people employed in the industry.

Starting with Stavanger, there are few large purely analytical industries in the region. However, combined knowledge base industries feature quite prominently. In particular, two large combined knowledge base industries dominate the industrial landscape, both part of the city’s dominant oil and gas industry. The high share of analytical workers in Stavanger are employed mainly in industries combining analytical with other types of knowledge (mainly synthetic). These industries are furthermore related to several smaller combined, symbolic or synthetic knowledge base industries.

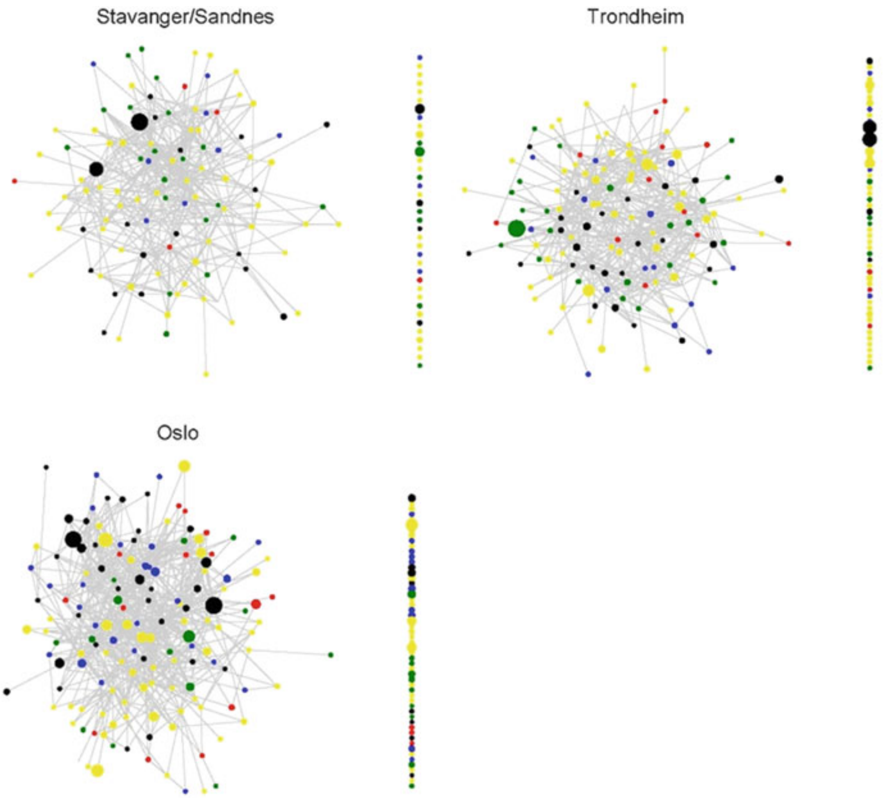

Fig. 2 Large cities

In Trondheim, a large synthetic industry is visible in the map, but the more central positions are occupied mainly by smaller symbolic or combined knowledge base industries. There are also several small analytical knowledge base industries in the map for Trondheim. The region has two large combined knowledge base industries. However, none of these are skill-related to any other industries in the region among higher educated workers, and they are thus shown as isolates to the right of the figure.

Various symbolic industries are centrally placed in the relatedness map for Oslo. However, the largest industries in the region tend to be either combined or, in at least one case, synthetic knowledge base industries. The region also has several large analytical knowledge base industries, which are mostly placed in peripheral positions in the network.

Are the large cities characterised by organisationally thick and diversified RIS, with all knowledge bases present? This is most clearly the case in Oslo, where large industries are dispersed throughout the network and relatively evenly sized. Different knowledge bases are represented with combinatorial knowledge base industries among the largest. In Stavanger and Trondheim, the largest nodes are more concentrated in one part of the network, suggesting that these regions are to some extent characterised by specialisation. In Stavanger, symbolic workers and industries are also relatively absent, despite recent efforts to develop creative industries in the region (see e.g. Bergsgard and Vassenden 2011). On the other hand, the region hosts large combinatorial knowledge base industries (mainly linking analytical and synthetic knowledge) with important connections to other industries. In all three regions, several nodes are isolates with no skill-related industries in the region, suggesting that fragmentation might indeed be an issue. In Trondheim, this includes two large combinatorial knowledge base industries. Overall, Oslo is the clearest case of a diversified RIS in Norway, while Stavanger and Trondheim have characteristics of diversified as well as specialised RIS.

4.2 Intermediate Cities

Intermediate cities are often characterised by more specialised RIS, often focusing on one knowledge base. Figure 3 shows the relatedness maps for three intermediate cities, all in Eastern Norway, with strong specialisations in one of the knowledge bases: Skien, Kongsberg and Lillehammer. Skien ranks fourth among the 78 regions in the analytical knowledge base category, fifteenth in synthetic and 27th in symbolic. While there are several analytical knowledge base industries in the relatedness network for Skien, the largest industries tend to be combined knowledge base or, in some cases, synthetic industries. These also occupy central positions in the network, while the purely analytical industries are more peripheral. However, one large synthetic industry is not skill-related to other industries in Skien and is shown as an isolate.

Kongsberg has by far the highest share of synthetic knowledge base workers of any Norwegian region. It ranks tenth for analytical and 41st for symbolic knowledge. The industry structure of Kongsberg is more specialised than that of Skien and Lillehammer, and employment tends to be concentrated in four industries. All of these are combined knowledge base industries and all are related to several other industries in the region. In addition, there are some smaller synthetic industries forming part of this network, with close ties to the larger combined knowledge base industries.

Lillehammer has the second highest share of symbolic knowledge base workers among all Norwegian regions. It has a low share of other knowledge bases, ranking 32nd for analytical and 23rd for synthetic knowledge. Nonetheless, the largest industry in the region has a synthetic knowledge base, and this industry also occupies a central position in the network. There are various symbolic knowledge base industries in Lillehammer, but these are mostly in peripheral positions and not very closely interrelated. The region also has some smaller combined knowledge base industries which are positioned as cutpoints in the network.

While these regions were selected for their strong specialisation in one knowledge base in terms of the share of educated workers, the composition of industries

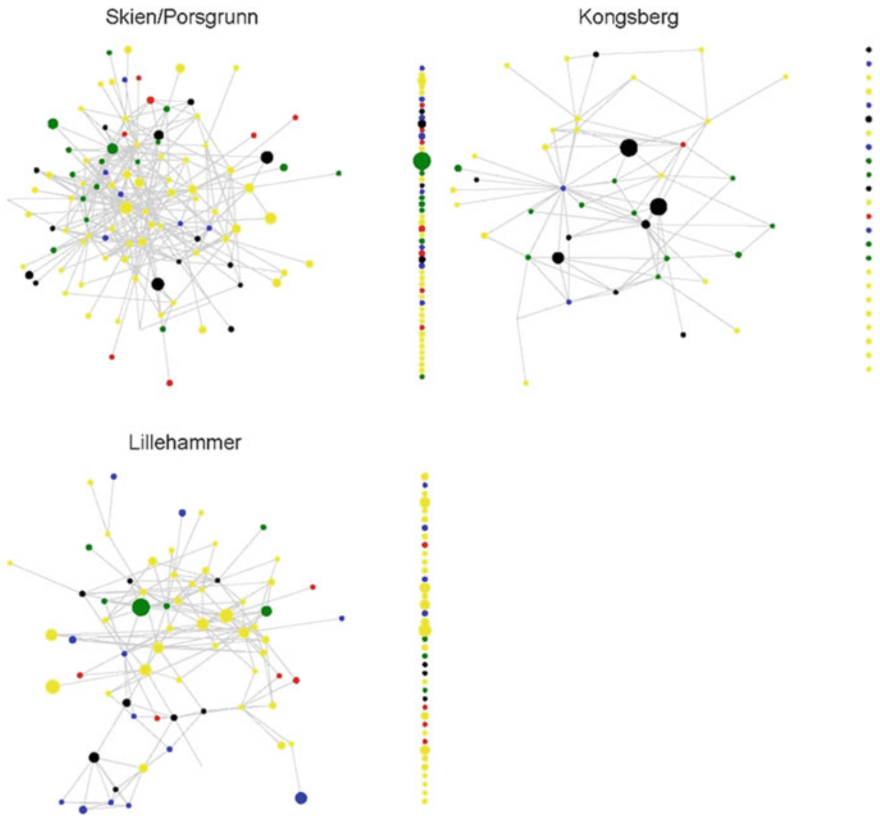

Fig. 3 Intermediate cities

tells a somewhat different story. Although Skien has a high share of analytical workers for its size, its RIS is actually quite diversified, with large industries dispersed throughout the network and many related industries with different knowledge bases. Kongsberg is more specialised, but tends more towards an organisationally thin RIS with few industries present in the network, given that it is so specialised in a few industries. This increases the risk of lock-in. Large combinatorial knowledge base industries are mainly related to much smaller ones specialising in only one of the knowledge bases, reducing the potential for regional knowledge exchange. Lillehammer fits the bill of an organisationally thick and specialised RIS best, again with relatedness mainly between industries with the same knowledge bases. Even in intermediate regions with ostensibly specialised knowledge bases, various types of RIS can thus be found, showing that it is necessary to examine the composition of regional industries closely before drawing conclusions about a region's innovation system and associated system failures.

4.3 Small Regions

Small regions are typically characterised by organisationally thin RIS with limited opportunities for knowledge exchange within the region. While larger city regions tend to be better endowed with highly educated workers, there are nonetheless some smaller and more peripheral regions which also stand out with strong concentrations of workers within particular knowledge bases. One small region makes it into the top five in each of the three knowledge bases: Sunndalsøra for analytical knowledge, Ulsteinvik for synthetic knowledge, and Ørsta for symbolic knowledge, which incidentally are all in Møre og Romsdal (see Fig. 4). Recent studies by Asheim and Grillitsch (2015), Grillitsch and Asheim (2015) and Asheim et al. (2016) have emphasized that Møre og Romsdal has a prevailing synthetic knowledge base, due to the predominance of knowledge application activities at regional R&D institutions, as well as in dominant industries, such as the maritime, marine and petroleum industries. At the county level, this is clearly also the case. The largest cities in the region (Ålesund and Molde) both place higher in the rankings for synthetic than for

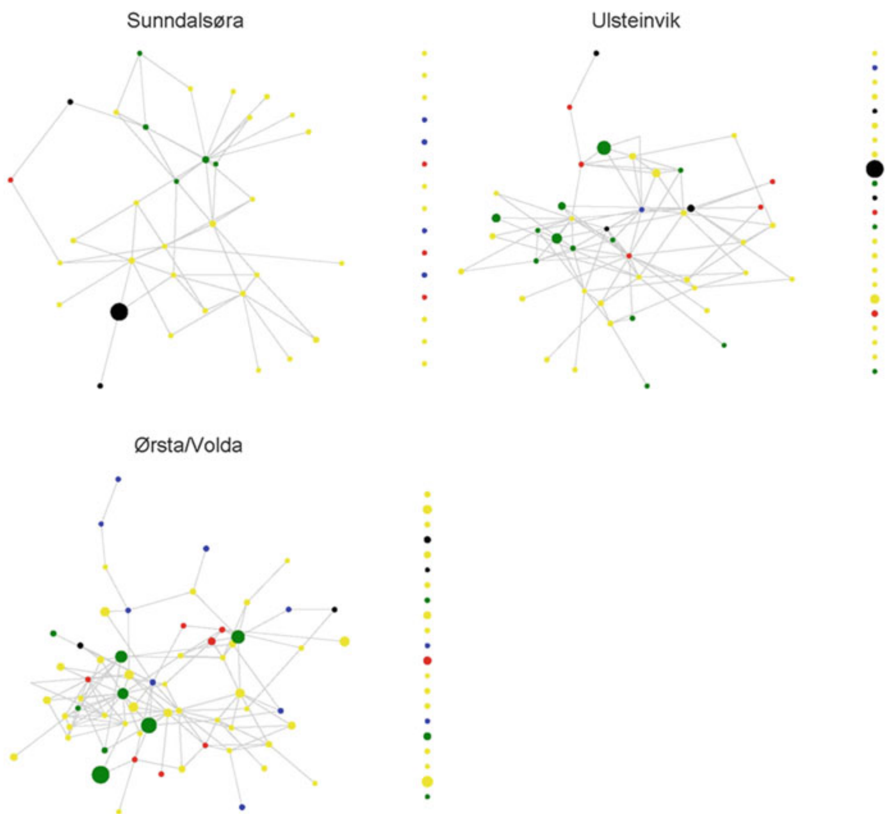

Fig. 4 Small regions

the other knowledge bases (Ålesund is 12th for synthetic, 41st for analytic, and 18th for symbolic knowledge; Molde is 14th for synthetic, 44th for analytic, and 48th for symbolic knowledge). However, the analysis at the sub-county/labour-market region level shows that Møre og Romsdal also has labour markets with strong endowments of analytical and symbolic knowledge base workers.

Sunndalsøra has the second highest share of analytical knowledge base workers among Norwegian regions. The region also scores fairly highly for synthetic knowledge, ranking 19th, while it is only 66th for symbolic knowledge. This is explained by the largest industry being a combined knowledge base industry which incorporates analytical as well as synthetic knowledge. However, this industry is only related to a few other industries in the region. The most central industries tend not to be intensive in any knowledge base, but there are also some small synthetic knowledge base industries in the network.

Ulsteinvik ranks fifth by share of synthetic knowledge base workers. Its workforce is heavily concentrated in this knowledge base, and it ranks only 49th for analytical and 59th for symbolic knowledge. The largest industries in Ulsteinvik tend to be synthetic knowledge base industries, and these are also central in the relatedness network. There is also one major combined knowledge base industry, which is not related to other industries in the region and is shown as an isolate. Despite the low level of workers trained in these disciplines, the region also has several small symbolic and analytical industries, sometimes in central positions in the network.

Ørsta has the fourth highest share of workers educated in symbolic knowledge base disciplines among Norwegian regions. The region also has a fair share of synthetic knowledge base workers, ranking 18th, while it is only 62nd in the analytical knowledge base. The relatedness map shows that the major industries in Ørsta are synthetic knowledge base industries. These are interrelated and hold central positions in the network. There are several smaller symbolic knowledge base industries which are dispersed around the network, sometimes in peripheral positions. The region also has several small analytical knowledge base industries in fairly central positions.

The typical small region problems of organisational thinness are to be found in Sunndalsøra, where few and mostly low-skilled industries are present in the network and the region relies on one major industry. Ørsta and Ulsteinvik have more typical traits of organisationally thick and specialised RIS, with network structures not dissimilar to that of Lillehammer, discussed above. In both cases—even in a symbolic region such as Ørsta—this revolves mainly around synthetic industries, although smaller analytical industries also play a role in both regions. The examples also suggest a need to analyse RIS as a disaggregated scale, as different labour markets in the same political region can have very different characteristics and associated needs for policy intervention.

5 Conclusion

A growing literature examines the potential for new path development arising from new combinations of related industries with different knowledge bases. Theoretical contributions (Asheim et al. 2011; Manniche et al. 2016) as well as case studies (Asheim and Grillitsch 2015; Asheim et al. 2016) have illustrated the utility of this approach in individual cases. However, previous research has not combined these two perspectives at a large scale by assessing whether industries with different knowledge bases are related across a large number of regions. This paper conducts such an analysis by combining data on skill relatedness across Norwegian industries and their regional distribution (Fitjar and Timmermans 2016) with measures of the knowledge base composition of such industries.

We examine relatedness across industries with different knowledge bases in regions of different sizes and with different knowledge base specialisations. The analyses show the centrality of combinatorial knowledge base industries across various regional settings. However, synthetic industries are also often central, even in regions which are not necessarily specialised in the synthetic knowledge base. In the Norwegian context, analytical and symbolic industries tend to be small, even in regions with relatively high shares of workers in these knowledge bases. This suggests that such knowledge is often applied in larger synthetic or combinatorial knowledge base industries.

Furthermore, the analyses show that industries are not necessarily related to other industries within the same knowledge base. In some regions, there are blocks of industries with the same knowledge base, but industries with different knowledge bases also often block together and create opportunities for new combinations of related industries with different knowledge bases. This indicates that it is not sufficient to examine the level of relatedness in a regional industry structure to determine the region's potential for knowledge exchange and new path development. It is also necessary to consider whether the related industries have the same or different knowledge bases. Regions with relatedness ties mainly across industries with the same knowledge base could still suffer from lock-in and limited opportunities for new path development, while other regions with less relatedness can nonetheless manage to link industries with different knowledge bases. Conversely, it is also not sufficient to examine the presence of industries with different knowledge bases, as the opportunities for combining these may depend on whether these industries are related or whether they cluster in different parts of the regional industry space. The region does not necessarily benefit from having a balanced mix of different knowledge bases if these are not related.

Furthermore, the distinction between organisationally thick and diversified, organisationally thick and specialised, and organisationally thin RIS do not necessarily follow clear patterns related to the size of the region. Some large cities display tendencies of specialisation with associated risks of lock-in, while intermediate cities—even among those with a high share of workers specialised in one knowledge base—can be quite diversified in the sense of hosting several industries with different knowledge bases, which are nonetheless related. The distinction between organisationally thick and organisationally thin regions also does not neatly follow from region size, as some intermediate cities appear quite thin with limited opportunities for regional knowledge exchange, while smaller peripheral regions can nonetheless host various interrelated industries, often with the same knowledge base.

The analysis comes with several limitations, but also provide opportunities for further research. First, the measure of knowledge bases is based on educated workers only, ignoring the significant knowledge inputs from workers without formal degrees from higher education institutions. This is bound to ignore some important bodies of knowledge, in particular in the synthetic and symbolic knowledge bases. Second, relatedness is measured on mobility patterns only. Some knowledge bases are expected to be related on other parameters; for example through research collaboration in industries that are predominantly analytical. Third, we have not formally analysed the effect of relatedness within and across knowledge bases on innovation or new path development. Therefore, it remains to be analysed whether skill relatedness within or across different knowledge bases is more beneficial. However, this analysis has provided a first stepping-stone towards building such an analysis, and we leave it for future research to follow up on this challenge.

Acknowledgements The research for this paper was funded by the Research Council of Norway, project no. 209761. Data from the Norwegian employment and educational registers were provided by Statistics Norway. An earlier version of the paper was presented at the 2016 Regional Innovation Policies Conference in Cardiff. We would like to thank participants at this session, as well as an anonymous reviewer and the editors of this book, for helpful suggestions in finalising the paper.

References

Asheim, B., & Coenen, L. (2005). Knowledge bases and regional innovation systems: Comparing Nordic clusters. *Research Policy, 34*(8), 1173–1190.

Asheim, B., & Coenen, L. (2006). Contextualising regional innovation systems in a globalising learning economy: On knowledge bases and institutional frameworks. *Journal of Technology Transfer, 31*(1), 163–173.

Asheim, B., & Gertler, M. (2005). The geography of innovation: Regional innovation systems. In J. Fagerberg, D. Mowery, & R. Nelson (Eds.), *The Oxford handbook of innovation* (pp. 291–317). Oxford: Oxford University Press.

Asheim, B., & Grillitsch, M. (2015). *Smart specialisation: Sources for new path development in a peripheral manufacturing region*. CIRCLE: Papers in Innovation Studies, 2015/11.

Asheim, B., & Hansen, H. K. (2009). Knowledge bases, talents, and contexts: On the usefulness of the creative class approach in Sweden. *Economic Geography, 85*(4), 425–442.

Asheim, B., & Mariussen, Å. (2003). *Innovations, regions and projects: Studies in new forms of knowledge governance*. Stockholm, Nordregio, report 3/2003.

Asheim, B., Coenen, L., & Vang, J. (2007). Face-to-face, buzz, and knowledge bases: Sociospatial implication for learning, innovation, and innovation policy. *Environment and Planning C: Government and Policy, 25*(5), 655–670.

Asheim, B., Boschma, R., & Cooke, P. (2011). Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies, 45*(7), 893–904.
Asheim, B., Grillitsch, M., & Trippl, M. (2016). *Smart specialization as an innovation-driven strategy for economic diversification: Examples from Scandinavian regions*. CIRCLE: Papers in Innovation Studies, 2016/23.
Aslesen, H., & Freel, M. (2012). Industrial knowledge bases as drivers of open innovation? *Industry and Innovation, 19*(7), 563–584.
Bergsgard, N., & Vassenden, A. (2011). The legacy of stavanger as capital of culture in Europe 2008: Watershed or puff of wind? *International Journal of Cultural Policy, 17*(3), 301–320.
Boschma, R. (2005). Proximity and innovation: A critical assessment. *Regional Studies, 39*(1), 61–74.
Boschma, R. (2015). Towards an evolutionary perspective on regional resilience. *Regional Studies, 49*(5), 733–751.
Boschma, R., & Frenken, K. (2011). The emerging empirics of evolutionary economic geography. *Journal of Economic Geography, 11*, 295–307.
Boschma, R., & Iammarino, S. (2009). Related variety, trade linkages and regional growth in Italy. *Economic Geography, 85*(3), 289–311.
Boschma, R., Minondo, A., & Navarro, M. (2013). The emergence of new industries at the regional level in Spain: A proximity approach based on product relatedness. *Economic Geography, 89*(1), 29–51.
Castaldi, C., Frenken, K., & Los, B. (2015). Related variety, unrelated variety and technological breakthroughs: An analysis of US state-level patenting. *Regional Studies, 49*(5), 767–781.
Diodato, D., & Weterings, A. (2014). The resilience of regional labour markets to economic shocks: Exploring the role of interactions among firms and workers. *Journal of Economic Geography, 15*(4), 723–742.
Essletzbichler, J. (2015). Relatedness, industrial branching and technological cohesion in US metropolitan areas. *Regional Studies, 49*(5), 752–766.
Fitjar, R. D., & Jøsendal, K. (2016). Hooked up to the international artistic community: External linkages, absorptive capacity and exporting by small creative firms. *Creative Industries Journal, 9*(1), 29–46.
Fitjar, R. D., & Timmermans, B. (2016). Regional skill relatedness: Towards a new measure of regional related diversification. *European Planning Studies, 25*, 516–538. https://doi.org/10.1080/09654313.2016.1244515
Florida, R. (2002). *The rise of the creative class*. New York: Basic Books.
Frenken, K., & Boschma, R. (2007). A theoretical framework for evolutionary economic geography: Industrial dynamics and urban growth as branching processes. *Journal of Economic Geography, 7*, 635–649.
Frenken, K., van Oort, F., & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional Studies, 41*(5), 685–697.
Grillitsch, M., & Asheim, B. (2015). *Cluster policy: Renewal through the integration of institutional variety*. CIRCLE: Papers in Innovation Studies, 2015/21.
Grillitsch, M., Martin, R., & Srholec, M. (2016). Knowledge base combinations and innovation performance in Swedish regions. *Economic Geography*, 1–22. https://doi.org/10.1080/00130095.2016.1154442
Gundersen, F., & Juvkam, D. (2013). *Inndelinger I senterstruktur, sentralitet og BA-regioner*. NIBR-rapport 2013-1.
Herstad, S., Aslesen, H., & Ebersberger, B. (2014). On industrial knowledge bases, commercial opportunities and global innovation network linkages. *Research Policy, 43*(3), 495–504.
Isaksen, A. (2015). Industrial development in thin regions: Trapped in path extension? *Journal of Economic Geography, 15*, 585–600.
Isaksen, A., & Trippl, M. (2016). Exogenously led and policy-supported new path development in peripheral regions: Analytical and synthetic routes. *Economic Geography*, 1–22. https://doi.org/10.1080/00130095.2016.1154443

Laestadius, S. (1998). Technology level, knowledge formation and industrial competence in paper manufacturing. In G. Elisasson et al. (Eds.), *Microfoundations of economic growth* (pp. 212–226). Ann Arbor: The University of Michigan Press.

Liu, J., Chaminade, C., & Asheim, B. (2013). The geography and structure of global innovation networks: A knowledge base perspective. *European Planning Studies, 21*(9), 1456–1473.

Manniche, J. (2012). Combinatorial knowledge dynamics: On the usefulness of the differentiated knowledge bases model. *European Planning Studies, 20*(11), 1823–1841.

Manniche, J., Moodysson, J., & Testa, S. (2016). Combinatorial knowledge bases: An integrative and dynamic approach to innovation studies. *Economic Geography*, 1–20. https://doi.org/10.1080/00130095.2016.1205948

Martin, R. (2012). Measuring knowledge bases in Swedish regions. *European Planning Studies, 20*(9), 1569–1582.

Martin, R., & Moodysson, J. (2011). Innovation in symbolic industries: The geography and organization of knowledge sourcing. *European Planning Studies, 19*(7), 1183–1203.

Martin, R., & Moodysson, J. (2013). Comparing knowledge bases: On the geography and organization of knowledge sourcing in the regional innovation system of Scania, Sweden. *European Urban and Regional Studies, 20*(2), 170–187.

Martin, R., & Trippl, M. (2014). System failures, knowledge bases and regional innovation policies. *disP–The Planning Review, 50*(1), 24–32.

Moodysson, J., Coenen, L., & Asheim, B. (2008). Explaining spatial patterns of innovation: Analytical and synthetic modes of knowledge creation in the Medicon Valley life-science cluster. *Environment and Planning A, 40*(5), 1040–1056.

Neffke, F., & Henning, M. (2013). Skill relatedness and firm diversification. *Strategic Management Journal, 34*(3), 297–316.

Neffke, F., Henning, M., & Boschma, R. (2011). How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. *Economic Geography, 87*(3), 237–265.

Neffke, F., Henning, M., & Boschma, R. (2012). The impact of aging and technological relatedness on agglomeration externalities: A survival analysis. *Journal of Economic Geography, 12*(2), 485–517.

Neffke, F., Otto, A., & Weyh, A. (2017). *Skill-relatedness matrices for Germany: Data method and access* (No. 201704_en). Nürnberg: Institut für Arbeitsmarkt-und Berufsforschung.

Nooteboom, B. (2000). *Learning and innovation in organizations and economies*. Oxford: Oxford University Press.

Rekers, J. (2016). What triggers innovation diffusion? Intermediary organizations and geography in cultural and science-based industries. *Environment and Planning C: Government and Policy, 34*(6), 1058–1075.

Sedita, S., De Noni, I., & Pilotti, L. (2017). Out of the crisis: An empirical investigation of place-specific determinants of economic resilience. *European Planning Studies, 25*(2), 155–180.

Statistics Norway. (2000). *Classification of economic regions*. Oslo and Kongsvinger: Statistics Norway, C616.

Storper, M., & Venables, A. (2004). Buzz: Face-to-face contact and the urban economy. *Journal of Economic Geography, 4*, 351–370.

Tavassoli, S., & Carbonara, N. (2014). The role of knowledge variety and intensity for regional innovation. *Small Business Economics, 43*(2), 493–509.

Timmermans, B., & Boschma, R. (2014). The effect of intra- and inter-regional labour mobility on plant performance in Denmark: The significance of related labour inflows. *Journal of Economic Geography, 14*(2), 289–311.

Tödtling, F., & Grillitsch, M. (2015). Does combinatorial knowledge lead to a better innovation performance of firms? *European Planning Studies, 23*(9), 1741–1758.

Trippl, M., Grillitsch, M., & Isaksen, A. (2017). Exogenous sources of regional industrial change: Attraction and absorption of non-local knowledge for new path development. *Progress in Human Geography*. https://doi.org/10.1177/0309132517700982

van den Berge, M., & Weterings, A. (2014). *Relatedness in eco-technological development in European regions*. Utrecht University: Papers in Evolutionary Economic Geography, 14.13.
van Oort, F., de Geus, S., & Dogaru, T. (2015). Related variety and regional economic growth in a cross-section of European urban regions. *European Planning Studies, 23*(6), 1110–1127.

Mapping Inventors' Networks to Trace Knowledge Flows Among EU Regions

Fiorenza Belussi, Ivan De Noni, and Luigi Orsi

Abstract

Recent literature on technological changes has highlighted the role of knowledge recombination in innovation. Evidence suggests that the production of scientific and technological knowledge is becoming an increasingly collective phenomenon. Thus, in rapidly developing industries, it is almost inevitable to develop inter-organizational collaborations to identify new opportunities for new technologies.

The aim of this chapter was to explore the innovative activities and networks in European regions (EU 27 plus Norway and Switzerland) from 1980 to 2010. Specifically, we analysed the most innovative sectors: environmental (green), biotechnology (biotech), laser and optic technology and nanotechnology (nanotech). This longitudinal study relies on European Patent Office (EPO) patents and inventors' data by year and region, as provided by OECD-Regpat database. Our main findings emphasize the rise of co-inventions in intra-regional and inter-regional inventive networks, the concentration of innovations in central regions and peripheral regions' reliance on external knowledge flows to compensate for their technological weaknesses.

Keywords

Innovation · Peripheral regions · Networks of innovators

F. Belussi (✉)
Department of Economics and Management, University of Padua, Padova, Italy
e-mail: fiorenza.belussi@unipd.it

I. De Noni · L. Orsi
Department of Environmental Science and Policy, University of Milan, Milano, Italy
e-mail: ivan.denoni@unimi.it; luigi.orsi@unimi.it

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_9

1 Introduction

Conventional innovation theories have attempted to explain the technological trajectory of discontinuities in corporate innovation processes (D'Aveni 1994; Tushmann and Anderson 1986). As demonstrated by the Schumpeterian tradition, radical innovations emerge erratically when dynamic entrepreneurs introduce 'new combinations', disrupting the economic system's equilibrium (Schumpeter 1934, 1947). However, technological changes and product improvements arise from incremental innovations (Arrow 1962; Freeman 1994; Malerba 1992). This was not acknowledged in the innovation literature of 1960s and 1970s, since the focus was on radical inventions and innovations (Clark et al. 1984; Jewkes et al. 1958). After the 1970s, the importance of marginal technical improvements as a means of sustaining innovation in firms was acknowledged (Basalla 1988; Dosi 1982; Rosenberg 1976, 1982). As argued by Mokyr (2000), 'Much if not most creativity comes from the manipulation of what is already known, rather than in addition of totally new knowledge' (p. 18).

Often innovations are fed by continuously re-combining pre-existing knowledge from different sectors or firms through cumulative learning processes, as Pavitt (1984, 1999) authoritatively illustrated. A critical aspect is how firms integrate old and new knowledge and apply it to new domains. Old knowledge might be reused as new information in other domains, or firms might acquire existing knowledge from the outside to feed their internal innovation activities (Asheim and Isaksen 2002; Chesbrough 2003a, b).

Generative collaborations, within an innovative ecosystem or regional innovation system (Asheim et al. 2011), may enlarge the realm of possibilities and identify new systems and functionalities, perpetuating the recombination process within an innovation cycle (Bonaccorsi 2011; Lane 2011). New literature on technological changes emphasized the role of knowledge recombination as one of the most important sources of technological novelty and invention (Weitzman 1998; Strumsky et al. 2011, 2012; Youn et al. 2014). Youn et al. (2014) showed that after the huge creation of new patent codes (indicating the introduction of novel technologies) between 1800 and 1850, the subsequent pattern of inventions was based on the recombination of existing codes, creating a practically infinite space of technological configurations. Patents are the main expression of technology novelty and new patents are typically associated with existing technological codes (Jaffe et al. 1993).

As Fleming (2001) affirmed, 'the source of technological novelty and uncertainty lies within the combination of new components and new configurations of previously combined components' (p. 130), while historically there were limited developments of original technologies (Strumsky et al. 2011). The literature suggested the production of scientific and technological knowledge became an increasingly collective phenomenon (Allen 1983; Freeman 1991; Gay et al. 2008).

In rapidly developing industries, it is almost inevitable for inter-firm collaborations to identify new opportunities and create new technologies (Powell 1998). Thus, technological innovation became a 'collective phenomenon'. As

Powell and Giannella (2010, p. 4) affirmed, 'Collective invention is technological advance driven by knowledge sharing among a community of inventors who are often employed by organizations with competing intellectual property interests'. Economic geography and regional science study the importance of geographic innovation proximities and network formations (Rallet and Torre 1999; Boschma and Frenken 2010; Cassi and Plunket 2015). Ter Wal (2013) demonstrated that the role of geographic distance, as a mechanism of the formation and network evolution shifts over time, was the technological regime of the industry changes.

2 Methodology

The aim of this research was to explore the innovation activity and networks in European regions (EU 27 plus Norway and Switzerland) from 1980 to 2010. The study is based on European Patent Office (EPO) patents and inventors per year and region as provided by OECD-Regpat database (release version February 2015). The 30-year range included 1980–2010. Firstly, a general cleaning process was applied to make the dataset usefull. Since the same patent identification was listed multiple times to capture each involved inventor (Inv_share is the inventor's share of involvement in the patent's creation) and region (Reg_share is the regional share, if the inventor is registered in different regions),[1] patents were counted as the sum of inventors' shares weighted for their regional share ($\sum$Reg_share*Inv_share). Thus, patents whose $\sum$Reg_share*Inv_share per patent was less than 0.99 or more than 1.01 were excluded. In addition, since only European regions were under consideration, patent data concerning 'not classified' regions were also deleted.

The preliminary dataset involved 284 European regions which were defined using the NUTS2 classification of EU 28 countries, plus Switzerland and Norway, and 2,493,658 EPO patents. However, since this study focused on knowledge flows across European regions by exploring inventor networks, and EPO patents include non-European inventors, EU patents were identified as EPO patents involving at least one European inventor. The EU patents dataset was thus reduced to 1,228,481 EU patents.

In addition, a further classification distinction was made between individual patents (which involved only one inventor) and co-invented patents (which involved more than one inventor). Then, co-invented patents were classified as intra-regional (patents involving inventors belonging the same EU region), inter-regional (patents involving inventors belonging to different EU regions) and extra-EU regional (patents involving some inventors belonging to regions outside the EU). The last group specifically focuses on inventors from developed countries (the US, Canada and Japan), emerging countries (BRICS[2]) and other countries.

[1] *Reg_share* is less than 1if the inventor is assigned to different regions because of moving in the three years preceding the patent's priority year. *Inv_share* is less than 1 when patent is co-invented.

[2] Brazil, Russia, India, China and South Africa.

Below, the data is organized to explore the transformation path of European regions over time by depicting the trends, technological specializations, role of collaborative innovations and the inter-regional knowledge flows through inventor networks. In addition, based on technological classes defined by the International Patent Classification (IPC), we observed the innovation process focusing on both traditional classifications of high, medium-high, medium-low, and low technology (Table 6), and the investigation of the patterns of geographical localization of new industries like biotechnology, nanotechnology, green technology and laser and optic technology.

The relationship between patents and sectors is depicted in the IPC maps as provided by Van Looy et al. (2014). We focused on the Statistical Classification of Economic Activities in the European Community (NACE) at the 2-digit level (Eurostat 2014). The IPC v.8—NACE rev.2 concordance table (Table 7) allows us to associate patents with 26 different sectors (i.e., the patent with an NACE corresponding to C08B is associated with the Manufacture of Chemicals and Chemical Product sector, sector 20).

Most of the patents in our database are in the 'high' and 'medium-high' tech groups (from 1980 to 2010, we found 1,061,319 and 1,350,486 patents, respectively). This suggests, as expected, the patenting process mainly involves the most high-tech sectors. 'Medium-low' and 'low technology' groups had 274,286 and 370,280 patents, respectively.

Furthermore, the patents related to innovative industries such as biotechnology, nanotechnology, green technology and laser and optic technology were listed using a standardized IPC (Table 8). Specifically, the IPC classes of biotech patents were provided in the Annex 6 of Eurostat indicators (Eurostat 2007), whereas the classes of green patents relied on the World Intellectual Patent Office (WIPO) database. The nanotechnology and the laser and optic technology patents were also aggregated based on Eurostat (2014).

The largest group was green technology patents (151,947), followed by biotechnology patents (126,100) and laser and optic patents (77,847). The smallest group was nanotechnology patents (4663). The overlap in these industries was less than 10%, with the exception of biotechnology and green technology at about 20%.

3 A Persistent Flow of European Innovations

Europe has experienced a long structural period of social expansion and economic growth. Patenting activity mirrored this trend. Similar to the overall trend in economic development in Europe, the yearly distribution of patents (Fig. 1) shows a smoothing and slowing growth of innovation productivity since 2007.

Figure 1 also shows the trends of individual and co-invented patents. The latter were further partitioned into intra-regional patents, inter-regional patents and extra-European patents. These trends suggest the propensity to co-patent has grown compared to individual patents since the mid-1990s. Conversely, the number of individual patents has slowly decreased since 2000. In 30 years, the share of

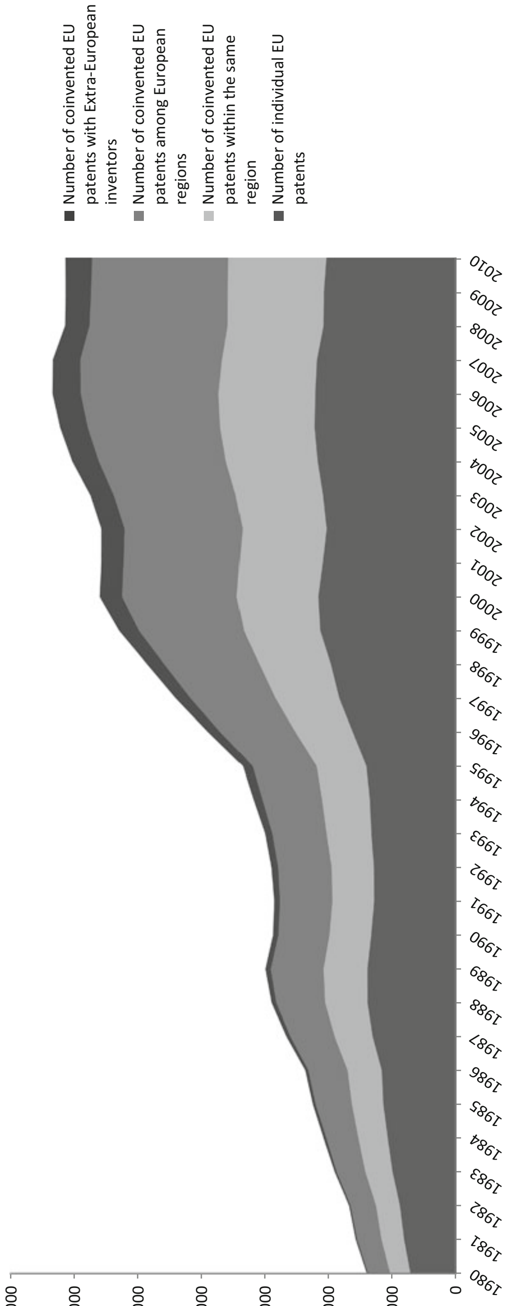

Fig. 1 Yearly distribution of EU patents

individual patents diminished from 50 to 40%, while the share of co-invented patents in the EU regions increased from 23 to about 30%. Moreover, the inter-regional collaboration increased at a faster rate than the intra-regional one.

The inventive activity in the EU has been quickly growing in recent decades (Fig. 1), from an average number of 13,000–15,000 patents issued yearly in the beginning of the 1980s, to the 29,000–30,000 of the 1990s, to the 50,000–52,000 of the 2000s, up to the 60,000 between 2008 and 2010.

The cumulative distribution over the 30-year period makes the previous findings even more evident (Fig. 2).

Similarly, the longitudinal analysis highlights the increasing relevance of extra-EU inventors over other networks since 1995. Specifically, more detailed data (Fig. 3) highlights these extra-EU collaborations involving inventors from the US, Canada and Japan. However, since 1995, the relevance of developed countries has decreased compared to the growing role of inventors from the BRICS countries. The latter have increased from nearly 0% to just less than 10%.

About 35–40% of the co-invented patents with inventors from outside the EU (Fig. 3) involved inventors localized in advanced countries (US, Canada and Japan). This share has been stable throughout the 30-year period, whereas patenting activity deriving from BRICS saw consistent growth.

During this 30-year period, the EPO registered 2,516,942 patents, of which about half (1,242,457) involved at least one EU inventor. The number of inventors of EPO patents was about 4.5 million, but the number of inventors related to EU patents was only about 2 million (1,921,002 units). EPO patents in Europe have slightly more inventors than EU patents in all years considered, on average 1.82 versus 1.55. This could be due to the higher technological complexity of foreign patents versus European patents. This was corroborated by the fact that the total number of EPO collective patents was greater than the total number of EU patents (64.91 vs. 60.01). Of the collective patents (680,517), the majority were invented by a network of inventors localized in more than one European region (388,557). Patents with a more local dimension, where the network of inventors was concentrated in the same region were less numerous (291,960 or 42.9%). Our database did not allow us to distinguish regional innovation networks from internal company networks, since we analysed data based on inventors' addresses. However, this data shows the large regional and extra-regional knowledge flows.

In Table 1, the total weighted number and growth rate of EPO patents are shown in three 10-year windows of time (1980–1990, 1990–2000 and 2000–2010) and the cumulated number from 1980 to 2010. Table 1 also summarizes the weighted number and growth rate of EU patents, as previously classified.

Finally, the total inventors' productivity was measured as the average number of EPO and EU patents per inventor. Since the average number of inventors of EPO patents (1828) was higher than the average number of EU patents (1592), it is likely these were more complex. The complexity of innovation systematically grew with time in both samples.

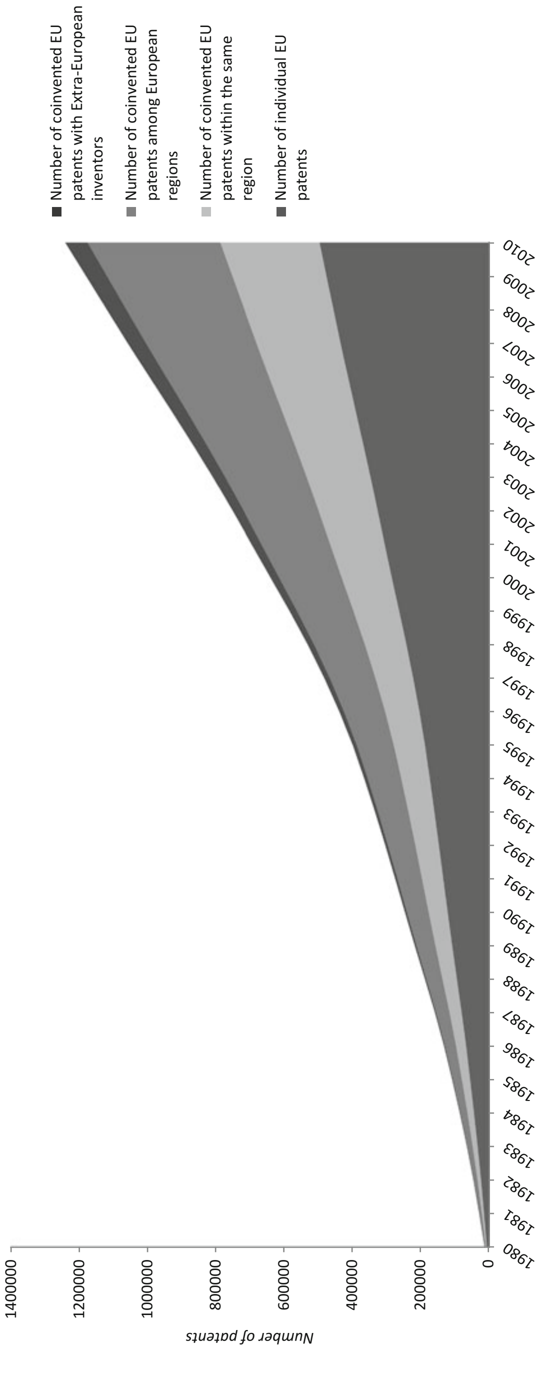

Fig. 2 Cumulative distribution of EU patents

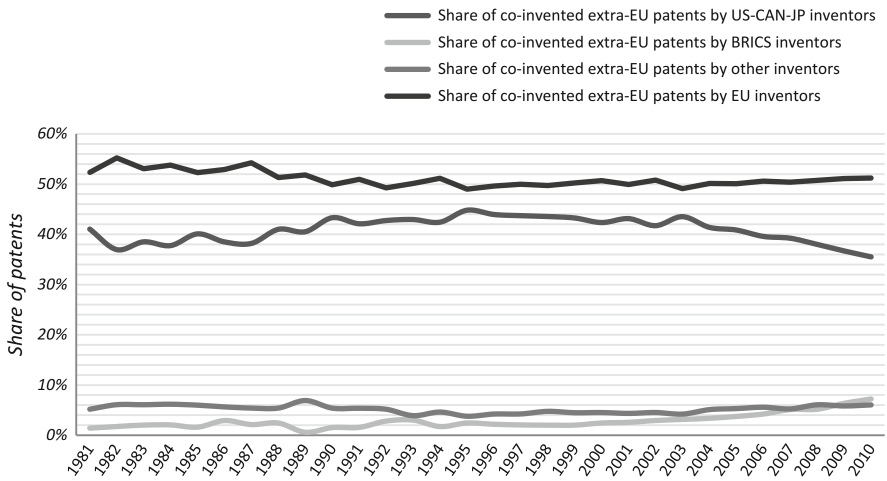

Fig. 3 Yearly share of patents involving Extra-EU inventors

4 The Geography of Invention in the EU

An important aspect of inventors' networks was their geographical localization. We analysed the EPO database for European Regions at the level of NUTS2 for the 28 EU countries, adding Switzerland and Norway, thus, considering 30 countries and 284 regions. In Fig. 4, innovation intensity per region (r) and year (y) was measured based on EU patents by operationalizing the sum of inventor shares weighted for regional shares, relative to each patent (i), aggregated according the inventors' region of localization and the patents' priority year. The figure suggests Germany has reasserted its economic and technological position, having emerged as the innovative heart of Europe.

The patent intensity by region indicator shows a highly concentrated core of innovative regions in EU, along the well-known 'blue banana', which starts in Finland and Sweden, descending along Germany, Switzerland, south eastern France, northern Italy and stopping in Rome (in the Lazio region). In the 30-year period, absolute growth in international inventive activity involved several regions in the 'blue banana' and the sun belt of northern Italy and southern France.

Three blue spots emerged: the regions of southern England, some regions in central France (Paris and later the area connecting Paris to the Bretagne), the areas in southern France (Provence, Rhone-Alps, Midi Pyrenees which include Toulouse) and Catalonia (centred in Barcelona). The blue core of EU regions was surrounded by a strong grey area with weaker adjacent regions. Spain, southern Italy, northern-most England, Greece and Eastern European countries exhibited lower levels of innovativeness.

Table 1 Cumulative statistics and growth rate of EPO and EU patents from 1980 to 2010

Variables	CumPat 1980–1990	CumPat 1990–2000	CumPat 2000-–2010	CumPat 1980–2010	GrwRate 80–90/00–10	GrwRate 90–00/00–10
EPO patents	**443,818**	**798,545**	**1,251,295**	**2,493,658**	**1.819**	**0.567**
Number of individual EPO patents	192,156	286,557	393,153	871,866	1.046	0.372
%	*43.30%*	*35.88%*	*31.42%*	*34.96%*	–	–
Number of co-invented EPO patents	251,662	511,988	858,142	1,621,792	2.410	0.676
%	*56.70%*	*64.12%*	*68.58%*	*65.04%*	–	–
EU patents[a]	**232,780**	**393,293**	**602,408**	**1,228,481**	**1.588**	**0.532**
Number of individual EU patents	114,514	163,502	211,745	489,761	0.849	0.295
%	*49.19%*	*41.57%*	*35.15%*	*39.87%*	–	–
Number of co-invented EU patents	118,266	229,791	390,663	738,720	2.303	0.700
%	*50.81%*	*58.43%*	*64.85%*	*60.13%*	–	–
Co-invented EU patents	**118,266**	**229,791**	**390,663**	**738,720**	**2.303**	**0.700**
within the same region	52,755	90,871	145,144	288,770	1.751	0.597
%	*46.63%*	*43.23%*	*41.41%*	*42.85%*	–	–
among European regions	60,384	119,319	205,360	385,063	2.401	0.721
%	*53.37%*	*56.77%*	*58.59%*	*57.15%*	–	–
involving Extra-European inventors	5127	19,601	40,159	64,887	6.833	1.049
%	*4.34%*	*8.53%*	*10.28%*	*8.78%*	–	–
Co-invention with Extra-EU inventors[b]	**5127**	**19,601**	**40,159**	**64,887**	**6.833**	**1.049**
Share of US-CA-JP inventors	2054	8472	16,010	26,536	6.795	0.890
%	*40.06%*	*43.22%*	*39.87%*	*40.90%*	–	–
Share of BRICS inventors	92	433	1784	2309	18.391	3.120
%	*1.79%*	*2.21%*	*4.44%*	*3.56%*	–	–
Share of other Extra-EU inventors	300	877	2112	3289	6.040	1.408
%	*5.85%*	*4.47%*	*5.26%*	*5.07%*	–	–
Share of EU inventors	2680	9820	20,250	32,750	6.556	1.062
%	*52.27%*	*50.10%*	*50.42%*	*50.47%*	–	–

[a]An EU patent is an EPO patent involving at least one European inventor
[b]Since the same patent may involve both US, CAN, JP, BRICS and other inventors, the sum of inventors' share is shown for each cluster of inventors to avoid patent duplication

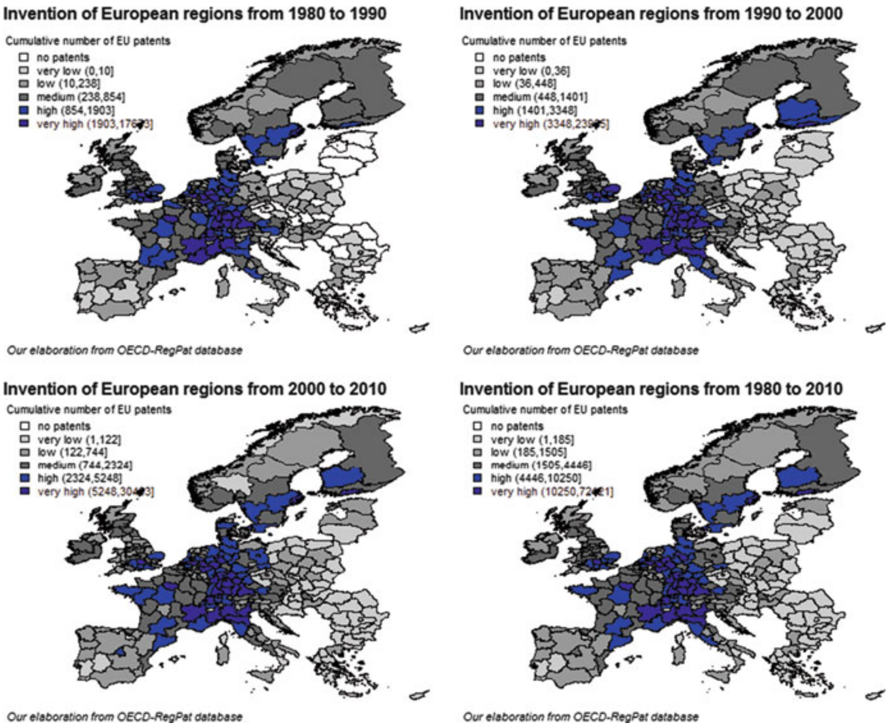

Fig. 4 Patent intensity by region based on the cumulative number. Note: Inventions in European regions are based on EU patents involving at least one EU inventor. Breaks in the legend correspond to percentiles 0th, 25th, 50th, 75th, 90th and 100th

Weighting the number of patents for capita (Fig. 5), the innovative ‘core’ regions were even more restricted with the regions of Provence, Piedmont, Tuscany, Veneto, Lazio, Midi Pyrenees and Catalonia no longer considered locations of concentrated innovation.

Regarding the variation of patent intensity by region (Fig. 6), two measurements address the phenomenon: the absolute and the relative variation. The highest shares of absolute variation occurred among the most innovative regions of the ‘banana blue’ and the areas already identified, while higher relative growth rates were significant among some of the weakest EU regions, including of all Spain, Ireland, Finland, Campania, Denmark and Poland.

Co-invented patents were similar to patenting distributions (Fig. 4), and thus those the figures are not reported here. Co-inventions appeared geographically concentrated in Norway, Finland, southern England, Germany, some regions of the former Soviet Bloc, northern Italy and multiple regions in France. These types of collective innovations benefit from proximity, where actors can recombine close and complementary knowledge.

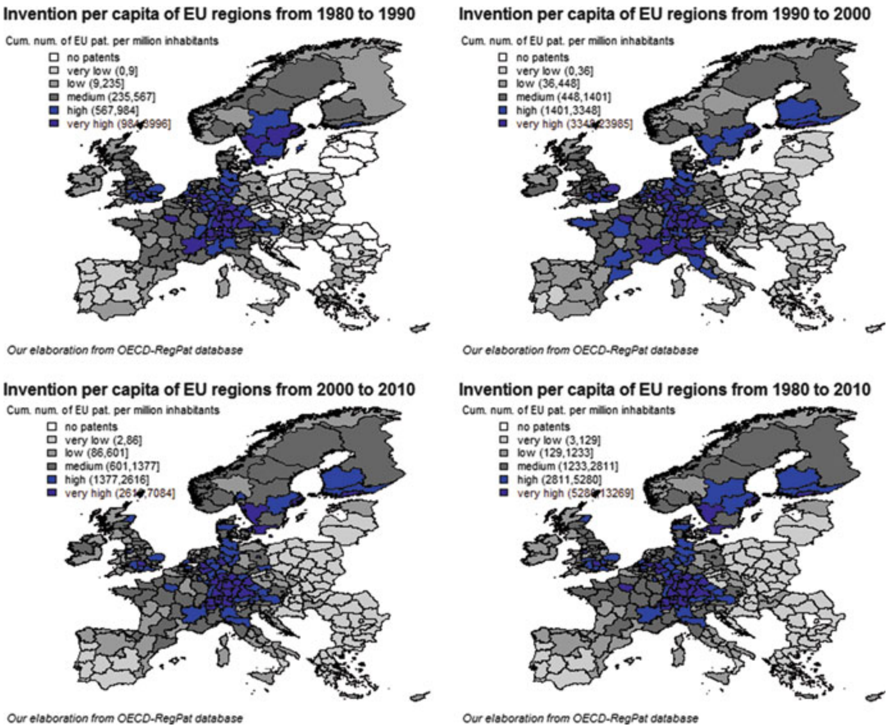

Fig. 5 Patent intensity per capita by region based on the cumulative number. Note: Inventions in European regions are based on EU patents involving at least one EU inventor. Breaks in the legend correspond to percentiles 0th, 25th, 50th, 75th, 90th and 100th

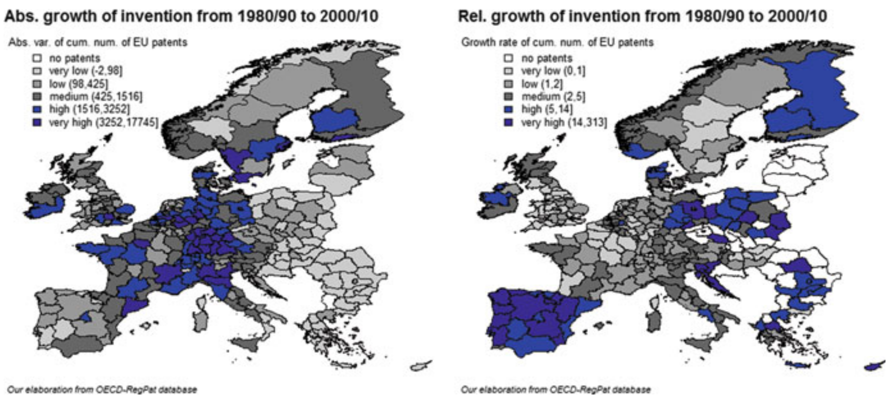

Fig. 6 Variation of patent intensity by region over 30-year window of time. Note: Inventions in European regions are based on EU patents involving at least one EU inventor. Breaks in the legend correspond to percentiles 0th, 25th, 50th, 75th, 90th and 100th

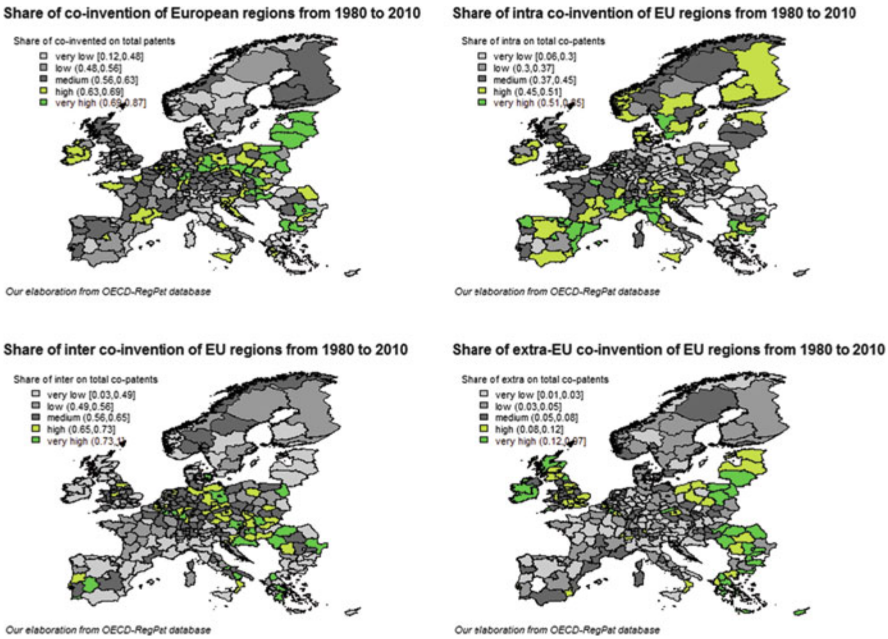

Fig. 7 Share of co-inventions and intra-regional, inter-regional and extra-EU co-inventions against the total number of inventions. Note: Co-invention in European regions is based on EU patents involving more than one inventor. Intra-regional co-invention in European regions is based on EU patents involving more than one inventor from the same region. Inter-regional co-invention in European regions is based on EU patents involving more than one inventor from a different European region than the other(s). Extra-EU co-invention in European regions is based on EU patents involving at least one inventor from an extra-EU region on the patent team. Breaks in the legend correspond to percentile 0th, 25th, 50th, 75th, 90th and 100th

Figure 7 weights the percentage of co-inventions against the total number of patents. This produces a different picture of EU regions: peripheral regions of the EU, where patenting activity was weaker, have higher concentrations of co-invented patents measured against total patents.

It is probable that weak innovative peripheral regions, having fewer inventors, have to utilize collective methods to participate in innovative research projects. The first picture on the right shows the share of co-inventions in relation to inter-regional information networks. Higher shares of co-invented patents were located in northern Italy, southern France and northern Spain, coinciding with their industrial districts. The modality of high inter-regional innovative activity characterizes several regions of Eastern Europe, southern Italy and southern Spain. These co-invention locations mirrored the presence of numerous cooperative EU projects. The higher number of co-invented patents involving inventors from regions outside the EU were visible on the extreme periphery of Eastern Europe, Scotland and Ireland. Those areas are characterized by MNE localizations.

5 The Innovative Sectors

In this section, we analysed European inventing activity by considering the most innovative sectors: green technology, biotechnology, laser and optic technology, and nanotechnology. These four sectors (Tables 2, 3, 4, and 5) cover about 160,000 patents, of which 65–83% were co-invented.

The largest sector was green technology, with about 70,000 patents (Table 2). Europe is the most advanced regional area in the global economy regarding green innovations, due to strict governmental regulations and environmental business practices. These practices were developed through science and technology innovations, both in companies and in research centres and universities. Of EU patents, 60% were co-invented patents.

Innovative efforts characterized both the 1990s and, even more so, the 2000s. Biotechnology patents (Table 3) form the second largest sector (about 46,000 patents). Despite the biotech revolution beginning in US in the 1980s, European organizations have closed the gap. Patenting activity in this sector was largely the result of collective inventions (85% of all EU patents were co-invented by more than one individual). Of the co-invented patents, 18% involved extra-EU inventors. However, the size of EU patenting is smaller than in the previous case, representing only 37% of the total international innovative activity (EPO patents).

The third analysed sector (Table 4) relates to laser and optic technology, with a cumulative number of 26,000 patents. During the 1990s and 2000s, the inventive activity grew at an average growth of about new 700 patents per year. In this sector, there were relatively fewer co-invented patents, comprising only 65% of total patents. For the 8% of patents involving extra-EU inventors co-invention activity.

The nanotechnology sector (Table 5) represent the smallest of our sample (only about 15,000 patents). The 2000s saw great expansion of nanotech patenting activity. During this decade, 82% of patents were co-invented. About 15% involved extra-EU inventors. EU patents represent about 33% of all innovative activity conducted at the international level (EPO patents).

Considering the geographical distributions of inventors in these innovative sectors (Fig. 8), the territorial pattern of green technologies resembles the geographical distributions both of cumulated patents and co-inventions, with a large central core around Germany, a dense area in the sun belt of northern Italy and southern France as well as the district of London, southern Finland, Sweden, the Danish peninsula and the extension towards Holland.

Specialized biotech areas were more restricted regionally, with the exclusion of many advanced areas of Italy, northern France, Spain, Greece, and Eastern European countries. Laser and optic technology overlaid the 'blue banana' together with the southern sunbelt, where northern Italy and France connect. Nanotechnology patents represented a small technological niche, where some peripheral regions of the UK, southern Italy, and Spain are included. Overall, these pictures suggest that the geography of new innovative sectors in EU significantly overlap with traditionally innovative areas.

Table 2 Cumulative statistics and growth rate of green tech EPO and EU patents from 1980 to 2010

Variables	CumPat 1980–1990	CumPat 1990–2000	CumPat 2000–2010	CumPat 1980–2010	GrwRate 80–90/00–10	GrwRate 90–00/00–10
EPO patents	**26,816**	**55,215**	**69,916**	**151,947**	**1.607**	**0.266**
Number of individual EPO patents	11,088	17,242	22,351	50,681	1.016	0.296
%	*41.35%*	*31.23%*	*31.97%*	*33.35%*	–	–
Number of co-invented EPO patents	15,728	37,973	47,565	101,266	2.024	0.253
%	*58.65%*	*68.77%*	*68.03%*	*66.65%*	–	–
EU patents[a]	**13,838**	**25,241**	**31,494**	**70,573**	**1.276**	**0.248**
Number of individual EU patents	6415	9468	11,915	27,798	0.857	0.258
%	*46.36%*	*37.51%*	*37.83%*	*39.39%*	–	–
Number of co-invented EU patents	7423	15,773	19,579	42,775	1.638	0.241
%	*53.64%*	*62.49%*	*62.17%*	*60.61%*	–	–
Co-invented EU patents	**7423**	**15,773**	**19,579**	**42,775**	**1.638**	**0.241**
within the same region	3042	5462	6906	15,410	1.270	0.264
%	*43.81%*	*39.60%*	*39.32%*	*40.23%*	–	–
among European regions	3901	8332	10,659	22,892	1.732	0.279
%	*56.19%*	*60.40%*	*60.68%*	*59.77%*	–	–
involving Extra-European inventors	480	1979	2014	4473	3.196	0.018
%	*6.47%*	*12.55%*	*10.29%*	*10.46%*	–	–
Co-invention with Extra-EU inventors[b]	**480**	**1979**	**2014**	**4473**	**3.196**	**0.018**
Share of US-CA-JP inventors	198	896	797	1891	3.025	−0.110
%	*41.25%*	*45.28%*	*39.57%*	*42.28%*	–	–
Share of BRICS inventors	5	38	81	124	15.200	1.132
%	*1.04%*	*1.92%*	*4.02%*	*2.77%*	–	–
Share of other Extra-EU inventors	29	104	147	280	4.069	0.413
%	*6.04%*	*5.26%*	*7.30%*	*6.26%*	–	–
Share of EU inventors	247	941	987	2175	2.996	0.049
%	*51.46%*	*47.55%*	*49.01%*	*48.63%*	–	–

[a]An EU patent is an EPO patent involving at least one European inventor

[b]The whole is less than the sum of the parts because of European co-patents with extra-EU inventors may involve both US, CAN, JP, BRICS and other inventors

Table 3 Cumulative statistics and growth rate of biotech EPO and EU patents from 1980 to 2010

Variables	CumPat 1980–1990	CumPat 1990–2000	CumPat 2000–2010	CumPat 1980–2010	GrwRate 80–90/00–10	GrwRate 90–00/00–10
EPO patents	**19,545**	**50,548**	**56,007**	**126,100**	**1.866**	**0.108**
Number of individual EPO patents	3970	8084	8347	20,401	1.103	0.033
%	*20.31%*	*15.99%*	*14.90%*	*16.18%*	–	–
Number of co-invented EPO patents	15,575	42,464	47,660	105,699	2.060	0.122
%	*79.69%*	*84.01%*	*85.10%*	*83.82%*	–	–
EU patents[a]	**7061**	**18,473**	**20,885**	**46,419**	**1.958**	**0.131**
Number of individual EU patents	1357	2652	2677	6686	0.973	0.009
%	*19.22%*	*14.36%*	*12.82%*	*14.40%*	–	–
Number of co-invented EU patents	5704	15,821	18,208	39,733	2.192	0.151
%	*80.78%*	*85.64%*	*87.18%*	*85.60%*	–	–
Co-invented EU patents	**5704**	**15,821**	**18,208**	**39,733**	**2.192**	**0.151**
within the same region	2002	4675	5518	12,195	1.756	0.180
%	*40.29%*	*36.98%*	*37.23%*	*37.60%*	–	–
among European regions	2967	7968	9303	20,238	2.135	0.168
%	*59.71%*	*63.02%*	*62.77%*	*62.40%*	–	–
involving Extra-European inventors	735	3178	3387	7300	3.608	0.066
%	*12.89%*	*20.09%*	*18.60%*	*18.37%*	–	–
Co-invention with Extra-EU inventors[b]	**735**	**3178**	**3387**	**7300**	**3.608**	**0.066**
Share of US-CA-JP inventors	298	1455	1426	3179	3.785	−0.020
%	*40.54%*	*45.78%*	*42.10%*	*43.55%*	–	–
Share of BRICS inventors	15	46	82	143	4.467	0.783
%	*2.04%*	*1.45%*	*2.42%*	*1.96%*	–	–
Share of other Extra-EU inventors	47	175	201	423	3.277	0.149
%	*6.39%*	*5.51%*	*5.93%*	*5.79%*	–	–
Share of EU inventors	375	1501	1679	3555	3.477	0.119
%	*51.02%*	*47.23%*	*49.57%*	*48.70%*	–	–

[a]An EU patent is an EPO patent involving at least one European inventor
[b]The whole is less than the sum of the parts because of European co-patents with extra-EU inventors may involve both US, CAN, JP, BRICS and other inventors

Table 4 Cumulative statistics and growth rate of laser and optic technology EPO and EU patents from 1980 to 2010

Variables	CumPat 1980–1990	CumPat 1990–2000	CumPat 2000–2010	CumPat 1980–2010	GrwRate 80–90/00–10	GrwRate 90–00/00–10
EPO patents	**16,768**	**30,010**	**31,069**	**77,847**	**0.853**	**0.035**
Number of individual EPO patents	6265	9427	9379	25,071	0.497	−0.005
%	*37.36%*	*31.41%*	*30.19%*	*32.21%*	–	–
Number of co-invented EPO patents	10,503	20,583	21,690	52,776	1.065	0.054
%	*62.64%*	*68.59%*	*69.81%*	*67.79%*	–	–
EU patents[a]	**6419**	**9768**	**10,138**	**26,325**	**0.579**	**0.038**
Number of individual EU patents	2688	3374	3024	9086	0.125	−0.104
%	*41.88%*	*34.54%*	*29.83%*	*34.51%*	–	–
Number of co-invented EU patents	3731	6394	7114	17239	0.907	0.113
%	*58.12%*	*65.46%*	*70.17%*	*65.49%*	–	–
Co-invented EU patents	**3731**	**6394**	**7114**	**17,239**	**0.907**	**0.113**
within the same region	1760	2752	2949	7461	0.676	0.072
%	*48.94%*	*47.46%*	*45.75%*	*47.10%*	–	–
among European regions	1836	3047	3497	8380	0.905	0.148
%	*51.06%*	*52.54%*	*54.25%*	*52.90%*	–	–
involving Extra-European inventors	135	595	668	1398	3.948	0.123
%	*3.62%*	*9.31%*	*9.39%*	*8.11%*	–	–
Co-invention with Extra-EU inventors[b]	**135**	**595**	**668**	**1398**	**3.948**	**0.123**
Share of US-CA-JP inventors	59	271	271	601	3.593	0.000
%	*43.70%*	*45.55%*	*40.57%*	*42.99%*	–	–
Share of BRICS inventors	2	17	24	43	11.000	0.412
%	*1.48%*	*2.86%*	*3.59%*	*3.08%*	–	–
Share of other Extra-EU inventors	6	20	35	61	4.833	0.750
%	*4.44%*	*3.36%*	*5.24%*	*4.36%*	–	–
Share of EU inventors	69	287	337	693	3.884	0.174
%	*51.11%*	*48.24%*	*50.45%*	*49.57%*	–	–

[a] An EU patent is an EPO patent involving at least one European inventor

[b] The whole is less than the sum of the parts because of European co-patents with extra-EU inventors may involve both US, CAN, JP, BRICS and other inventors

Table 5 Cumulative statistics and growth rate of nanotech EPO and EU patents from 1980 to 2010

Variables	CumPat 1980–1990	CumPat 1990–2000	CumPat 2000–2010	CumPat 1980–2010	GrwRate 80–90/00–10	GrwRate 90–00/00–10
EPO patents	**66**	**1313**	**3284**	**4663**	**48.758**	**1.501**
Number of individual EPO patents	20	269	631	920	30.550	1.346
%	*30.30%*	*20.49%*	*19.21%*	*19.73%*	–	–
Number of co-invented EPO patents	46	1044	2653	3743	56.674	1.541
%	*30.30%*	*20.49%*	*19.21%*	*19.73%*	–	–
EU patents[a]	**24**	**422**	**1077**	**1523**	**43.875**	**1.552**
Number of individual EU patents	5	81	173	259	33.600	1.136
%	*20.83%*	*19.19%*	*16.06%*	*17.01%*	–	–
Number of co-invented EU patents	19	341	904	1264	46.579	1.651
%	*79.17%*	*80.81%*	*83.94%*	*82.99%*	–	–
Co-invented EU patents	**19**	**341**	**904**	**1264**	**46.579**	**1.651**
within the same region	7	114	322	443	45.000	1.825
%	*43.75%*	*39.45%*	*41.60%*	*41.06%*	–	–
among European regions	9	175	452	636	49.222	1.583
%	*56.25%*	*60.55%*	*58.40%*	*58.94%*	–	–
involving Extra-European inventors	3	52	130	185	42.333	1.500
%	*15.79%*	*15.25%*	*14.38%*	*14.64%*	–	–
Co-invention with Extra-EU inventors[b]	**3**	**52**	**130**	**185**	**42.333**	**1.500**
Share of US-CA-JP inventors	1	22	57	80	56.000	1.591
%	*33.33%*	*42.31%*	*43.85%*	*43.24%*	–	–
Share of BRICS inventors	0	1	4	5	–	3.000
%	*0.00%*	*1.92%*	*3.08%*	*2.70%*	–	–
Share of other Extra-EU inventors	0	3	9	12	–	2.000
%	*0.00%*	*5.77%*	*6.92%*	*6.49%*	–	–
Share of EU inventors	2	27	62	91	30.000	1.296
%	*66.67%*	*51.92%*	*47.69%*	*49.19%*	–	–

[a]An EU patent is an EPO patent involving at least one European inventor
[b]The whole is less than the sum of the parts because of European co-patents with extra-EU inventors may involve both US, CAN, JP, BRICS and other inventors

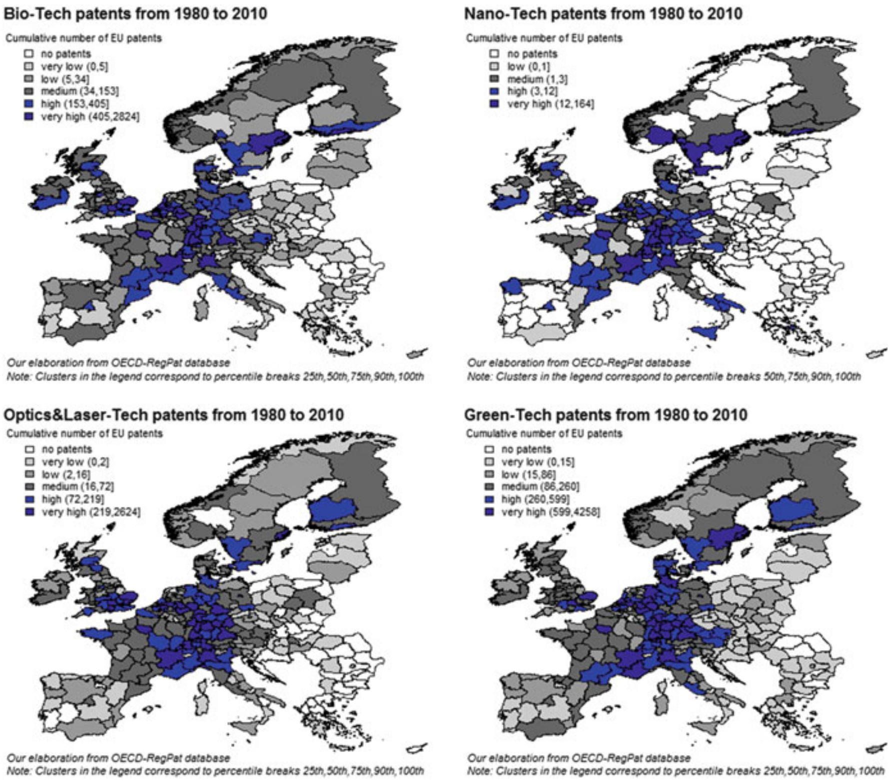

Fig. 8 Patent intensity by region and innovation sector

6 Conclusion

Innovation activity in the EU has shown a persistent pattern of growth, particularly in the last decade (2000–2010). Some of our results deserve special attention. First, we must emphasize the rise of collective co-inventions, considering the dimension of intra-regional and inter-regional inventive networks.

Second, the concentrations of innovation activity appear to be long-term structural features of these EU regions, with the most innovative central kernel of EU integrating some regions from Eastern Europe, southern England, southern Norway, Sweden and Finland in with Germany, Holland, and Denmark. There was a remarkable innovative presence in the European sunbelt, which connects Italy and France. In Spain, only Catalonia and Madrid have become more advanced innovative regions.

Third, despite the addition of policies and programs, the original innovative divide of the early 1980s has not changed. Novel innovative sectors like green technology, biotechnology, laser and optic technology, and nanotechnology have emerged in the same places older innovators worked in the post-war period. The overlap of old and new sectors underscores the importance of regional branching (Boschma and Frenken 2011; Tanner 2014). Regions with the highest number of cumulative inventors also have high co-invention levels and the dynamics of innovation are more sustained. From 1980 to 2010, the number of inventors per patent continued to grow, and in the case of new sectors, this trend is even higher.

Fourth, in regions characterized by lower levels of innovation, co-inventions made up a large amount of the total number of patents. This suggests that weaker regions resort to external knowledge flows to balance their technological inferiorities, and accessing new radical knowledge is facilitated through connections with other EU programs. However, the role of partnering strategies and different knowledge flows from advanced to less developed regions deserves further investigation.

Acknowledgements This EU research project was funded under the FP7 grant number 320131, SMARTSPEC.

Appendix

Table 6 Technological manufacturing industry classifications

Manufacturing industry	NACE codes (2-digit level)
High-technology	21 Manufacture of basic pharmaceutical products and pharmaceutical preparations 26 Manufacture of computer, electronic and optical products
Medium-high-technology	20 Manufacture of chemicals and chemical products 27–30 Manufacture of electrical equipment, manufacture of machinery and equipment n.e.c., manufacture of motor vehicles, trailers and semi-trailers, manufacture of other transport equipment
Medium-low-technology	19 Manufacture of coke and refined petroleum products 22–25 Manufacture of rubber and plastic products, manufacture of other non-metallic mineral products, manufacture of basic metals, manufacture of fabricated metal products (except machinery and equipment) 33 Repair and installation of machinery and equipment
Low-technology	10–18 Manufacture of food products, beverages, tobacco products, textiles, wearing apparel, leather and related products, wood and of products of wood, paper and paper products, printing and reproduction of recorded media. 31–32 Manufacture of furniture, other manufacturing

Table 7 NACE Rev. 2—IPC V8 concordance (NACE 2-digit level)

NACE	Sector definition	Patents' IPC
10	Manufacture of food products	A01H A21D A23B A23C A23D A23F A23G A23J A23K A23P C12J C13F C13J C13K A23L001 A23L003 C13B A01J
11	Manufacture of beverages	C12C C12F C12G C12H A23L002
12	Manufacture of tobacco products	A24B A24D A24F
13	Manufacture of textiles	D06C D04G D04H D06J D06M D06P D06Q D04D D06N
14	Manufacture of wearing apparel	A41B A41C A41D A41F
15	Manufacture of leather and related products	A43B A43C B68B B68C
16	Manufacture of wood and of products of wood and cork, except furniture; Manufacture of articles of straw and plaiting materials	B27D B27H B27M B27N
17	Manufacture of paper and paper products	B42F D21C D21H D21J
18	Printing and reproduction of recorded media	B41M B42D B44F
19	Manufacture of coke and refined petroleum products	C10G C10L
20	Manufacture of chemicals and chemical products	C07B C07C C07F C07G C12S C40B C08B C08F C08G C08K C08L C05B C05C C05D C05F C05G C09B C09C C09K C10B C10C C10H C10J C10K C01B C01C C01D C01F C01G C25B B01J F25J B09B B09C C02F G21F C08J F17C F17D A01N A01P C09D B27K C09F C11D D06L A61K008 A61Q C08H C06D C09G C09H C09J C10M C11B C11C C23F C23G C14C A62D D01C C10N C06C C06B F42B F42D D01F
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	A61P C07D C07H C07J C07K C12N C12P C12Q A61K (except A61K008)
22	Manufacture of rubber and plastic products	B67D B29C B29D B60C C08C B29B
23	Manufacture of other non-metallic mineral products	B32B C03C C03B B28B B28C E03D C04B
24	Manufacture of basic metals	B22D C21B C21C C21D C22B C22C C22F C25C C25F B21C G21H
25	Manufacture of fabricated metal products, except machinery and equipment	B21G F27D A44B A47H F22B F22G F24J F16T F17B G21C G21D G21B B63G F41A F41B F41C F41F F41G F41H F41J F42C G21J B22F C23D C25D E05B E05D E05F E06B A01L F16B E05C

(continued)

Table 7 (continued)

NACE	Sector definition	Patents' IPC
26	Manufacture of computer, electronic and optical products	G11C H01C H01F H01G H01J H01L H05K C30B B82B B81B B81C B82Y G06C G06D G06E G06F G06G G06J G06N G06T G02F G09C G08B H04B H04J H04K H04M H04Q H04L H03B H03C H03D H03G H03H H03M G03H H03J H04H H04N H04R H04S H04W H01Q H01S H03K H03L H03F F15C G01B G01C G01D G01F G01H G01J G01M G01N G01R G01S G01W G12B G01Q G04R G01V G01K G01L G05B G08C G05F G04B G04C G04D G04F G04G A61N H05G G21K H05H G02B G02C G03B G03C
27	Manufacture of electrical equipment	H02K H02N H02P H02B H02J H01M H01B H02G H01H H01R F21H F21K F21L F21M F21S F21V H01K F21P F21Q F21W F21Y A21B A45D A47G A47J A47L B01B D06F E06C F24B F24C F24D F25C F25D H05B B60M B61L G08G G10K H01T H02H H02M H05C H01P
28	Manufacture of machinery and equipment N.E.C.	B23F F01B F01C F01D F03B F03C F03D F03G F04B F04C F04D F23R F15B F16C F16D F16F F16H F16K F16M G05D G05G F01K F01M F01N F01P F02G F02C F02K A47K F23G F27B B66B B66D B66F B61B B60S E02C G07B G07C G07D G07F G07G G09D G09G G11B B41J B41K B43M G06K G06M G10L G03G F24F F24H F28F H05F G01G C10F B01D B04C B05B A62C F23J B65G B66C C12L F22D F23B F23C F23D F23H F23K F23L F23M F25B F28B F28C F28D F28G F16G F23N A01B A01C A01D A01F A01G A01K A01M B27L B24D B21K B21L B25B B25C B25F B25G B25H B26B B27G B21D B21F B21H B21J B23B B23C B23D B23G B23H B23K B23P B23Q B24B B24C B25D B25J B26F B27B B27C B27F B27J B28D B30B B44C B65F001 B65F005 B65F007 B65F009 F15D A21C A22B A22C A23N A24C A41H A42C A43D B02B B02C B05C B05D B06B B07B B07C B08B B21B B22C B26D B31B B31C B31D B31F B41B B41C B41D B41F B41G B41L B41N B42B B42C B44B B65B B65C B65H B67B B67C

(continued)

Table 7 (continued)

NACE	Sector definition	Patents' IPC
		B68F C13C C13D C13G C13H C23C D06G D06H D21B D21D D21G E01C E02D E02F E21B E21D E21F F04F F16N F26B E01D E01F E21C D01B D01D D01G D01H D02G D02H D02J D03C D03D D03J D04B D04C D05B D05C D06B D21F E05G E01H B01F B03B B03C B03D C14B F16P
29	Manufacture of motor vehicles, trailers and semi-trailers	B60B B60D B60G B60H B60J B60K B60L B60N B60P B60Q B60R B60T B62D F01L F02B F02D F02F F02M F02N F02P F16J G01P B60W
30	Manufacture of other transport equipment	B65F003 B60F B60V B61C B61D B61F B61G B61H B61J B61K B62C B62H B62J B62K B62L B62M B63B B63C B63H B63J B64B B64C B64D B64F B64G E01B F03H
31	Manufacture of furniture	A47B A47C A47D A47F
32	Other manufacturing	F16L A45C D07B A41G A42B A44C A45B A45F A46B A46D A63B A63C A63D A63F A63G A63H A63J A63K B43K B43L B44D B62B B68G C06F F23Q G10B G10C G10D G10F G10G G10H A61B A61C A61D A61F A61G A61H A61J A61L A61M C12M not A61K except A61K 8/* B01L B04B G01T G21G A62B G09B G09F G03D G03F
42	Civil engineering	E03B E03C E02B
43	Specialised construction activities	E04G E04B E04C E04D E04F E03F E04H
62	Computer programming, consultancy and related activities	G06Q
Co-IPC	Remove this code and allocate by following the Co-IPC	F16S B29K B29L C12R

Note: We associated IPC B65D to prevalent NACE 22, even though it should be associated to NACE 13 (5.88%), 22 (35.96%), 23 (21.31%), 25 (15.17%), 17 (20.44%) and 16 (1.25%); IPC B65F001, B65F005, B65F007, B65F009 are associated to NACE 28, whereas the IPC B65F003 to NACE 30; A61K and A61K008 are respectively associated to NACE 21 and 20; C07B, C07C, C07F, C07G, C12M, C12S and C40B are associated to NACE 20

Table 8 Innovative industry classifications

Sectors	Patents' IPC
Biotechnology	A01H001/00 A01H004/00 A61K038/00 A61K039/00 A61K048/00 C02F003/34 C40B040/00 C40B070/00 C40B080/00 C40B010/00 G01N027/327 G01N033/53 G01N033/54 G01N033/55 G01N033/57 G01N033/74 G01N033/76 G01N033/78 G01N033/88 G01N033/92 C12N C12P C12Q
Nanotechnology	B81B B82B B82Y
Green technology	A01G023/00 A01G025/00 A01H A01N025/00 A01N065/00 A43B001/12 A43B021/14 A61L011/00 A62D003/00 A62D003/02 A62D101/00 B01D045/00 B01D051/00 B01D053/00 B01D053/02 B01D053/04 B01D053/047 B01D053/14 B01D053/14 B01D053/22 B01D053/24 B01D053/62 B01D053/92 B01D053/96 B03B009/06 B03C003/00 B09B B09C B22F008/00 B29B017/00 B60K006/00 B60K006/10 B60K006/20 B60K006/28 B60K006/30 B60K016/00 B60L003/00 B60L007/10 B60L007/22 B60L008/00 B60L009/00 B60L011/16 B60L011/18 B60W010/26 B60W020/00 B61D017/02 B62D035/00 B62D035/02 B62D067/00 B62K B62M001/00 B62M003/00 B62M005/00 B62M006/00 B63B001/34 B63B001/40 B63B035/00 B63B035/32 B63H009/00 B63H013/00 B63H016/00 B63H019/02 B63H019/04 B63H021/18 B63J004/00 B64G001/44 B65F B65G005/00 C01B031/20 C01B033/02 C02F C04B007/24 C04B0077/30 C04B018/04 C04B018/10 C05F C08J011/00 C08J011/04 C08J011/28 C09K003/22 C09K003/32 C09K005/00 C09K011/01 C09K017/00 C10B021/18 C10B053/00 C10B053/02 C10G001/10 C10J C10L005/48 C10L001/00 C10L001/02 C10L001/14 C10L003/00 C10L005/00 C10L005/40 C10L005/42 C10L005/44 C10L005/46 C10L005/48 C10L005/48 C10L009/00 C10L010/02 C10L010/06 C11B011/00 C11B013/00 C11B013/04 C12M001/107 C12N001/13 C12N001/15 C12N001/21 C12N005/10 C12N015/00 C12P005/02 C14C003/32 C21B003/04 C21B005/06 C21B007/22 C21C005/38 C22B007/00 C22B007/04 C22B019/30 C22B025/06 C23C014/14 C23C016/24 C25C001/00 C30B029/06 D01F013/00 D01F013/04 D01G011/00 D21B001/08 D21B001/32 D21C005/02 D21C011/00 D21F005/20 E02B015/04 E02D003/00 E03C001/12 E03F E04B001/90 E04B001/62 E04B001/74 E04B001/80 E04B001/88 E04B002/00 E04B005/00 E04B007/00 E04B009/00 E04C001/41 E04C001/40 E04C002/284 E04C002/296 E04D001/28 E04D003/35 E04D013/00 E04D013/16 E04D013/18 E04F013/08 E04F015/18 E04H001/00 E04H012/00 E06B003/263 E21B041/00 E21B043/16 E21F017/16 F01K F01N003/00 F01N003/38 F01N009/00 F02B043/00 F02B075/10 F02C001/05 F02C003/28 F02C006/18 F02M021/02 F02M027/02 F03D F03D011/04 F03G004/00 F03G004/06 F03G005/00 F03G005/08 F03G006/00 F03G006/06 F03G007/04 F03G007/05 F03G007/08 F16H003/00 F16H003/78 F16H048/00 F16H048/30 F21K099/00 F21L004/00 F21L004/02 F21S009/03 F22B001/00 F22B001/02 F23B080/02 F23B090/00 F23C009/00 F23G F23J007/00 F23J015/00 F24D003/00 F24D005/00 F24D011/00 F24D011/02 F24D015/04 F24D017/00 F24D017/02 F24D019/00 F24F005/00 F24F012/00 F24H004/00 F24H007/00 F24J001/00 F24J002/00 F24J002/04 F24J002/06 F24J002/42 F24J002/54 F24J003/00 F24J003/06 F24J003/08 F25B027/00 F25B027/02 F25B030/00 F25B030/06 F25J003/02 F26B003/00 F26B003/28 F27B001/18

(continued)

Table 8 (continued)

Sectors	Patents' IPC
	F27B015/12 F27D017/00 F28D017/00 F28D020/00 F28D020/02 G01R G02B007/183 G05F001/67 G06Q G08B021/12 G08G G21B G21C G21D G21F009/00 H01G009/155 H01G009/20 H01J009/50 H01J009/52 H01L025/00 H01L025/03 H01L025/16 H01L025/18 H01L027/142 H01L027/30 H01L031/00 H01L031/058 H01L031/078 H01L033/00 H01L033/64 H01L051/42 H01L051/48 H01L051/50 H01M002/00 H01M002/04 H01M004/86 H01M004/98 H01M006/52 H01M008/00 H01M008/24 H01M010/44 H01M010/46 H01M010/54 H01M012/00 H01M012/08 H01M014/00 H02J H02K007/18 H02K029/08 H02K049/10 H02N006/00 H02N010/00 H05B033/00
Laser and optic technology	H01S G02B G02C G03B G03C

References

Allen, R. C. (1983). Collective invention. *Journal of Economic Behavior and Organization, 4*, 1–24.

Arrow, K. (1962). The economic implications of learning by doing. *Review of Economic Studies, 29*(3), 155–173.

Asheim, B. T., & Isaksen, A. (2002). Regional innovation systems: The integration of local 'sticky' and global 'ubiquitous' knowledge. *The Journal of Technology Transfer, 27*(1), 77–86.

Asheim, B. T., Smith, H. L., & Oughton, C. (2011). Regional innovation systems: Theory, empirics and policy. *Regional Studies, 45*, 875–891.

Basalla, G. (1988). *The evolution of technology*. Cambridge: Cambridge University Press.

Bonaccorsi, A. (2011). A functional theory of technology and technological change. In *Handbook on the economic complexity of technological change* (p. 286). Cheltenham: Edward Elgar.

Boschma, R., & Frenken, K. (2010). The spatial evolution of innovation networks. A proximity perspective. In *The handbook of evolutionary economic geography* (pp. 120–135). Cheltenham: Edward Elgar.

Boschma, R. A., & Frenken, K. (2011). Technological relatedness and regional branching. In H. Bathelt, M. P. Feldman, & D. F. Kogler (Eds.), *Dynamic geographies of knowledge creation and innovation* (pp. 64–81). London: Routledge.

Cassi, L., & Plunket, A. (2015). Research collaboration in co-inventor networks: Combining closure, bridging and proximities. *Regional Studies, 49*(6), 936–954.

Chesbrough, H. (2003a). The era of open innovation. *The MIT Sloan Management Review, 44* (Spring), 35–41.

Chesbrough, H. (2003b). The logic of open innovation: Managing intellectual property. *California Management Review, 45*(3), 33–58.

Clark, J., Freeman, C., & Soete, L. (1984). Long waves, inventions and innovations. In C. Freeman (Ed.), *Long waves and the world economy*. London: Frances Pinter.

D'Aveni, R. (1994). *Hypercompetition*. New York: The Free Press.

Dosi, G. (1982). Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change. *Research Policy, 11*(3), 147–162.

Eurostat. (2007). *Eurostat indicators on high-tech industry and knowledge – Intensive services, Annex 6 – High-tech aggregation by patents*.

Eurostat. (2014). *Aggregations of manufacturing based on NACE Rev. 2, Annex 3 – High-tech aggregation by NACE Rev. 2*.

Fleming, L. (2001). Recombinant uncertainty in technological search. *Management Science, 47* (1), 117–132.

Freeman, C. (1991). Network of innovators: A synthesis of research issue. *Research Policy, 20*, 499–514.

Freeman, C. (1994). *The handbook of industrial innovation*. Cheltenham: Edward Elgar.

Gay, C., Latham, W., & Le Bas, C. (2008). Collective knowledge, prolific inventors and the value of inventions: An empirical study of French, German and British patents in the US, 1975–1999. *Economics of Innovation and New Technology, 17*(1–2), 5–22.

Jaffe, A., Trajtenberg, M., & Henderson, R. (1993). Geographic localization of knowledge spillovers as evidenced by patent citations. *Quarterly Journal of Economics, 108*, 577–598.

Jewkes, J., Sawers, D., & Stillerman, R. (1958). *The sources of invention*. London: Macmillan.

Lane, D. A. (2011). Complexity and innovation dynamics. In *Handbook on the economic complexity of technological change* (Vol. 63). Cheltenham: Edward Elgar.

Malerba, F. (1992). Learning by firms and incremental technical change. *The Economic Journal, 102*(2), 845–859.

Mokyr, J. (2000, January). Evolutionary phenomena in technological change. In *Technological innovation as an evolutionary process* (pp. 52–65). Cambridge: Cambridge University Press.

Pavitt, K. (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory. *Research Policy, 13*(6), 343–373.

Pavitt, K. (1999). *Technology, management and systems of innovation*. Cheltenham: Edward Elgar.

Powell, W. W. (1998). Learning from collaboration: Knowledge and networks in the biotechnology and pharmaceutical industries. *California Management Review, 40*(3), 228–240.

Powell, W. W., & Giannella, E. (2010). Collective invention and inventor networks. *Handbook of the Economics of Innovation, 1*, 575–605.

Rallet, A., & Torre, A. (1999). Is geographical proximity necessary in the innovation networks in the era of global economy? *GeoJournal, 49*(4), 373–380.

Rosenberg, N. (1976). *Perspectives on technology*. Cambridge: Cambridge University Press.

Rosenberg, N. (1982). *Inside the black box: Technology and economics*. Cambridge: Cambridge University Press.

Schumpeter, J. (1934). *The theory of economic development*. Cambridge: Harvard University Press.

Schumpeter, J. (1947). The creative response in history. *Journal of Economic History, 7*(02), 149–159.

Strumsky, D., Lobo, J., & Van der Leeuw, S. (2011). *Measuring the relative importance of reusing, recombining and creating technologies in the process of invention*, SFI Working Paper.

Strumsky, D., Lobo, J., & Van der Leeuw, S. (2012). Using patent technology codes to study technological change. *Economics of Innovation and New technology, 21*(3), 267–286.

Tanner, A. N. (2014). Regional branching reconsidered: Emergence of the fuel cell industry in European regions. *Economic Geography, 90*(4), 403–427.

Ter Wal, A. L. (2013). The dynamics of the inventor network in German biotechnology: Geographic proximity versus triadic closure. *Journal of Economic Geography, 14*, 589–620.

Tushmann, M., & Anderson, P. (1986). Technological discontinuities and organizational environments. *Administrative Science Quarterly, 31*, 439–465.

Van Looy, B., Vereyen, C., & Schmoch, U. (2014, October). *Patent statistics: Concordance IPC V8 – NACE REV.2*, Eurostat, Euopean Commission.

Weitzman, M. L. (1998). Recombinant growth. *Quarterly Journal of Economics*, 331–360.

Youn, H., Bettencourt, L., Strumsky, D., & Lobo, J. (2014). *Invention as a combinatorial process: Evidence from US patents*. arXiv preprint arXiv:1406.2938.

Regional Innovation Systems and Transformative Dynamics: Transitions in Coal Regions in Australia and Germany

Lars Coenen, Stephanie Campbell, and John Wiseman

Abstract

This chapter aims to better understand the implications of transformative change for regional innovation systems (RIS) research and policy by looking more closely into processes of structural change within coal regions against a context of transitions to a low-carbon future. Case studies of Germany's Ruhr and Australia's Latrobe Valley are used to demonstrate the challenges in implementing regional innovation policies under conditions of fundamental uncertainty. In the absence of regional innovation system structures and institutions, there is first and foremost a need for organisational and institutional innovation to arrive at working configurations of actors, networks and institutions that could act as proto- or 'pop-up' innovation systems. This chapter aims to shed some light on how to approach such processes. It argues that policymakers and researchers should explicitly acknowledge the experimental nature of RIS policy and conceptualize RIS policy development and implementation as a series of governance experiments.

Keywords

Low-carbon transition · Old industrial regions · Regional development · Regional innovation systems

1 Introduction

In recent decades, the regional innovation systems (RIS) approach has arguably offered one of the most influential and comprehensive frameworks with which to analyze the innovative capacity of regions (Asheim and Gertler 2005; Doloreux

L. Coenen (✉) · S. Campbell · J. Wiseman
Melbourne Sustainable Society Institute (MSSI), University of Melbourne, Melbourne, Australia
e-mail: lars.coenen@unimelb.edu.au

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_10

2002). The approach has been developed in close interaction with the policy-making process, and widely used as a framework for the design, implementation and evaluation of innovation-based regional development policies in a variety of countries and regions. It provides an umbrella framework that synthesizes notions, ideas, insights and lessons from a range of studies and literatures that deal with innovation in a regional context (Doloreux 2002)—including (among others) various agglomeration theories on regional clusters and industrial districts, as well as institutional theory and, most recently, evolutionary economic geography (EEG).

Typically, RIS studies have been carried out by 'mapping' the core elements and mechanisms of a system along two dimensions (Cooke et al. 1998). Firstly, relevant firms and organizations in the RIS are identified, along with as their knowledge linkages and networks. In addition, important locational advantages (or the lack thereof) are analyzed to determine the role played by proximity within the innovation system (Boschma 2005). Secondly, an analysis is carried out of the governance system that underpins the coordination and decision-making processes for innovation. This identifies the role played by various institutions in the innovation system, as well as in the policy environment. It considers, among other things, the administrative, financial and legal framework, the role of the public sector, and specific regional cultural commonalities.

In part due to the evolutionary turn in economic geography, recent theoretical advancements in the RIS literature have addressed the criticism that the approach is primarily geared to providing static snapshots of a region's innovation system. Insights and concepts borrowed from EEG (e.g. Boschma and Martin 2010) have enabled a deeper understanding of the inherently historically-shaped factors and conditions that influence regional development and RIS. Drawing on the evolutionary notion of path dependence, recent RIS research has identified different types of regional industrial development pathways conceptualized as path extension, path renewal and path creation (Isaksen 2014; Trippl et al. 2015; Coenen et al. 2017).

Nevertheless, Asheim et al. (2016) observe that much of the RIS literature has ignored transformative dynamics at the system level, and argue that a better understanding of the processes and mechanisms that drive transformative change remain a core issue for future research. Within the policy domain, the OECD (2015) observes that "by and large, most innovation policies aim to foster incremental change; fostering wider system change is a new challenge for innovation policy makers, especially as many of the actions will fall in areas outside the direct remit of research ministries or innovation agencies but where their input, coordination and implementation actions will remain critical" (p. 9). This challenge, in turn, requires so-called 'system innovation policy', understood as "a horizontal policy approach that mobilises technology, market mechanisms, regulations and social innovations to solve complex societal problems in a set of interacting or interdependent components that form a whole socio-technical system" (OECD 2015, p. 7).

Following RIS' pragmatist rationale in embracing strategic problem-solving, Asheim et al. (2016) suggest extending the traditional market and system failures, to include transformational system failures as heuristics for identifying and analyzing transformative dynamics. Broadly, these failures relate to directionality, demand articulation, reflexivity and policy coordination (Weber and Rohracher 2012). This new orientation paves the way for new and original research in RIS as it extends its perspective from a supply-side bias (Marques 2011) to include demand-side aspects (Martin 2016). Even more importantly, incorporation of such failure types hone in on the often understudied process and politics of (innovation) policymaking (Coenen et al. 2015a, b). However, relatively little empirical research has been conducted to date on such transformational system failures in a RIS context.

Studies on old industrial regions therefore provide a potentially useful empirical entry point into the theoretical discussion on RIS and transformative dynamics. Old industrial regions are typically specialized in mature technologies and industries experiencing decline, thus facing various types of lock-in (detailed below). Innovation activities in these regions often follow mature technological trajectories of an incremental character. Policy support is therefore needed to help transition old industrial regions into new pathways by means of disruptive path-breaking innovation and technological change (Coenen et al. 2015a, b). This has proven to be easier said than done. Even though regional actors (including policy-makers) are aware of the challenges to break out of the old industrial region 'mould', they are often struggling to find ways and practices to effectively do so. This is because the region and its industries are nested within a broader process of industrial transformation and institutional adaptation.

In this chapter, we focus on a particular kind of old industrial region facing transformative change, namely coal regions. Reducing greenhouse gas emissions at the speed and scale required to achieve the Paris Agreement goals will require rapid and fundamental transformation of current economic and social structures. The required transition away from reliance on coal and other fossil fuel-based energy sources towards renewable energy sources obviously has significant implications for those regions that are economically reliant on coal mining and specialized in coal-based energy and industry (Hudson 2005). Coal regions thus provide salient empirical case studies offering insights into transformative dynamics in RIS. Within this context, the aim of this chapter is to better understand the processes that drive transformative change in coal regions and to identify relevant RIS policy implications. To do so, the chapter draws on empirical analysis of two coal regions—namely Germany's Ruhr and Australia's Latrobe Valley. It should however be noted that the study has not been conducted in a systematically comparative way—this is partly because in the Ruhr the transition away from coal has largely taken place, while the one in Latrobe Valley has only recently begun.

In the remainder of the chapter we first outline the RIS framework (with a particular focus on RIS policy), followed by empirical case studies of the Ruhr and Latrobe Valley respectively. The next section will proceed with a discussion of the implications for RIS policy dealing with transformative change, before concluding the paper and providing suggestions for future research.

2 RIS and Systemic Innovation Policy

In the innovation systems literature that emerged during the early 1990s, the RIS approach has to date been most explicitly concerned with spatial dimensions of innovation and innovation-based regional development policies (Asheim and Gertler 2005; Asheim and Isaksen 2002; Braczyk et al. 1998; Cooke et al. 2004; Lundvall and Borrás 1997). This approach is based on the notion that regional competitiveness in a globalizing knowledge-based economy depends upon a region's ability to continuously and collectively recombine and exploit knowledge, including instances where innovations emerge when existing knowledge is reconfigured into new combinations in local contexts. According to Cooke et al. (2004), a RIS 'consists of interacting knowledge exploration and exploitation sub-systems linked to global, national and other RIS for commercialising new knowledge'. By emphasizing the interplay of knowledge exploration and exploitation, Cooke et al. (2004) stresses the centrality of interactions between industry and organisations involved in knowledge exploration, such as universities and research centres. Later developments within RIS literature have increasingly emphasised the importance of inter-industry dynamics and, correspondingly, how policy should support horizontal linkages (Cooke et al. 2007) based on the recognition that 'old' knowledge and technology from other sectors may be as important for innovation as 'new' knowledge and technology from within a sector or from academia (Asheim et al. 2011a).

The systemic perspective implies that RIS can be conceptualized in terms of (a) system components, (b) system linkages and (c) system boundaries (Asheim et al. 2011b). The system components refer to the private and public organisations involved in innovation processes, as well as to the institutions guiding their behaviour. System linkages refer to the relationships between the components which are part of a localized innovation network that allows for interactive learning to take place (Cooke 1998). The boundaries of the RIS draw attention to the demarcation, overlap and relationships between extra-regional actors, networks and institutions. For many years, industrial clusters have been very influential in the theoretical development of RIS, which also influenced the policy implications of RIS. Regarding policy, RIS has also drawn substantially from insights and lessons derived from a systems perspective on innovation, firstly pioneered within National Innovation Systems (NIS) but shortly after extended to RIS.

To a large extent, RIS follows the rationale for policy support in systemic approaches to innovation, which is to address system failures (Laranja et al. 2008). A system perspective on innovation goes beyond the neoclassical economic rationale that policy intervention is only legitimate and required in response to market failures resulting from sub-optimal resource allocation by firms. Rather, it builds on the notion that innovation processes are social learning processes that take place in a context of networks and institutions, and which can proactively influence the innovation capacity of firms, regions and nations. This implies that public intervention is legitimate and necessary not only if the complex interactions that take place among the different organisations and institutions involved in innovation do not function effectively, but also even in the absence of failure to promote a dynamic, innovation-based competitiveness trajectory, or what is often referred to as a 'high road strategy' of competition. This perspective is also emphasised in the constructed regional advantage approach—an important policy concept derived from RIS theory and empirics (Asheim et al. 2011a, b). What is especially highlighted here is the role of a proactive public-private partnerships and the impact of the public sector and public policy support, by acknowledging to a greater extent the importance of institutional complementarities in knowledge economies. This approach represents an improved understanding of key regional development challenges, as well as a better anticipation and response by addressing system failures in regional innovation systems.

Various authors (e.g. Klein Woolthuis et al. 2005; Smith 1998; Weber and Rohracher 2012) have identified a number of structural system failures that inform and shape system-oriented public policy support for innovation. These include:

- *Capabilities' failure*: The lack of appropriate competencies and resources at the firm and organisational level limiting and/or preventing the generation of, access to and exploitation of knowledge.
- *Infrastructural failure*: Lack of physical and knowledge infrastructure due to large scale, long time horizon of operation and ultimately too low return on investment for private investors.
- *Hard institutional failure*: Absence, excess or shortcomings of formal institutions such as laws, regulations and standards (in particular regarding IPR and investment).
- *Soft institutional failure*: Lack of informal institutions such as social norms and values, culture, entrepreneurial spirit, trust and risk-taking that impede collaboration for innovation.
- *Strong network failures*: Intensive cooperation in closely tied networks leading to myopia and a lack of infusion of new ideas.
- *Weak network failures*: Too limited interaction and knowledge exchange with other actors inhibiting the exploitation of complementary sources of knowledge and processes of interactive learning.

One of the main contributions of the RIS approach has been to specify what type of innovation support and policy best fit and are needed to address specific regional characteristics and challenges. There is no single permanent 'best practice' policy or mix of policy instruments available for every situation, as regions and nations are very different. Instruments and policy systems must therefore be context-specific and adapted to the particular needs and bottlenecks local firm and regional circumstances.

The systemic perspective in the RIS approach has been translated to an operational level by focusing on instrument mixes or 'policy mixes' (Flanagan et al. 2011) that combine different types of measures. This mix can be conceptualized in different ways. Borrás and Edquist (2013) suggest a classic mix of regulatory instruments, economic and financial instruments and soft instruments, following the popular distinction between ‘sticks’, ‘carrots’ and ‘sermons’ of public policy instruments (Bemelmans-Videc et al. 2003). However, while a focus on instrument mixes has received considerable attention from policymakers in recent years, most innovation policy efforts are *de facto* limited to enhancing levels of public and/or private R&D expenditures (Borrás and Edquist 2013). Nauwelaers and Wintjes (2002) have arrived at a similar conclusion based on their review of regional innovation policies in Europe, where they find that most policies constitute resource-focused individual firm support in the form of R&D subsidies, rather than policy instruments selected in response to the actual problems identified in the innovation system. As such, it seems that considerable challenges remain to translate RIS theory to policy practice.

3 The Ruhr Valley

An illuminating example of a coal region that successfully transformed and diversified into a low-carbon development path can be found in Germany’s Ruhr region. The Ruhr Valley of northwestern Germany has been a centre of European coal (and steel) production since the mid-1800s. At their peak in 1956, the coal mines of the Ruhr produced 124 million tonnes of coal, employing almost half a million people (Hospers 2004). Due to the rise of oil as an alternative fuel to coal, cheap coal imports from countries such as the US and the increasing availability of less costly steel on the global market during the 1960s and 1970s, the Ruhr’s core industries—coal, steel and related industries—began to contract, and the region experienced sharp industrial decline and rising unemployment. By the 1990s, about two-thirds of the jobs in these industries no longer existed. At the same time, environmental conditions suffered severely as a result of the air and water pollution from the heavy industry, leading Willy Brandt (who would become one of West Germany’s most famous Chancellors) to declare that ‘the sky above the Ruhr must turn blue again’.

According to Hospers (2004), policy responses to the Ruhr’s challenges since the 1960s can be divided in two categories: re-industrialisation and neo-industrialisation. The former prevailed largely as an initial response during the 1960s and 1970s. This response unfolded against a degree of denial of change in the region and a belief that ‘the good days would return’. To improve competitiveness, core industry cooperation increased and lead to several mergers between former competitors and closer linkages with customers and suppliers. Public policy support and investment was mainly directed to infrastructure—especially intraregional and interregional public transport systems and roads, yet also establishing new organisations of higher learning, universities and technical institutes where none has existed before. Despite these efforts to remain competitive, many mines and plants were still forced to close, albeit in a relatively controlled and coordinated manner through the provision of wage subsidies, compensation payments or early retirement (Stroud et al. 2014). Local government also tried to attract inward investment in large-scale de-novo industries such as micro-electronics, cars and chemicals. Partly due to the resistance from vested industrial interests in the region, these government economic restructuring initiatives failed. As documented in Hospers (2004), the reaction of a famous industrial leader Gustav Krupp to the establishment of higher education in the Ruhr was telling: “What we need in the Ruhr are muscles, not brains” (p. 151).

In 1984, the State of North-Rhine Westphalia shifted its response towards neo-industrialisation via a more pro-active industrial policy and developed a program aimed at “sunrise technologies”, with a focus on environmental and renewable energy technology. Due to the massive amounts of energy resources needed and waste produced by the coal and steel plants, innovation in the field of energy efficiency, renewable resources, recycling and waste combustion was emphasised in the Ruhr relatively early compared to other regions in the world. This regional knowledge base, though for many years ‘hidden’ within the coal and steel industry, ultimately provided the resource base from which new industrial paths emerged. Moreover, state-led environmental protection policies supported the transformation of “the largest contributors to problems in the Ruhr district into problem solvers” (Kilper et al. 1996, p. 15). Today, the Ruhr has become one of the key centres for environmental industry, technology and research in Germany (Schepelmann et al. 2013). Local firms, universities, research institutes (e.g. the Soil Protection Centre and the Environmental and Packaging R&D Centre) and environmental agencies cooperate closely. Former mines and steel factories are currently used for tourist purposes (to preserve and exhibit ‘industrial culture’), with Zollverein, formerly one of Europe’s largest industrial coal complexes, now a UNESCO World Heritages Site and regional museum of the Ruhr area.

The state government has been central to the process of shaping these regeneration strategies, acting in partnership with municipalities, universities and private actors. The way that the neo-industrialisation approach towards structural change was organised departed significantly from previous approaches. The late 1980s and 1990s witnessed the beginning of new bottom-up development approaches, guided by regional planning and key State (Land) institutions, but designed and implemented by local groups. The renewal from within approach was organized in close dialogue with, and met with approval from, the local community.

An innovative approach was offered by the Emscher River International Building Exhibition (IBA)—with the official subtitle ‘Workshop for the Future of Old Industrial Regions’. From the early 1900s, the Emscher River had become a wastewater open sewer for local industry and households. It was considered the country’s most polluted river and in the 1980s, characterized by vacant factories, closed mines and abandoned docks, sinking ground, and heaps of mining residues and dams (Schepelmann et al. 2013). Established by the Ministry of Urban Development, Housing and Transport for the State of Northrine-Westfalia, the IBA’s aim was “to be an answer to the complex economic, social and ecological problems of the Emscher sub-region and secondly, an attempt to give an internationally recognized example of state-led economic, social and ecological restructuring of old industrial areas” (Danielzyk and Wood 2006, p. 133). The initiative lasted from 1989 to 1999 and invited proposals from all sectors, including municipalities, companies, lobby groups and individuals, to address five themes for restructuring:

the renovation of the Emscher landscape into parkland, ecological regeneration of the Emscher River system, development of new work sites in derelict industrial sites, development of new housing forms and districts, and new uses for industrial buildings and monuments.

However, while the IBA is often associated with the restructuring of the Ruhr (Hospers 2004), it would be naïve to view its role as a silver bullet. As Shaw (2002) notes, it failed to deliver on a number of objectives. The first is direct job creation, with the pronounced focus of the IBA on supporting activities in culture, tourism and recreation failing to compensate for the job losses from traditional industries. The Emscher region remains well above national unemployment average. Shaw (2002) also highlights the failure to encourage environmentally sound products and production methods in the region, principally to a lack of investors. Both failures should, however, be viewed in terms of immediate direct outcomes of the program, as with respect to longer-term and indirect impacts the IBA has played a significant role for job creation and green industry build-up.

The approach implemented in the IBA initiative has informed the design, implementation and testing of institutional innovation for renewal. Over 10 years, 123 cooperative projects were implemented, varying from the setting up of technology centres to the renovation of apartments and the restoration of industrial monuments for tourist purposes. It is however this very role of providing a local and inclusive participation framework—combined with top-down quality control in contrast to previously more centralized policy and governance approaches—that constitutes the success of the IBA initiative in restructuring the Ruhr. First and foremost, the IBA provided an organizational form for dialogue and collaboration between stakeholders that lead to the inception of "regional development coalitions", i.e. bottom-up, horizontally based co-operation between different actors in a local or regional setting based on a socially broad mobilization and participation of human agency (Asheim 2001). The establishment of such regional development coalitions has been an important foundation for the development of new industries in the Ruhr via related diversification processes.

4 The Latrobe Valley[1]

Australia's Latrobe Valley is located in the state of Victoria, approximately 150 km east of the state capital of Melbourne, in a region called Gippsland that is approximately the size of the Netherlands. The Latrobe Valley is situated on one of the world's largest brown coal reserves, including 93% of Australia's reserves (Geoscience Australia 2016). These lignite reserves are mined from three open-cut mines—Yallourn, Hazelwood and Loy Yang—and are used almost entirely for baseload electricity generation for domestic use, with the Latrobe Valley supplying more than 90% of Victoria's electricity needs (Latrobe City Council 2016).

[1]This section draws on Wiseman et al. (2017).

The Victorian government designated the region as a centre of electricity production in the 1920s, when it founded wholly state-owned power stations adjacent to the Valley's coal reserves. The combustion techniques, briquette technology and adjacent power station model employed in Germany to utilise lignite coal were studied and brought to the Valley (Heritage Council of Victoria 2008). The Victorian Government established a State Electricity Management Commission (SECV) whose mandate included managing Victorian electricity generation and supply, and developing its brown coal reserves (*Ibid.*) In the following decades, coal-fired electricity generation formed a central part of the SECV and state government's industrial and employment strategy in the Valley. As production and employment grew, subsidized housing, regulated wages, unionized workplaces and state-provided social infrastructure combined to create a prosperous region (Weller 2012). By 1981, mining and electricity generation in the Valley employed a largely male workforce of over 10,000 employees (Eklund 2017). In addition, ancillary industries had developed in the manufacturing and services sectors throughout the 1970s (Cameron and Gibson 2005). The region enjoyed periods of rapid economic growth and full employment, and the SECV was known for providing secure, reliable and often career-long jobs (Weller et al. 2011; Fairbrother and Testi 2002). During the 1980s and 1990s, however, Australia transitioned from a protectionist to open economy, with both Coalition and Labour governments at the state and national level consistently supporting economic rationalism or neoliberalism (Baer 2016).

In 1994, in line with a neoliberal agenda, the Victorian government announced that the SECV would be disaggregated and the coal mines and power stations privatised (Cameron and Gibson 2005). By the end of privatisation, approximately 8000 workers had lost their jobs and the Valley had become the most disadvantaged region in Victoria, with full-time employment in the region falling by 9% between 1994 and 2001 and a large increase in migration from the region occurring as job-seekers searched for alternative work (Tomaney and Somerville 2010; Giurco et al. 2011; Weller et al. 2011). Since privatisation, a series of government statements and plans have been developed, with the aim of re-positioning the Valley and decreasing the region's high dependence on the electricity and resources sectors.[2] However, despite some diversification (into the community services and retail sectors in particular), these initiatives have had limited success and the regional economy has remained dominated by the electricity generation sector, leaving it vulnerable to the anticipated power station closures (Weller et al. 2011). Cameron and Gibson (2005) note that the dominant economic development approach was to seek replacement by large-scale industries—including attempts to attract call centres, food processing, magnesium smelters and industry parks—to

[2]These include the Latrobe Valley Ministerial Taskforce, established by the Victorian Government in 2000; The Latrobe Economic Development Strategy 2004–2008; Latrobe 2021—The Vision for Latrobe Valley, by the Latrobe City Council; and The Latrobe Valley Industry and Employment Roadmap in 2012 by the Victorian Government.

locate in the region. The failure of such an approach is epitomised in the attempt to attract National Foods, which opened a diary processing plant in the Valley in 1996–1997 and received approximately $1.5 million in incentives from the Council, promising the creation of 700 new jobs and ultimately providing only 120—many of which were filled by inter-state transfer from other closures (*Ibid.*)

More recently, the need for regional industrial diversification and policies and plans that change the development pathway of the regional economy of this coal region has become highly acute with closure of the Hazelwood power plant. Prior to its closure in 2017, Hazelwood was one of the oldest coal-fired power stations in Australia, with its oldest units aged 52 years' old and its newest, 42 years (Colebatch 2017). Given its high emissions intensity, Hazelwood was known as "Australia's dirtiest power station", responsible for an estimated 16 million tonnes of pollution per year (Jotzo and Mazouz 2015). Several changes in re-branding and share ownership of Hazelwood Power Partnership have occurred since privatisation, with the majority owners since 2012 being French multinational Engie (formerly GDF Suez) holding a 72% share, and Japanese multinational Mitsui the remaining 28% (Engie 2017). On the 3rd November 2016, Engie announced that it had decided to close the power station permanently on the 31st March, 2017 (Engie 2016). This announcement provided only 5 months' notice for workers and the community. Engie consistently emphasised that its decision was made on a commercial basis. It cited a difficult national energy market environment and the large costs required to ensure continued safe and viable operation (*Ibid.*)

On the 3rd November, the day of the closure announcement, the Federal Government announced a $43 million package to be provided by the Commonwealth Government to assist workers affected by Hazelwood's closure (Australian Department of Environment and Energy 2016). This included $20 million to support local infrastructure, a $3 million labour market structural adjustment package—including re-training, active job-seeking assistance and other support—and $20 million as part of Regional Jobs and Investment Package, focused on local job creation, diversifying the regional economy and building a highly-skilled workforce via projects determined by community input.

The State Government promised an additional $224 million of funding, bringing the Victorian Government's support package to a value of $266 million and making it the largest regional development project ever announced by a Victorian government (Baxendale 2016; ABC 2016). The $224 million funding package was intended to create jobs in the region and encourage local business growth through the establishment of an Economic Growth Zone. The package consisted of two major components—a $50 million Economic Growth Zone to encourage businesses to re-locate to the Valley via financial incentives such as stamp duty concessions and fee reimbursements and $174 million for a Community Infrastructure & Investment Fund to finance local infrastructure projects such as road, rail, school upgrades, and the construction of health facilities (Andrews 2016; Gordon and Preiss 2016).

The Latrobe Valley experience provides an example of the negative consequences arising from the failure to adequately and proactively plan for long-term shifts away from coal based industries and employment. Structural transformation and regional renewal processes had not been adequately considered before the announcement of Hazelwood's closure. One of the key aspects of the debate has been focused on energy security and affordability with both business and much of the mainstream media emphasizing the potential impact of Hazelwood's closure on household electricity prices and energy security.

Most policy options considered have been reactive and transactional rather than proactive and transformational. The proactive and inclusive conversations between all regional actors that should take place prior to 'the crisis hitting' have generally not occurred. In response, worker and community anxiety has been heightened and there has been significant resistance to the closure—with some politicians and business groups still raising the possibility of a last-minute intervention just days before the closure, further exacerbating uncertainty. The reactive and often acrimonious public debate created considerable fear and polarisation in some sections of the community. It also led to criticism of the Victorian government's role in bringing forward the Hazelwood closure, despite the fact that this was primarily a commercial decision made by a private, foreign-owned, multinational company.

5 Discussion: Implications for RIS Policy Facing Transformative Change

The challenges for coal regions are in many ways similar to those of old industrial regions. Like many old industrial regions, the development pathways of coal regions are locked-in through interconnected and co-evolving processes of path-dependency (Hassink 2010; Tödtling and Trippl 2005). Lock-in becomes problematic when path-dependency steers a region to deep specialization in long-established technologies and industries with little scope for further economic exploitation of knowledge while, often simultaneously, curtailing efforts by novel industries or technologies to emerge and develop.

Grabher (1993) highlights the multi-dimensionality of regional lock-in by distinguishing between three types of interrelated lock-in; functional, cognitive and political, noting that regional lock-in results from the interplay between these three types of lock-in. Functional lock-in refers to how overly strong and often hierarchical inter-firm networks in declining industries tend to block the development of alternative linkages and reorientations in the value chain. Cognitive lock-in refers to how a common world-view or mindset among actors reinforces 'group-think' and precludes the creativity and imagination necessary for the development of new ideas. Political lock-in is related to the existence of dense relationships between public and private sectors that aim at preserving traditional industrial structures, thus hampering alternative directions for industrial development (Grabher 1993; Underthun et al. 2014).

Hassink (2010, p. 455) has helped to further operationalize Grabher's categories by suggesting a set of economic-structural and political-institutional impact factors. Drawing on this framework, it is clear that both the Ruhr and the Latrobe Valley display similar ‘old industrial region’ challenges. Moreover, our analysis shows that these challenges can be further specified into three characteristics of coal regions:

1. A marked industrial mono-structure centered around the coal industry, characterized by high capital-intensity, high entry and exit barriers, above average company size, oligopolistic market structure, and influential trade unions.
2. Dense actor-networks at the regional level, consisting of local, regional policymakers, captains of industry, regional trade unionists, and representatives of industry associations that are strongly focused on the coal industry and hence weakly on external relations.
3. National and supra-national institutions that strongly affect the policy conditions relevant to the leading industry (e.g. in industrial development and energy).

The above examples of the Ruhr and Latrobe Valley coal regions illustrate three interrelated challenges for the RIS approach and policies when addressing transformative change. The first concerns changing the direction of key regional development pathways. Due to lock-in, regional innovation and development strategies tend to be primarily based on path-extension driven by the core competences and vested interests of established actors (Isaksen 2014). This tendency for path-extension explains the delay (in the case of the Ruhr) or ambivalence (in the case of the Latrobe Valley) in recognising and responding to the crisis. Secondly, the two cases demonstrate coal regions suffering from weak regional capabilities in entrepreneurship, as not only is the regional industry characterized by a mono-structure based on the production chains of the leading (coal) industry, but there is little opportunity for new start-ups and entrants in the region. Moreover, there tends to be little entrepreneurship in the local research environment, educational facilities, and public administration, and marginal appetite for risk-taking, whether in the economic or political sphere. This results in ossified industrial and political institutions. Thirdly, the contested nature of coal mining and burning in light of climate change has amplified the risk of distrust and antagonism between different actors within the regional innovation system. The political nature of the low-carbon energy transition easily results in entrenched positions that make it difficult for the actors in the innovation system to collaborate, coordinate collective action or engage in reciprocal learning processes.

So, what are the policy implications of such challenges? What type of policy support does a coal region’s innovation system require? While much research on old industrial regions has led to a solid understanding of the troublesome conditions for innovation in such regions and its consequent challenges for renewal and revitalization, policy advice and analyses of initiatives that seek to facilitate such renewal are much less developed. Undoubtedly, this is a daunting task as ‘the capacity of a region to transform the whole regional innovation system turns out to be the decisive factor for renewal processes’ (Trippl and Otto 2009, p. 1231).

Indeed, in line with Trippl and Otto (2009), it can be argued that the challenges of directionality, entrepreneurship and trust address some of the essential underpinnings of the RIS approach. How to design systemic regional innovation strategies and policies if there is no viable innovation system to work with in the first place? This may call for a very different policy approach than the one that is usually advocated in RIS—to address the systemic problems of the innovation system (Tödtling and Trippl 2005; Coenen et al. 2017). Rather, an approach that aims to change institutions and involve new actors, rather than to reinforcing existing institutional arrangements and actor positions, is required. To this end, Frenken (2016) has argued for temporary or 'pop-up' innovation systems. Indeed, the Emscher IBA can be conceived as such a temporary innovation system that contributed to the development of more permanent innovation system structures in the region. Similarly, renewal of the Latrobe Valley is currently hampered due to a lack of effective innovation system governance structures and thus little absorptive and leverage capacity for the public policy investments made in the region in response to the coal crisis.

According to Frenken (2016), such temporary innovation systems can take many forms, including urban innovation programs, sectoral voluntary agreements, monitoring and labelling instruments, social enterprises, government task forces, citizen movements, online communities, and many others. What essentiality is at stake here is experimentation with a plurality of governance structures in a variety of technological, institutional and political contexts in which such "pop-up" innovation systems emerge. Through the notion of entrepreneurial discovery, the role of experimentation is also increasingly recognized in the European Union's burgeoning smart specialization policy framework. Entrepreneurial discovery is more than 'taking a technology to the market' (Sotarauta and Pulkkinen 2011), as it involves linking knowledge and its societal use. Rather than a straightforward discovery, it is better understood as a trial-and-error process in which existing knowledge is used and combined, new knowledge is created, suitable routines are elaborated upon, market opportunities are screened and combinations of knowledge, routines, and markets are tested and continually adapted (Benner 2013).

Experimentation can thus be understood as an iterative construction process where networks of distributed actors jointly develop knowledge, create new market segments and user profiles, adapt regulations, lobby for subsidies, or define new technical standards—ultimately creating the conducive environment that helps a new product, process or indeed an entire industry to develop and mature (Garud and Karnøe 2003; Garud et al. 2010). This involves institutional entrepreneurship whereby actors break with the existing institutionalised rules and practices associated with the dominant institutional logics, and institutionalise the alternative rules, practices or logics that they are championing (Battilana 2006; Garud et al. 2007).

This focus on experiments and experimentation helps to explain some key features of contemporary regional innovation policies—notably the ways that they are delivered through projects understood as temporary inter-organizational arrangements. At first glance, the project-based organisation of many (if not most) regional innovation policies may not align well with objectives for structural renewal of a regional economy. How can such relatively short-term and small-size arrangements leverage impact at a systemic and aggregate level? Surely policy reform may offer greater purchase in this respect? It would be naïve to assume that such policy-induced projects offer optimum conditions for firms and other stakeholders to engage in risky and unruly activities related to innovation. However, it would be more viable to conceive of the plethora of innovation projects that are planned, resourced and implemented through regional innovation policies as governance experiments.

In such governance experiments, innovation projects in real-life contexts are seen to be critical, by bringing together actors from a variety of environments in shared networking and learning activities. In these experiments, firms, research institutes, universities and governments search and explore the best possible combinations of innovations and their social and institutional embedding (Bulkeley and Castán Broto 2013). As such these innovation projects act as pop-up innovation systems that explore, examine, experiment, test and evaluate the feasibility of new technologies and institutional arrangements, whether they are workable solutions to given problems and can create sufficient demand.

6 Conclusions

By examining more closely the structural change processes of coal regions against a context of unfolding transitions to a low-carbon future, this chapter has aimed to better understand the implications of transformative change for RIS research and policy. The case studies of German's Ruhr and Australia's Latrobe Valley have demonstrated the challenges to implementing regional innovation policies under conditions of fundamental uncertainty—there is simply no substantial innovation system at the regional scale to begin with.

In the absence of such structures and institutions, there is first and foremost a need for organisational and institutional innovation to arrive at working configurations of actors, networks and institutions that could act as proto or pop-up innovation systems. These processes are by their nature experimental (Asheim et al. 2016). This chapter has tried to shed some light on how to approach such processes. It argues for explicitly acknowledging the experimental nature of RIS policy and for conceptualising RIS policy as governance experiments. While the concept of governance experiments is conceived in the debate on urban climate governance, it is probably fair to also apply the term to RIS policy. A closer reading of the Triple-Helix literature[3], which has been very influential in the debate on RIS governance, also points to the creation of new institutional configurations and actor networks.

[3]Beyond straightforward university-business-government interactions.

Acknowledging the experimental nature of RIS policy can be difficult to legitimise, as governments may have their own stake in supporting existing institutional arrangements or be subject to strong lobby pressure by incumbent actors, and are generally reluctant to experiment with new rules and regulations (Bugge et al. 2017). With reference to the above cases, it seems also that regions may vary in their preconditions for and capabilities to carry out regional innovation policies as governance experiments.

Typically, a RIS in coordinated market economies (more typical of German regions or regions in the Nordic countries) is characterised by the positive effects of systemic relationships between the production structure and the knowledge infrastructure embedded in networking governance structures regionally and supporting regulatory and institutional frameworks on the national level. In contrast, a RIS in liberal market economies (found in the US, UK and other Anglo-American economies) lacks these strong systemic elements, and instead sources its dynamism from local venture capital, entrepreneurs, scientists, market demand and incubators. Such a system will, of course, be more flexible and adjustable and thus will not run the same risk of ending up in 'lock-in' situations as traditional RIS caught in path-dependency on old technological trajectories. On the other hand, RIS in liberal market economies do not seem to have the same long-term stability, slack capacity and systemic support for cross-sector collaboration and coordination, raising important questions about their long-term resilience in the face of potentially disruptive economic, social and environmental change.

In light of the large-scale adoption and mainstreaming of RIS policy in Europe under the banner of Smart Specialisation Strategies (Morgan 2017), there is an opportunity to study and compare how RIS are being constructed at an unprecedented scale and scope. Here, there is a need to better understand the design and practice of RIS policies as governance experiments in different contexts—for example, across coordinated and liberal market economies. An important area for future research will be to further unpack the notion of experimentation and the variety of ways it is being articulated (Ansell and Bartenberger 2016). RIS researchers are obviously very well-positioned to undertake this dual role of both designing and evaluating different institutional and governance arrangements to support regional innovation and transformation. In this task, Bjørn has been a highly inspiring role-model providing critical thought leadership and intellectual guidance.

Acknowledgments The authors gratefully acknowledge financial support provided by the project *Coal Transitions: Research and Dialogue on the Future of Coal* led by IDDRI (Paris) and Climate Strategies (London).

References

Andrews, D. (2016, November 4). Economic growth zone to boost Latrobe Valley business – Media release.

Ansell, C., & Bartenberger, M. (2016). Varieties of experimentalism. *Ecological Economics, 130*, 64–73.

Asheim, B. T. (2001). Learning regions as development coalitions: Partnership as governance in European workfare states? *Concepts and transformation, 6*(1), 73–101.

Asheim, B. T., & Gertler, M. (2005). The geography of innovation – Regional innovation systems. In J. Fagerberg, D. C. Mowery, & R. R. Nelson (Eds.), *The Oxford handbook of innovation*. Oxford: Oxford University Press.

Asheim, B. T., & Isaksen, A. (2002). Regional innovation systems. The integration of local 'sticky' and global 'ubiquitous' knowledge. *Journal of Technology Transfer, 27*, 77–86.

Asheim, B. T., Boschma, R., & Cooke, P. (2011a). Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies, 45*, 893–904.

Asheim, B. T., Lawton Smith, H., & Oughton, C. (2011b). Regional innovation systems: Theory, empirics and policy. *Special Issue of Regional Studies, 45*, 875–891.

Asheim, B., Grillitsch, M., & Trippl, M. (2016). Regional innovation systems: Past – present – future. In R. Shearmur, C. Carrincazeaux, & D. Doloreux (Eds.), *Handbook of geographies of innovation* (pp. 45–46). Cheltenham: Edward Elgar.

Australian Broadcasting Corporation. (2016, November 4). Hazelwood closure: Special economic zone to be established for Latrobe Valley. Accessed June 16, 2017, from http://www.abc.net.au/news/2016-11-04/hazelwood-closure-prompts-economic-package-for-latrobe-valley/7994718

Australian Department of Environment and Energy. (2016, November 3). Media release: Government to support hazelwood workers. Accessed August 28, 2017, from http://www.environment.gov.au/minister/frydenberg/media-releases/pubs/mr20161103.pdf

Baer, H. A. (2016). The nexus of the coal industry and the state in Australia: Historical dimensions and contemporary challenges. *Energy Policy, 99*, 194–202.

Battilana, J. (2006). Agency and institutions: The enabling role of individuals' social position. *Organization, 13*, 653–676. https://doi.org/10.1177/1350508406067008

Baxendale, R. (2016, November 4). Hazelwood closure bad news for Victoria warns Josh Frydenberg. *The Australian*. Accessed 19 July, 2017, from http://www.theaustralian.com.au/national-affairs/hazelwood-closure-bad-news-for-victoria-warns-josh-frydenberg/news-story/5ae3e0948f229894e71d28aa822f3a92

Bemelmans-Videc, M.-L., Rist, R. C., & Vedung, E. (2003). *Carrots, sticks and sermons: Policy instruments and their evaluation*. New Brunswick, NJ: Transaction Publishers.

Benner, M. (2013). From smart specialisation to smart experimentation: Towards a new theoretical framework for EU regional policy. *SPACES online*, Vol. 11, Issue 2013-04. Toronto and Heidelberg: www.spaces-online.com

Borrás, S., & Edquist, C. (2013). The choice of innovation policy instruments. *Technological Forecasting & Social Change, 80*, 1513–1522.

Boschma, R. (2005). Proximity and innovation: A critical assessment. *Regional Studies, 39*, 61–74.

Boschma, R., & Martin, R. (2010). *The handbook of evolutionary economic geography*. Cheltenham: Edward Elgar.

Braczyk, H.-J., Cooke, P., & Heidenreich, M. (1998). *Regional innovation systems: The role of governances in a globalized world*. London: UCL Press.

Bugge, M., Coenen, L., Marques, P., & Morgan, K. (2017). Governing system innovation: Assisted living experiments in the UK and Norway. *European Planning Studies, 25*, 1–19.

Bulkeley, H., & Castán Broto, V. (2013). Government by experiment? Global cities and the governing of climate change. *Transactions of the Institute of British Geographers, 38*, 361–375. https://doi.org/10.1111/j.1475-5661.2012.00535.x

Cameron, J., & Gibson, K. (2005). Alternative pathways to community and economic development: The Latrobe Valley community partnering project. *Geographical Research, 43*(3), 274–285.

Coenen, L., Hansen, T., & Rekers, J. V. (2015a). Innovation policy for grand challenges. An economic geography perspective. *Geography Compass, 9*(9), 483–496.

Coenen, L., Moodysson, J., & Martin, H. (2015b). Path renewal in old industrial regions: Possibilities and limitations for regional innovation policy. *Regional Studies, 49*, 850–865. https://doi.org/10.1080/00343404.2014.979321

Coenen, L., Asheim, B., Bugge, M. M., & Herstad, S. J. (2017). Advancing regional innovation systems: What does evolutionary economic geography bring to the policy table?. *Environment and Planning C: Politics and Space,* 35(4), 600–620.

Colebatch, T. (2017, March 28). Old coal, no new gas: How to generate an electricity crisis, National affairs. *Inside Story*.

Cooke, P. (1998). Introduction: Origins of the concept. In H. J. Braczyk, P. Cooke, & M. Heidenreich (Eds.), *Regional innovation systems: The role of governance in a globalized world* (pp. 2–25). London: UCL Press.

Cooke, P., Uranga, M. G., & Etxebarria, G. (1998). Regional systems of innovation: An evolutionary perspective. *Environment and Planning A, 30*, 1563–1584.

Cooke, P., Heidenreich, M., & Braczyk, H.-J. (2004). *Regional innovation systems: The role of governance in a globalized world*. London: UCL Press.

Cooke, P., Laurentis, C. D., Tödtling, F., et al. (2007). *Regional knowledge economies: Markets, clusters and innovation*. Cheltenham: Edward Elgar.

Danielzyk, R., & Wood, G. (2006). Innovative strategies of political regionalization: The case of North Rhine-Westphalia. *European Planning Studies, 12*(*2*), 191–207. https://doi.org/10.1080/0965431042000183932

Doloreux, D. (2002). What we should know about regional systems of innovation. *Technology in Society, 24*, 243–263.

Eklund. (2017, March 30). Hazelwood power station: From modernist icon to greenhouse pariah. *The Conversation*. Accessed April 10, 2017, from https://theconversation.com/hazelwood-power-station-from-modernist-icon-to-greenhouse-pariah-75217

Engie. (2016, November 3). Hazelwood to close in March 2017 – Media release. Accessed August 11, 2017, from http://www.gdfsuezau.com/media/UploadedDocuments/News/Hazelwood%20Clousure/Hazelwood%20closure%20-%20Media%20release.pdf

Engie. (2017). *History of Hazelwood*. Accessed August 11, 2017, from http://www.gdfsuezau.com/media/UploadedDocuments/Hazelwood%20Closure/History/Hazelwood%20History%20Brochure.pdf

Fairbrother, P., & Testi, J. (2002). The advent of multinational ownership of the Victorian electricity generating plants: Questions for labour. In P. Fairbrother, M. Paddon, & J. Teicher (Eds.), *Privatisation, globalisation and labour: Studies from Australia*. Annandale, NSW: The Federation Press, as cited in Cameron & Gibson (2005).

Flanagan, K., Uyarra, E., & Laranja, M. (2011). Reconceptualising the 'policy mix' for innovation. *Research Policy, 40*, 702–713.

Frenken, K. (2016). *A complexity-theoretic perspective on innovation policy*. Innovation Studies Utrecht (ISU) Working Paper Series, 16(01), 1–17.

Garud, R., & Karnøe, P. (2003). Bricolage versus breakthrough: Distributed and embedded agency in technology entrepreneurship. *Research Policy, 32*, 277–300.

Garud, R., Hardy, C., & Maguire, S. (2007). Institutional entrepreneurship as embedded agency: An introduction to the special issue. *Organization Studies, 28*, 957–969. https://doi.org/10.1177/0170840607078958

Garud, R., Kumaraswamy, A., & Karnøe, P. (2010). Path dependence or path creation. *Journal of Management Studies, 47*, 760–774. https://doi.org/10.1111/j.1467-6486.2009.00914.x

Geoscience Australia. (2016). Coal – summary. Accessed August 28, 2017, from http://www.ga.gov.au/aera/coal

Giurco, D., Cohen, B., Langham, E., & Warnken, M. (2011). Backcasting energy futures using industrial ecology. *Technological Forecasting & Social Change, 78*(2011), 797–818.

Gordon, J., & Preiss, B. (2016, November 4). Latrobe Valley set to gain $266 million rescue package. *The Age*. Accessed July 20, 2017, from http://www.theage.com.au/victoria/latrobe-valley-set-to-gain-266-million-rescue-package-20161103-gshhqe.html

Grabher, G. (1993). The weakness of strong ties: The lock-in of regional development in the Ruhr area. In G. Grabher (Ed.), *The embedded firm* (pp. 255–277). London: Routledge.

Hassink, R. (2010). Regional resilience: A promising concept to explain differences in regional economic adaptability? *Cambridge Journal of Regions Economy and Society, 3*, 45–58.

Heritage Council of Victoria. (2008). *Mining heritage study in Victoria,* Prepared by Jack Vines. Melbourne: Heritage Council of Victoria.

Hospers, G.-J. (2004). Restructuring Europe's rustbelt: The case of the German Ruhrgebiet. *Intereconomics*, *39*(*3*), 147–156.

Hudson, R. (2005). Rethinking change in old industrial regions: Reflecting on the experiences of North East England. *Environment and planning A, 37*(4), 581–596.

Isaksen, A. (2014). Industrial development in thin regions: Trapped in path extension? *Journal of Economic Geography, 15*(3), 585–600.

Jotzo, F., & Mazouz, S. (2015). Brown coal exit: A market mechanism for regulated closure of highly emissions intensive power stations. *Economic Analysis and Policy, 48*, 71–81.

Kilper, H., Lehner, F., Rehfeld, D., & Schmidt-Bleek, F. (1996). *Wegweiser in die Zukunft. Perspektiven und Konzepte für den Strukturwandel im Ruhrgebiet*. Essen: Klartext.

Klein Woolthuis, R., Lankhuizen, M., & Gilsing, V. (2005). A system failure framework for innovation policy design. *Technovation, 25*, 609–619.

Laranja, M., Uyarra, E., & Flanagan, K. (2008). Policies for science, technology and innovation: Translating rationales into regional policies in a multi-level setting. *Research Policy, 37*, 823–835.

Latrobe City Council. (2016, December). *A strength-led transition.* Accessed July 26, 2017, from www.latrobe.vic.gov.au/.../A_Strength_Led_Transition_-_Latrobe_City_Council_2016_-_low_res.pdf

Lundvall, B.-Å., & Borrás, S. (1997). *The globalising learning economy: Implications for innovation policy*. Brussels: DG XII, Commission of the European Union.

Marques, P. (2011). Theories and policies of innovation: A critical review. *Geography Compass, 5*, 838–850.

Martin, H. (2016). *Innovation for tackling grand challenges: Cleantech industry dynamics and regional context*. PhD thesis, Lund University, Sweden.

Morgan, K. (2017). Nurturing novelty: Regional innovation policy in the age of smart specialisation. *Environment and Planning C: Politics and Space, 35*(4), 569–583.

Nauwelaers, C., & Wintjes, R. (2002). Innovating SMEs and regions: The need for policy intelligence and interactive policies. *Technology Analysis and Strategic Management, 14*, 201–215. https://doi.org/10.1080/09537320220133866

OECD. (2015). *System innovation: Synthesis report*. Paris: OECD Publishing.

Schepelmann, P., Kemp, R., Klement, J., & Schneidewind, U. (2013). *The eco-restructuring of the ruhr area as an example of a managed transition*. Sustainability Transitions IST 2013 Conference, June 2013.

Shaw, R. (2002). The International Building Exhibition (IBA) Emscher Park, Germany: A model for sustainable restructuring? *European Planning Studies, 10*(*1*), 77–97. https://doi.org/10.1080/09654310120099272

Smith, K. (1998). What is 'basic science?' In E. Kallerud (Ed.), *Basic research in innovation and science policy* (pp. 79–96). Oslo: Norwegian Institute for Studies in Research and Higher Education, Report 9/98.

Sotarauta, M., & Pulkkinen, R. (2011). Institutional entrepreneurship for knowledge regions: In search of a fresh set of questions for regional innovation studies. *Environment and Planning C, 29*, 96–112. https://doi.org/10.1068/c1066r

Stroud, D., Fairbrother, P., Evans, C., & Blake, J. (2014). Skill development in the transition to a 'green economy': A 'varieties of capitalism' analysis. *The Economic and Labour Relations Review, 25*(1), 10–27.

Tödtling, F., & Trippl, M. (2005). One size fits all? Towards a differentiated regional innovation policy approach. *Research Policy, 34*, 1203–1219.

Tomaney, J., & Somerville, M. (2010). Climate change and regional identity in the Latrobe Valley, Victoria. *Australian Humanities Review, 49*, 29–47.

Trippl, M., & Otto, A. (2009). How to turn the fate of old industrial areas: A comparison of cluster-based renewal processes in Styria and the Saarland. *Environment and Planning A, 41*, 1217–1233.

Trippl, M., Asheim, B., & Miorner, J. (2015). Identification of regions with less developed research and innovation systems. CIRCLE Papers in Innovation Studies Paper no. 2015/1.

Underthun, A., Hildrum, J., Svare, H., Finsrud, H., & Vareide, K. (2014). The restructuring of the old industrial region of Grenland in Norway: Between lock-in, adjustment, and renewal. *Norsk Geografisk Tidskrift – Norwegian Journal of Geography, 68*, 121–132. https://doi.org/10.1080/00291951.2014.894566

Weber, K. M., & Rohracher, H. (2012). Legitimizing research, technology and innovation policies for transformative change – Combining insights from innovation systems and multi-level perspective in a comprehensive 'failures' framework. *Research Policy, 41*, 1037–1047.

Weller, S. A. (2012). The regional dimensions of the 'Transition to a low-carbon economy': The case of Australia's Latrobe valley. *Regional Studies, 46*(9), 1261–1272.

Weller, S., Sheehan, P., & Tomaney, J. (2011, November). *The regional effects of pricing carbon emissions: An adjustment strategy for the Latrobe Valley*. Final Report to Regional Development Victoria. Centre for Strategic Economic Studies, Victoria University.

Wiseman, J., Campbell, S., & Green, F. (2017). Prospects foer a "just transition" away from coal-fired power generation in Australia: Learning from the closure of the Hazelwood Power Station, CCEP Working Paper 1708, November 2017. Crawford School of Public Policy, Australian National University.

Part III

Regional Innovation Systems and Policy

Innovation Policies for Regional Structural Change: Combining Actor-Based and System-Based Strategies

Arne Isaksen, Franz Tödtling, and Michaela Trippl

Abstract

This chapter analyses opportunities and challenges for regional innovation policies designed to promote new path development in different types of regional innovation systems (RISs). RISs differ enormously in their capacity to develop new growth paths due to pronounced differences in endogenous potentials and varying abilities to attract and absorb exogenous sources for new path development. We distinguish between different types of regional industrial path development, which reflect various degrees of radicalness of regional structural change. The chapter offers a conceptual analysis of conditions and influences that enable and constrain new path development in different types of RISs and outlines the contours of policy strategies that are suitable for promoting new path development in different RISs. Regarding policy strategies, a distinction is drawn between system-based and actor-based policy approaches. System-based strategies aim to improve the functioning of the RIS by targeting system failures, promoting local and non-local knowledge flows and adapting the organizational and institutional set-up of the RIS. Actor-based strategies, in contrast, support entrepreneurs and innovation projects by firms and other stakeholders. We argue that both strategies will have only a limited impact on regional economic change when applied alone. However, if

A. Isaksen (✉)
School of Business and Law, University of Agder, Grimstad, Norway
e-mail: arne.isaksen@uia.no

F. Tödtling
Vienna University of Economics and Business, Vienna, Austria
e-mail: franz.toedtling@wu.ac.at

M. Trippl
Department of Geography and Regional Research, University of Vienna, Vienna, Austria
e-mail: michaela.trippl@univie.ac.at

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_11

they are combined, they are well suited to promote new path development. The chapter discusses which specific combinations of system-based and actor-based policy strategies matter for different types of RISs.

Keywords
Regional innovation policy · Actor-based policy strategy · System-based policy strategy · New path development · Thick RIS · Thin RIS

1 Introduction

There is an agreement in the academic and policy literature that the promotion of existing economic strongholds and specializations does no longer suffice in order to ensure the long-term competitiveness of regions (Asheim et al. 2011; European Commission 2012). New policy concepts such as smart specialization and other variants of new industrial policy (Rodrik 2004) highlight the need to develop innovation strategies that foster regional structural change, i.e. policies that support regional economies to renew their industrial base by diversifying into new but related economic fields or creating entirely new sectors (see, for instance, Foray 2015; Morgan 2016).

This new strategic orientation for regional innovation policies has been informed by evolutionary economic geography and related disciplines, which have offered new insights into how regional economies transform over time and how new growth paths come into being (Martin and Sunley 2006; Martin 2010; Neffke et al. 2011; Simmie 2012; Boschma 2015, 2017). Engaging with a regional innovation system (RIS) perspective, recent scholarly work suggests that such processes of regional structural change vary enormously across different types of regions (Capello and Lenzi 2015). RISs differ in their capacities to nurture new growth paths due to differences in endogenous potentials and varying abilities to attract and harness exogenous ideas, knowledge and resources for new path development (Isaksen 2015; Trippl et al. 2017). Such uneven preconditions and barriers to new path development have also implications for policy that need to be clarified. 'One size fits all' strategies have been largely dismissed, but place-based policies for regional structural change so far remain vague and provide little guidance in this regard.

The aim of this chapter, therefore, is to identify opportunities and limitations of regional innovation policies to nurture new path development in different types of RISs. Regarding changes of industrial paths we distinguish between *path modernization* (upgrading of existing industries based on new technologies or organizational change); *branching* (diversification of existing industries into new but related ones); *path importation* (setting up of an established industry that is new to the region); and *path creation* (rise of entirely new industries in a region). As regards types of RISs we draw a distinction between (1) organizationally thick and diversified RIS, (2) organizationally thick and specialized RIS and (3) thin RIS.

The chapter addresses the following research questions:

- Which conditions, supporting factors and barriers to the development of new paths or major path changes tend to prevail in different types of RISs?
- Which conclusions for targeted innovation policies can be derived and which kind of policies might be appropriate in the investigated RIS types?

The chapter offers a literature-based conceptual analysis of conditions and influences that enable and constrain new path development in each RIS type and elaborates on policy strategies that are suitable for promoting new regional industrial path development in those different types of RIS.

In the following sections we are going to present at first our core concepts based on economic geography and regional innovation systems literatures (Sect. 2) and we deal with conditions, and supporting factors for new path development in different types of RISs (Sect. 3). In Sect. 4 we present and discuss main barriers and potential policies for these RIS types. Section 5 summarizes the main results and draws conclusions.

2 Conceptual Frame

To explore opportunities and challenges for new path development in different types of regions we draw on recent findings from evolutionary economic geography and the RIS literature. We highlight forms and mechanisms of structural change, the importance of the geographical context, and the roles played by actors, institutions and networks in influencing innovation and diversification patterns of regional economies.

2.1 New Industrial Growth Paths in Regions

The literature offers various typologies to distinguish between and categorize different types of path development (Martin and Sunley 2006; Tödtling and Trippl 2013; Boschma 2017; Isaksen 2015; Isaksen and Trippl 2016a). We differentiate between five main forms of regional industrial path development (Table 1).

Path extension is mainly ‘business as usual’. It is based on incremental innovations in firms relying mostly on the use of existing knowledge. Little inflow of new, supplementary knowledge may reduce the innovation potential of a regional industry and cause stagnation and decline of the industry (Isaksen and Trippl 2016a).

Path modernization or upgrading refers to major intra-path changes, i.e., changes of an existing path into a new direction. Such processes could be triggered by the infusion of new technologies or major organizational changes. Examples are the use

Table 1 Types and mechanisms of path development

Forms of path development	Mechanisms
Path extension	Continuation of an existing industrial path based on incremental innovation in existing industries along well-established technological trajectories
Path modernization	Major change of an industrial path into a new direction based on new technologies or organizational innovations
Path branching	Development of a new industry based on competencies and knowledge of existing related industries (related variety)
Path importation	Setting up of an established industry that is new to the region (e.g. through foreign firms)
Path creation	Emergence and growth of entirely new industries based on radically new technologies and scientific discoveries or as outcome of search processes for new business models, user-driven innovation and social innovation

Source: Modified after Tödtling and Trippl (2013), Isaksen (2015) and Isaksen and Trippl (2016a)

of laser technology in the metal industry or the forest industry, the use of new materials in the automotive industry or the introduction of project organization in creative industries (Grabher 2002; Trippl and Tödtling 2008; Foray 2015).

Path branching implies that new paths emerge from industries and capabilities already existing in the region. Boschma and Frenken (2011) argue that this is an important route for diversification and regional development that is based on 'related variety' (see also Neffke et al. 2011; Rigby and Brown 2015). Branching can occur through different routes such as the diversification of existing firms into new product areas. In this case incumbent firms move into new sectors by redeploying existing assets and capabilities. An example is the emergence of environmental technology industries that branched from existing engineering, materials- and machinery industries in regions such as the Northrhine Westfalia or Upper Austria (Tödtling et al. 2014). Branching, however, can also occur through the setting up of new firms based on competencies in existing industries. New spin-off firms from incumbents in related industries have been shown to play an important role in the emergence of new industries (Boschma and Wenting 2007; Klepper 2007).

Path importation refers to the setting up of established industries that are new to the region. Such processes could be based on the arrival of foreign companies, inflow of skilled individuals with competences not available in the region or innovation partnerships with distant sources. Inward investment by foreign companies is often considered as a key route for path importation, if these companies feature high value-added functions and embed themselves in the regional economy by creating links to regional actors. Path importation can be combined with endogenous factors and forces. This is demonstrated by the case of the automotive industry in the region of Styria where the interplay of incoming foreign owned companies, diversification strategies of incumbent firms (e.g. in the metal industry) and the existence of traditional roots and competencies in the automotive sector has resulted in the establishment of a new growth path (Trippl and Tödtling 2008).

Path creation in new industries represents the most radical form of change. It is brought about by the emergence and growth of industries based on new technological and organizational knowledge. There is a growing recognition that chance, contingent events, serendipity or historical accidents should not be overemphasized as causes for such new paths, because they often emerge 'in the context of existing structures and paths of technology, industry and institutional arrangements' (Martin and Simmie 2008, p. 186). More specifically, path creation in new industries is often based on the existence of assets, resources or competencies rooted in the area, such as an excellent scientific base (for the Boston region see Tödtling 1994 and Bathelt 2001) or the availability of a highly skilled labour force (Martin and Sunley 2006; Martin 2010). The emergence of new high-tech and knowledge-intensive industries often hinges on the establishment of new companies and spin-offs (Bathelt et al. 2010). Also existing endogenous firms and universities (Tanner 2014) as well as the inflow of individuals, entrepreneurs and firms from outside (Neffke et al. 2014; Trippl et al. 2017) can play a role in 'seeding' new paths. The growth of the "red" biotechnology sector in Vienna in the 1990s e.g. has been based both on endogenous competencies in medical sciences and on investment and knowledge of foreign firms (Tödtling and Trippl 2007). Also the IT industry in the Finnish region of Tampere exemplifies the importance of home-grown leading firms such as Nokia in stimulating new path creation by acting as sophisticated customers (O'Gorman and Kautonen 2004). This differs from the rise of the software industry in Ireland that has been triggered rather by the attraction of foreign companies (O'Malley and O'Gorman 2001). Path creation in new industries preconditions a major transformation of the regional knowledge infrastructure and is often linked to processes of institutional change.

2.2 Regional Innovation Systems and Policy Approaches

The regional innovation system (RIS) literature has enhanced our understanding of how path changes and new paths come into being and in particular how and why such processes vary between different types of regions. The RIS approach highlights the regional dimension of the generation, absorption, and exploitation of new knowledge and of innovation. RISs can be conceptualized as the set of firms, organizations and institutions, which influence the innovative behaviour and economic performance at the regional level (Cooke et al. 2004; Asheim and Gertler 2005). The RIS approach emerged in the 1990s, based on the conceptualization of national innovation systems and the observation that interactive innovation processes often take place at the subnational level, supported by socio-cultural environments and targeted policy from regional authorities (Cooke et al. 1997). RISs are shaped by existing industry structures and technological trajectories, the presence or absence of knowledge- and support organizations, and the prevailing institutions and networks. RISs differ in their capacity to develop new growth paths due to pronounced differences in endogenous potentials and varying abilities to attract and absorb exogenous sources for new path development.

As regards *policy approaches* we differentiate between actor-based and system-based policy approaches building on the target groups of policy tools. System-based strategies build on the strong emphasis on the interactive nature of innovation, which lead to innovation policy instruments that aim ‘at bringing different parts of the system together in the pursuit of innovation’ (Fagerberg 2017, p. 502). Such policy instruments include e.g. cluster policies aimed at increasing cooperation between local firms, policies to increase knowledge flows between universities and industry and public procurement for innovation. Actor-based policy approaches include to ‘equipping actors in the system with the required capabilities for making the most out of the innovation-diffusion’ (op. cit., p. 502). Policy instruments then support entrepreneurs and firms’ innovation projects with financial resources, advice, networks etc. Instruments also include to support e.g. R&D-activity at universities and research institutes.

We argue that both strategies have only a limited impact on regional structural change when applied alone. However, if they are combined, they are well suited to promote new path development. This argument departs from the fact that a new industry in a region or a major path change advance through two micro processes; via the establishment of firms that introduce new activities in the region, or through new activities in existing firms. New firms are established by local entrepreneurs, such as spin-offs from other local firms or organizations (like universities and research organizations) or by external actors, such as multinational companies, that invest in the region (which may spur path importation).

However, individual entrepreneurs and firms cannot create new growth paths or fuel major path changes on their own if one follows the RIS approach. A new growth path emerges in a region (1) when several functionally related firms are established; (2) when the firms face an existing or potential demand and market, and (3) when the firms find input factors in a regional innovation system and also often gain access to production and knowledge networks outside the region (Binz et al. 2015). Firms are functionally related when they use complementary knowledge and technology or belong to the same value chain. The basic idea is that the emergence of new growth paths demands more than entrepreneurship and innovation activity in itself; it demands related firms that benefit from supportive actors and institutions.

Regional innovation systems in themselves are also no guarantee for the emergence of new growth paths or major path changes. Evolutionary economic geography understands new growth paths as evolving mainly through combinations of related knowledge and branching processes based on regions’ pre-existing industrial structures and organizational routines (Boschma and Frenken 2011). The regional innovation system and industry structure affect the type of new firms established by local entrepreneurs and by external investors. Thus, even if ‘the actual agents of development and innovation are the firms’, these ‘are grounded in specific territories, industries and institutions’ (Parrilli et al. 2016, p. 6). ‘The likelihood of starting up a business is intimately related to the conditions of the territory' (Parrilli et al. 2016, p. 10).

Following this approach of actors embedded in institutional, economic and social structures (Uzzi 1997), strong RISs first of all tend to support path extension rather than new growth paths. One reason is that 'entrepreneurship is an inherently local phenomenon. Individuals start companies based on their previous experience and interests' (Feldman 2007, p. 252). In the same way 'spin-offs are entrants founded by employees of firms in the same industry, which inherit knowledge and competencies from their parent firms' (Cusmano et al. 2015, p. 50). External investors establish companies, for example affiliations of multinational firms, in places where they are backed by regional industrial and institutional actors. Thus, entrepreneurs, spin-offs and external investments most often prolong existing regional competences and networks. This provides a sound basis for incremental innovations and growth in new firms, but not for the emergence of new regional industrial paths. Thus, RISs first of all support the further development of existing industries, also via research activity and education programmes targeting already strong industries in a region.

In this line of thought new regional growth paths or major path changes are initiated by actors who introduce new activities in the region at the same time as the regional innovation system is further developed or restructured to be better adapted to the new activities. New growth paths may be difficult to achieve if innovation policies and strategies are exclusively actor- or system-based; if the policy supports entrepreneurs, commercialization and innovation activities without any ideas of how these initiatives can add up to new growth paths that are supported by the knowledge and institutional system, or if policy supports strong RISs without any ideas of how to achieve more than path extension. Regional innovation systems differ, however, in their preconditions and capacities for developing new growth paths. In the next section we discuss which specific combinations of system-based and actor-based policies and strategies matter for different types of RISs.

3 Supporting Factors and Barriers to New Growth Paths in Different Types of Regional Innovation Systems

Both the modernization of existing industrial paths and the setting up of new ones are based on the one hand on specific endogenous capabilities in regions. These refer to the knowledge base, a skilled labour force, potential entrepreneurs, absorptive capacity, risk capital, a favourable business environment, and interactions among regional firms, support organizations and policy actors. On the other hand also external links and gatekeepers, as well as the attractiveness of regions for mobile firms and highly skilled people are of high importance for bringing in new ideas, knowledge and entrepreneurial capital. Different types of regions and RISs, however, vary considerably in their ability to induce and harness endogenous and exogenous forms of path development (Isaksen and Trippl 2016a). Changes of industrial paths and the emergence of new paths are context-specific phenomena that vary markedly between types of RISs. Some RISs lack preconditions, i.e. due to a narrow industrial structure, few knowledge organizations or few knowledge links, to achieve related or unrelated diversification of existing industries (Boschma et al. 2017). We approach the question of regional variations in abilities to create new growth paths by distinguishing between (1) organizationally thick and diversified RIS, (2) organizationally thick and specialized RIS and (3) organizationally thin RIS (Isaksen and Trippl 2016a).

Organizationally thick and diversified RISs such as metropolitan areas and advanced technology regions host a variety of industries and knowledge- and innovation supporting organizations in a wide range of technological areas. They offer favourable conditions for the setting up of new paths. The industrial diversity, 'Jabobian externalities' and institutional variety present in these regions are considered as particularly conducive to new path development. There is a high potential for cross-industrial knowledge flows and new re-combinations of knowledge (Boschma 2015). Moreover, organizationally thick and diversified RIS are often characterized by bridging social capital (Malecki 2012) and geographically open knowledge networks. This constitutes favourable conditions for path branching, that is, the evolution of existing regional industries into new but related ones through firms' diversification processes, labour mobility, spin-offs and networking (Boschma and Frenken 2011; Boschma 2015). At the same time, this RIS type offers excellent potentials for research-driven path creation processes. These RISs are usually well endowed with strong universities and other research organizations, which can be an important source of path creation. They serve as seedbeds of academic spin-offs and promote the commercialization of research results that might lead to the emergence of science-based industries. In addition, diversified core areas often host a large number of public and private support organizations aiding new path development, such as providers of information about new markets and technologies, organizations offering counselling services, bridging organizations, technology transfer agencies, science parks, incubators, and so on. To summarize, organizationally thick and diversified RISs offer strong potentials for path modernization, path branching and the creation of new paths.

Organizationally thick and specialized RISs are characterized by the presence of strong clusters in one or a few industries, and by an institutional-set-up that 'fits' the region's narrow industrial base. Such conditions tend to prevail in specialized manufacturing regions, old industrial areas (Grabher 1993; Hassink 2005; Trippl and Otto 2009; Morgan 2016) or in industrial districts (Belussi and Sedita 2009). This RIS type exhibits a rather weak endogenous capacity for path changes and new growth paths. These regions lack the diversity of industries, knowledge bases, support organizations and institutional forms that might stimulate the development of new industrial paths (Asheim et al. 2011; Boschma and Frenken 2011). There is a low degree of both related and unrelated variety and there are only few opportunities for (re-)combining diverse knowledge bases at the regional scale (Boschma 2015). Networks tend to be strongly shaped by dominant sectors and they are quite stable. The strong degree of specialization of industrial and support structures and related Marshallian externalities promote incremental innovations in existing industries and along prevailing technological paths (Martin and Sunley 2006). Path extension and path modernization are thus the most likely forms of development that are favoured in this type of RIS. This type of RIS is particularly vulnerable to industrial decline. Firms and the whole RIS may lose their capacity to adjust or positively react to changes of global markets and technologies. As many cases have demonstrated, there is a weak potential for adaptability, innovation and transformation. Negative functional, cognitive and political lock-in often result in stagnation, economic downturn and the decline of industrial paths (Grabher 1993; Hassink 2010; Simmie and Martin 2010).

Organizationally thin RISs by definition have few organizations of higher education or R&D, none or only weakly developed clusters, and consequently little local knowledge exchange. The regions are often dominated by SMEs in traditional and resource-based industries, which sometimes co-exist with larger, externally owned firms (Tödtling and Trippl 2005). In particular the SMEs operating in this RIS type and industries are often characterized by the DUI (Doing, Using, Interacting) mode of innovation (Jensen et al. 2007; Isaksen and Karlsen 2013) that is based on experience and competences acquired on the job as employees face new problems or demands. The external ownership in some thin RISs may lead to a 'branch plant culture' that is hampering local entrepreneurship and innovativeness (Petrov 2011). In particular rural areas are also often seen as inward looking and fairly homogenous with regard to knowledge bases and 'world views'. The prevailing 'bonding social capital' is said to stimulate cooperation and knowledge exchange among already well-known, local actors who do not challenge the values and norms that hold the networks together (Westlund and Kobayashi 2013). Malecki (2012, p. 1031) in this context argues that 'too much bonding social capital becomes negative, creating conformity rather than variety'. Conformity, however, hampers more radical innovation and the creation of new paths, and does not support the emergence of new industries in the region (Boschma and Frenken 2011).

4 Challenges and Policies for Path Creation in Different Types of RISs

Innovation policies should not be applied in a standardized way but should be targeted to the specific problems and needs of a particular type of region and take the specific strengths and weaknesses and conditions into account (Tödtling and Trippl 2005; Asheim et al. 2011; Isaksen and Trippl 2016a). Based on the reasoning of the innovation systems literature the distinction between actor-based and systemic policies is useful for designing respective strategies (Asheim et al. 2003). Actor-based policies intend to strengthen the innovation potential and -performance of individual actors (such as firms, SMEs, universities, research organizations, etc), whereas systemic policies aim at improving the performance of the overall RIS. Systemic policies target the system's coherence and functioning, and the internal and external interaction of actor groups (e.g. within and among clusters, university-business links, training- and mobility schemes etc). Since the different types of RIS face specific problems and barriers for new path development, the strategies and policies should be targeted and fine-tuned to the respective conditions.

4.1 Development Challenges for Organizationally Thick and Diversified RISs

Thick and diversified RIS are confronted with two development challenges. On the one hand they face the challenge to sustain their strong capacity to modernize existing industrial paths and to explore and create new paths. They have to compete successfully in the global knowledge economy and universities and research organsations need to attract the best scientific talent, students and financial resources. There is also a high demand of investment in the research infrastructure, and universities and research organizations have continuously to keep up with new scientific developments. Also the infrastructure must stay flexible enough to cope with new developments and changes in science and business. On the other hand, this type of RISs cannot rely on new paths only but faces also the challenge to exploit and extend existing paths. There is also a need to successfully commercialize available and new knowledge e.g. through spin-offs, start-ups, university-industry collaborations, etc. Policy actors, thus, also face the challenge to support a business environment for knowledge application and commercialization.

Due to their good pre-conditions, that is, the presence of a heterogeneous industrial mix, institutional variety and bridging social capital, organizationally thick and diversified RISs are often core centres of continuous and radical change. New path development activities occur on a more or less regular basis. This reflects the fact that this RIS type often demonstrates comparatively high entrepreneurial activities. One key challenge is that the knowledge and supporting infrastructure of the RIS may not succeed in staying up to date, failing to adapt to newly emerging fields (Miörner and Trippl 2017). There is thus a need to continuously adjust research and educational programmes and institutional structures. However, permanent change might imply too much exploration and too little exploitation in the RIS leading to a lack of industrial focus. Under such conditions emerging industries may not achieve a critical mass (Boschma 2015) and companies might not be able to exploit new discoveries and turn them into innovation. These reflections lead to the argument that system-based policy should be most in focus in thick and diversified RISs. Actors are numerous and conditions for entrepreneurship and innovation activity are generally favourable compared to other types of RISs. However, to achieve full benefits of the comparatively many innovative actors the RIS has to support new initiatives and their commercialization.

The challenges sketched out above imply that organizationally thick and diversified RISs may benefit from policy interventions that promote exploitation activities and path extension. Key tasks of policy-makers comprise the identification of the most promising industrial fields that have emerged out of past rounds of path creation, and the provision of support to achieve positive lock-in and to facilitate their further growth. A key element of such an approach might include measures that promote the adaptation of the institutional set-up of the RIS, that is, promotion of research activities, education programmes, counselling services, and so on that support innovation and growth along newly established trajectories. An approach may be to identify possible generic knowledge and technology that are common in a number of new firms and innovation projects. The RIS could then focus on building competence in such generic fields, e.g. by developing R&D and education programmes, instead of trying to support every possible seed of new paths.

In the long term, these areas may also face challenges in maintaining their capacity to set in motion path branching and new path creation activities. Even organizationally thick and diversified RISs may be confronted with an erosion of their transformative capacity over time, resulting, for instance, from a rigidification of industrial and institutional structures or factors that prevent related activities to connect. Consequently, an essential policy objective should be to sustain the ability of these areas to renew their industrial structures over time. Sound policy actions might include the removal of obstacles that hamper new combinations between industries and knowledge bases (Boschma 2015), investment in new research fields and reconfiguration of the institutional set up to match new industrial requirements.

4.2 Development Challenges and Policy Approaches for Organizationally Thick and Specialized RISs

These types of regions face major renewal challenges. Existing development paths can become exhausted if positive lock-in turns into negative lock-in. As a consequence, policy should focus on avoiding path exhaustion by promoting continuous innovation and upgrading in established industries. However, in the long-term policy interventions to stimulate path extension and path upgrading are insufficient. A key challenge is to move beyond existing industrial paths and to facilitate the development of new ones.

As diversity and related variety are barely present at the regional scale, policy should target exogenous development impulses as a key source for regional transformation. Policy options include the support of links to extra-regional knowledge networks to get access to complementary knowledge from extra-regional sources and its combination with assets available in the region (Boschma 2015). Attraction of foreign direct investment in new or related technology areas may also be a sound policy approach to support new path development processes in such types of regions. The success of a policy strategy that builds on the importation of external firms and the promotion of non-local networks, however, is contingent on the absorption capabilities and competences of the existing industrial base (Martin and Sunley 2006).

Policy actors can also play an important role by promoting diversification processes of existing companies into new but related fields (branching) and supporting new firm formation in entirely new industries. However, such firm- and industry-oriented policy measures need to be complemented by instruments that induce changes in other RIS dimensions (Trippl and Tödtling 2008). This points to the fact that thick and specialized RISs in general face a double problem. On the one hand there is often a lack of entrepreneurship and innovation activity in new areas; on the other hand the prevailing knowledge and support structures of the RIS are geared towards path extension. A question might be what the best combination and timing of actor-based versus system-based policy strategies are in this situation. One argument is that specialized RISs are hard to change, and that it is difficult for anyone to know exactly in which direction to change the RISs, which would imply a variant of a picking the winner strategy. In line with this argument, actor-based policies to strengthen the entrepreneurship and innovation potential and performance of firm- and non-firm actors should be the starting point. Development and reorganization of the RIS and the facilitation of extra-regional knowledge links could then focus on obvious common knowledge needs among young and existing firms that innovate in areas that are new for the region. Investment in new scientific fields, reorientation of the support structure and the formation of new networks should then be key policy priorities.

4.3 Development Challenges and Policy Approaches in Regions with Organizationally Thin RISs

This type of RIS faces problems in the change of existing, and in particular in the formation of new regional development paths. Path changes are in general triggered by the presence of a broad variety of firms and knowledge bases in a region (Frenken et al. 2007), conditions that are usually not found in thin RISs. Firms in thin RISs can compensate for a scarce local knowledge supply base by internalising some of the resources that are missing in the local business environment (Isaksen 2015), and by entering into distant collaboration networks (Grillitsch and Nilsson 2015). The first strategy may not lead to more than path extension if firms build up internal resources (e.g. R&D-competence) to strengthen their already dominant activities. The second strategy points to the fact that firms often use extra-regional knowledge sources and find innovation partners outside their region. One element in a strategy for more extra-regional knowledge links would be to raise the absorptive capacity of regional firms e.g. through recruiting skilled and qualified people. This would increase the ability of at least some firms (gatekeepers) in a region to identify and acquire external knowledge, and assimilate it, combine it with existing knowledge, develop it further with other firms and regional actors, and then apply it to commercial ends (Giuliani and Bell 2005).

The situation in thin RISs with few technology related firms and industries means that cluster- or RIS based strategies are less relevant on their own (Monsson 2014). Rather than focusing only on the industry- or RIS level (system-based strategies), innovation policy in thin RIS should therefore also be directed at the firm level (actor-based strategies). Isaksen and Karlsen (2013) point out that some resourceful firms in thin RISs might act as ‘door openers’ to external knowledge for other local firms, while Monsson (2014) proposes to target high-growth firms from a variety of industries. From these arguments it follows to place less emphasis on the endogenous development capacities of regions but rather target specific firms that have the ability and willingness to innovate, to support their innovation process and foster the diffusion of competence and technology from the ‘target firms’ to other local firms and organizations. The ‘diffusion strategy’ is important to avoid situations in which regions have a few advanced firms with mainly extra-regional knowledge links and innovation partners but which are not really embedded in, and contribute to, the local industrial milieu. Such a situation is quite likely as thin RISs have little ‘local related externalities’ to support firms’ innovation activities and hence little local knowledge spillovers. Policy tools that compensate for the lack of spontaneously created externalities, for example technology parks, *can* be relevant.

Whereas firms in core areas have far better access to specialized suppliers, experienced labour and knowledge organizations nearby, and can benefit from local spill-overs, organizationally thin RISs may rely more on policies to mobilize such resources. Following such reasoning, thin RISs may achieve path changes first of all by adapting resources that often derive from outside the region. This requires some local organizations with boundary-spanning- and bridging capabilities that aim to enhance knowledge spillovers from resourceful and externally linked firms. This means that a kind of system policy is also relevant in thin RISs. There is a risk that the relatively few innovative firms and entrepreneurs, who are able to initiate new paths in thin regions become isolated from the rest of the regional industry- and knowledge structure. Thus, firms and entrepreneurs pioneering (possible) new growth paths need access to relevant, regional and extra-regional input factors. Policy recommendations therefore include to link firms to partners and knowledge sources outside and inside the region.

Attracting innovative firms and branches of national research institutions or research centres from outside is also put forward as policy option for thin RISs (Tödtling and Trippl 2005). Such initiatives may demand national initiatives, which point to the fact that the change and creation of industrial paths in organizationally thin RISs are potentially more reliant on policy interventions than is the case in particular in thick and diversified regions (Dawley 2014; Dawley et al. 2015; Isaksen and Trippl 2016b). Such kind of network and system building policies should be supplemented by actor-based strategies to stimulate more ‘followers’ to the pioneers among other firms and entrepreneurs that can then benefit from policy-initiated networks and organizations.

To summarize, all three types of RIS require actor-based and system-based policies to nurture major path changes and new growth paths. The respective measures and initiatives to be launched to induce changes at the actor and system level and their combination should, however, differ in nature, reflecting the varying opportunities and barriers to new path development in the investigated RIS types (Table 2).

Table 2 Actor- and system-based policy approaches for different types of RIS

	Actor-based policies	System-based policies
Thick and diversified RIS	Strengthen exploration- and knowledge generation capabilities of universities and research organizations Strengthening exploitation capabilities of firms and non-firm actors	Enhance international attractiveness of RIS Adapt RISs to requirements of emerging industries
Thick and specialized RIS	Strengthening entrepreneurship and innovation capabilities of firms and non-firm actors in new fields	De-locking and major reorientation of RIS Strengthen external knowledge links
Thin RIS	Targeting high-growth firms and pioneers of new growth paths; support followers; enhance absorptive capabilities of companies	Build networks between local firms Strengthen external knowledge links

Source: Own compilation

5 Summary and Conclusions

Over the past few years, a growing body of literature has pointed to the need for a strategic re-orientation of innovation policy, advocating a shift from supporting existing economic strongholds and specializations towards promoting structural change and new path development. The question of how policy could nurture such processes across a variety of regions with different innovation and diversification capabilities has, however, received insufficient attention to date. This chapter set out to reflect on sound policy approaches for catalysing new path development in three ideal types of regional innovation systems, namely, organizationally thick and diversified RIS, thick and specialized RIS and thin RIS. These RIS types are found to display very different capacities to induce major path changes and new growth paths and they face unique development challenges. Drawing on recent accounts of enabling and constraining factors for path development in thick and diversified, thick and specialized and thin RIS, we sought to discuss how policy could stimulate path changes and new industrial paths in each RIS type.

The paper suggests that new path development could be nurtured by policies that manage to incorporate both actor-based and system-based elements in the design of innovation strategies. We have also shown that the three investigated RIS types require rather different combinations of actor-oriented and system-oriented policy measures. Being core centres of innovation and new path development, thick and diversified RIS should benefit from policies that strengthen both the exploration and the exploitation capacity of actors and facilitate the adaptation of the RIS to keep abreast with high levels of industrial path dynamics that typify these regions. Thick and specialized RIS, in contrast, require a completely different policy approach. These regions could be classified as 'centres of continuity', offering conditions that enable path extension and constrain new path development. Therefore, actor-based policy measures that stimulate entrepreneurship and foster innovation capabilities of firm and non-firm actors in new fields are high in demand. Such initiates need to be complemented by system-based policies that 'de-lock' the RIS and promote its re-orientation towards new growth paths. Finally, thin RIS may benefit most from an actor-based approach that targets externally linked high-growth firms, pioneers of new growth paths and their potential followers within the region. However, actor-based strategies need to be combined with system-oriented policies geared towards the building-up of RIS structures to compensate for the lack of spontaneously created knowledge spillovers and –interactions in this RIS type.

The conceptual arguments outlined above open up a set of key issues for future research. First, empirical investigations of actor-based and system-based innovation policies implemented in different types of RIS are needed to gain a better knowledge of what combinations of policy initatives work in practice, how they work and why. Such empirical examinations should also take into account that policy capacities to fashion sound strategies for structural change may differ enormously between regions, not least due to differences in quality of government and policy path dependencies. Second, an extension of the conceptual framework could yield additional insights. Incorporating demand-side policies and connecting actor-based and system-based strategies to different roles of the state may be a promising undertaking. Furthermore, it would be intriguing to explore how regional and supra-regional policies could interact fruitfully in shaping new path development and which policy level is best suited for implementing what type of actor-based and system-oriented strategies. Finally, a broader multi-actor perspective may be adopted to take account of the role played by institutional and policy entrepreneurs and to deal with the question of how actor-based policies could be designed to target these key agents of change.

References

Asheim, B. T., & Gertler, M. (2005). The geography of innovation: Regional innovation systems. In J. Fagerberg, D. C. Mowery, & R. Nelson (Eds.), *The Oxford handbook of innovation* (pp. 291–317). Oxford: Oxford University Press.

Asheim, B. T., Isaken, I., Nauwelaers, C., & Tödtling, F. (Eds.). (2003). *Regional innovation policy for small-medium enterprises*. Cheltenham: Edward Elgar.

Asheim, A., Boschma, R., & Cooke, P. (2011). Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies, 45*(7), 893–904.

Bathelt, H. (2001). Regional competence and economic recovery: Divergent growth paths in Boston's high technology economy. *Entrepreneurship & Regional Development, 13*(4), 287–314.

Bathelt, H., Kogler, D. F., & Munro, A. K. (2010). A knowledge-based typology of university spin-offs in the context of regional economic development. *Technovation, 30*(9), 519–532.

Belussi, F., & Sedita, S. R. (2009). Life cycle vs. multiple path dependency in industrial districts. *European Planning Studies, 17*(4), 505–528.

Binz, C., Truffer, B., & Coenen, L. (2015). Path creation as a process of resource alignment and anchoring: Industry formation for on-site water recycling in Beijing. *Economic Geography, 92* (2), 172–200.

Boschma, R. (2015). Towards an evolutionary perspective on regional resilience. *Regional Studies, 49*(5), 733–751.
Boschma, R. (2017). Relatedness as driver of regional diversification: A research agenda. *Regional Studies, 51*(3), 351–364.
Boschma, R., & Frenken, K. (2011). Technological relatedness and regional branching. In H. Bathelt, M. Feldman, & D. Kogler (Eds.), *Beyond territory. Dynamic geographies of knowledge creation, diffusion, and innovation* (pp. 64–81). London: Routledge.
Boschma, R., & Wenting, R. (2007). The spatial evolution of the British automobile industry does location matter? *Industrial and Corporate Change, 16*(2), 213–238.
Boschma, R., Coenen, L., Frenken, K., & Truffer, B. (2017). Towards a theory of regional diversification: Combining insights from evolutionary economic geography and transitions studies. *Regional Studies, 51*(1), 31–45.
Capello, R., & Lenzi, C. (2015). The knowledge–innovation Nexus. Its spatially differentiated returns to innovation. *Growth and Change, 46*(3), 379–399.
Cooke, P., Uranga, M. G., & Etxebarria, G. (1997). Regional innovation systems: Instituional and organisational dimensions. *Research Policy, 26*, 475–491.
Cooke, P., Heidenreich, M., & Braczyk, H. J. (Eds.). (2004). *Regional innovation systems* (2nd ed.). London: Routledge.
Cusmano, L., Morrison, A., & Pandolfo, E. (2015). Spin-off and clustering: A return to the Marshallian district. *Cambridge Journal of Economics, 39*, 49–66.
Dawley, S. (2014). Creating new paths? Offshore wind, policy activism, and peripheral region development. *Economic Geography, 90*(1), 91–112.
Dawley, S., MacKinnon, D., Cumbers, A., & Pike, A. (2015). Policy activism and regional path creation: The promotion of offshore wind in North East England and Scotland. *Cambridge Journal of Regions, Economy and Society, 8*(2), 257–272.
European Commission, E. (2012). *Guide to research and innovation strategies for smart specialisations (RIS3)*. Luxembourg: Publications Office of the European Union.
Fagerberg, J. (2017). Innovation policy: Rationales, lessons and challenges. *Journal of Economic Surveys, 31*(2), 497–512.
Feldman, M. (2007). Perspectives on entrepreneurship and cluster formation: Biotechnology in the US Capitol region. In K. Polenske (Ed.), *The economic geography of innovation* (pp. 241–260). Cambridge: Cambridge University Press.
Foray, D. (2015). *Smart specialization: Opportunities and challenges for regional innovation policies*. Abingdon: Routledge.
Frenken, K., Van Oort, F., & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional Studies, 41*(5), 685–697.
Giuliani, E., & Bell, M. (2005). The micro-determinants of meso-level learning and innovation: Evidence from a Chilean wine cluster. *Research Policy, 34*(1), 47–68.
Grabher, G. (1993). The weakness of strong ties: The lock-in of regional development in the Ruhr area. In G. Grabher (Ed.), *The embedded firm: On the socioeconomics of industrial networks* (pp. 255–277). London: Routledge.
Grabher, G. (2002). Cool projects, boring institutions temporary collaboration in social context. *Regional Studies, 36*, 205–214.
Grillitsch, M., & Nilsson, M. (2015). Innovation in peripheral regions: Do collaborations compensate for a lack of local knowledge spillovers? *The Annals of Regional Science, 54*, 299–321.
Hassink, R. (2005). How to unlock regional economies from path dependency? From learning region to learning cluster. *European Planning Studies, 13*(4), 521–535.
Hassink, R. (2010). Locked in decline? On the role of regional lock-ins in old industrial areas. In R. Boschma & R. Martin (Eds.), *The handbook of evolutionary economic geography* (pp. 450–468). Cheltenham: Edward Elgar.
Isaksen, A. (2015). Industrial development in thin regions: Trapped in path extension. *Journal of Economic Geography, 15*(3), 585–600.

Isaksen, A., & Karlsen, J. (2013). Can small regions construct regional advantages? The case of four Norwegian regions. *European Urban and Regional Studies, 20*(2), 243–257.

Isaksen, A., & Trippl, M. (2016a). Path development in different regional innovation systems. In M. D. Parrilli, R. D. Fitjar, & A. Rodriguez-Pose (Eds.), *Innovation drivers and regional innovation strategies* (pp. 66–84). New York and London: Routledge.

Isaksen, A., & Trippl, M. (2016b). Exogenously led and policy supported new path development in peripheral regions: Analytical and synthetic routes. *Economic Geography, 93*(5), 436–457.

Jensen, M. B., Johnson, B., Lorenz, E., & Lundvall, B. Å. (2007). Forms of knowledge and modes of innovation. *Research Policy, 36*, 680–693.

Klepper, S. (2007). Disagreements, spinoffs, and the evolution of Detroit as the capital of the US automobile industry. *Management Science, 53*(4), 616–631.

Malecki, E. J. (2012). Regional social capital: Why it matters. *Regional Studies, 46*(8), 1023–1039.

Martin, R. (2010). Roepke lecture in economic geography—rethinking regional path dependence: Beyound lock-in to evolution. *Economic Geography, 86*(1), 1–27.

Martin, R., & Simmie, J. (2008). Path dependence and local innovation system in city-regions. *Innovation: Management, Policy & Practice, 10*(2–3), 183–196.

Martin, R., & Sunley, P. (2006). Path dependence and regional economic evolution. *Journal of Economic Geography, 64*(4), 395–437.

Miörner, J., & Trippl, M. (2017). Paving the way for new regional industrial paths: Actors and modes of change in Scania's games industry. *European Planning Studies, 25*(3), 481–497.

Monsson, C. K. (2014). Development without a metropolis: Inspiration for non-metropolitan support practices from Denmark. *Local Economy*. OnlineFirst Version. https://doi.org/10.1177/0269094214532903

Morgan, K. (2016). Nurturing novelty: Regional innovation policy in the age of smart specialisation. *Environment and Planning C: Government and Policy*. https://doi.org/10.1177/0263774X16645106

Neffke, F., Henning, M., & Boschma, R. (2011). How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. *Economic Geography, 87*(3), 237–265.

Neffke, F., Hartog, M., Boschma, R., & Henning, M. (2014). *Agents of structural change. The role of firms and entrepreneurs in regional diversification*. Papers in Evolutionary Economic Geography No. 1410. Utrecht University, Section of Economic Geography.

O'Gorman, C., & Kautonen, M. (2004). Policies to promote new knowledge-intensive industrial agglomerations. *Entrepreneurship & Regional Development, 16*(6), 459–479.

O'Malley, E., & O'Gorman, E. (2001). Competitive advantage in the Irish indigenous software industry and the role of inward foreign direct investment. *European Planning Studies, 9*(3), 303–321.

Parilli, M. D., Fitjar, R. D., & Rodrigues-Pose, A. (2016). Innovation drivers and regional innovation strategies. Territorial and business insights. In M. D. Parilli, R. D. Fitjar, & A. Rodrigues-Pose (Eds.), *Innovation drivers and regional innovation strategies* (pp. 1–19). New York: Routledge.

Petrov, A. N. (2011). Beyond spillovers. Interrogating innovation and creativity in the peripheries. In H. Bathelt, M. P. Feldman, & D. T. Kogler (Eds.), *Beyond territory. Dynamic geographies of knowledge creation, diffusion, and innovation* (pp. 168–190). London: Routledge.

Rigby, D. L., & Brown, W. M. (2015). Who benefits from agglomeration? *Regional Studies, 49*(1), 28–43.

Rodrik, D. (2004). *Industrial policy for the twenty-first century*. CEPR Discussion Paper No. 4767.

Simmie, J. (2012). Path dependence and new technological path creation in the Danish wind power industry. *European Planning Studies, 20*(5), 753–772.

Simmie, J., & Martin, R. (2010). The economic resilience of regions: Towards an evolutionary approach. *Cambridge Journal of Regions, Economy and Society, 3*(*1*), 27–43.

Tanner, A. (2014). Regional branching reconsidered. Emergence of the fuel cell industry in European Regions. *Economic Geography, 90*(4), 403–427.

Tödtling, F. (1994). Regional networks of high-technology firms—the case of the greater Boston region. *Technovation, 14*(5), 323–343.

Tödtling, F., & Trippl, M. (2005). One size fits all? Towards a differentiated regional innovation policy approach. *Research Policy, 34*(8), 1203–1219.

Tödtling, F., & Trippl, M. (2007). Knowledge links in high-technology industries: Markets, networks, or milieu? The case of the Vienna biotechnology cluster. *International Journal of Entrepreneurship and Innovation Management, 7*(2–5), 345–365.

Tödtling, F., & Trippl, M. (2013). Transformation of regional innovation systems: From old leagacies to new development paths. In P. Cooke (Ed.), *Reframing regional development* (pp. 297–317). London: Routledge.

Tödtling, F., Höglinger, C., Sinozic, T., & Auer, A. (2014). Factors for the emergence and growth of environmental technology industries in upper Austria. *Mitteilungen der Österreichischen Geographischen Gesellschaft, 156*, 1–25.

Trippl, M., & Otto, A. (2009). How to turn the fate of old industrial areas: A comparison of cluster-based renewal processes in Styria and the Saarland. *Environment and Planning A, 41*(5), 1217–1233.

Trippl, M., & Tödtling, F. (2008). Cluster renewal in old industrial regions—continuity or radical change? In C. Karlsson (Ed.), *Handbook of research on clusters* (pp. 203–218). Cheltenham: Edward Elgar.

Trippl, M., Grillitsch, M., & Isaksen, A. (2017). Exogenous sources of regional industrial change: Attraction and absorption of non-local knowledge for new path development. *Progress in Human Geography*. https://doi.org/10.1177/0309132517700982

Uzzi, B. (1997). Social structure and competition in interfirm networks: The paradox of embeddedness. *Administrative Science Quarterly, 42*(*1*), 35–67.

Westlund, H., & Kobayashi, K. (2013). Social capital and sustainable urban-rural relationships in the global knowledge society. In H. Westlund & K. Kobayashi (Eds.), *Social capital and rural development in the knowledge society*. Cheltenham: Edward Elgar.

Entrepreneurship Policies and the Development of Regional Innovation Systems: Theory, Policy and Practice

Helen Lawton Smith

Abstract

The regional innovation systems (RIS) approach tends to be short in the coverage of the importance of agency in the dynamics of economic change. This paper addresses this by putting the entrepreneur, which Schumpeter (Capitalism, socialism and democracy. Harper & Row, 1911/1934) placed at the heart of the analysis of economic change, as the driving force of regional innovation systems and associated policies. This is consistent with work by Feldman and Francis (Clusters and Regional Development, Routledge, 2006) who identified the entrepreneur as a regional agent of change.

The paper provides an appraisal and synthesis of the regional innovation systems approach in relation to entrepreneurship policies. It addresses a number of areas where theoretical, empirical and policy-based issues are currently under-developed in relation to entrepreneurship and entrepreneurship policy. There are three major themes. The first is the agency of both entrepreneurs and entrepreneurship policies in an RIS. The second is the rationale for entrepreneurship policies in an RIS. The third relates to what do entrepreneurship policies look like in RIS and how they might be evaluated as contributing towards an RIS.

Keywords

Innovation systems · Entrepeneurship policies · European entrepreneurial regions

H. Lawton Smith (✉)
Department of Management, Birkbeck & Director of Research, Oxfordshire Economic Observatory, Oxford University, Oxford, UK
e-mail: h.lawton-smith@bbk.ac.uk

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_12

1 Introduction

One of the greatest weaknesses of the regional innovation systems (RIS) concept, as of all other innovation system concepts, is its neglect of the determinant "entrepreneurship" as far as the actors and elements of an RIS are concerned (Sternberg and Müller 2005). Definitions of RIS stress the role of intra-regional networks and linkages between innovation actors (see for example Asheim et al. 2011) but generally do not explicitly consider entrepreneurial activities of very young firms. Sternberg and Müller (2005) find this surprising as, citing Feldman (2001), they point out that entrepreneurial activities are to a large extent a regional event. They argue that local conditions are more significant in whether an individual decides to be an entrepreneur and whether a firm survives and grows. Moreover, the agency of entrepreneurs as innovators is missing. It is a key driver of change (Schumpeter 1911/1934) and hence a driver of change of an RIS that incorporates entrepreneurship policies. Moreover, an RIS must have strength not only in innovation, but also the capacity to generate and attract entrepreneurship and talent (Cooke 2007).

The rationale for a focus on entrepreneurship therefore is that start-up firms have been proposed as 'the embodiment of innovation' (Feldman 2001, p. 861). Schumpeter (1911/1934) saw "entrepreneurs as innovators" as introducing new combinations such as new goods, new methods or processes, new markets, or the new organization of an industry (Malecki and Spigel 2013). Later Schumpeter (1942) saw large enterprises as sources of change and impact on innovation, having more resources for research and development. He failed to see, however, that entrepreneurial start-ups as well as large firms would continue to play a major role in economic development.

Indeed, as (Hekkert et al. 2007, p. 421) argue "There is no such thing as an innovation system without entrepreneurs. Entrepreneurs are essential for a well functioning innovation system". Earlier, Feldman and Francis (2006) argued that entrepreneurs may act collectively and in so doing create economic competitiveness. They may then actively shape local environments by building institutions that further the interests of their emerging industry by building capacity that will sustain economic development (Feldman 2014). A tension here is that the role of policy-making. If it appears at all then it is secondary to the agency of entrepreneurs to develop governance mechanisms that have reinforcing effects on entrepreneurial activity.

A rationale for entrepreneurship policy is that, as Malecki and Spigel (2013) point out, entrepreneurs have to learn from their local environment and other actors within it than do large firms (Zahra et al. 2006). By implication, they can gain significantly from entrepreneurship policies which help them to learn. Moreover, the co-existence of larger (anchor firms) and smaller firms in a regional economy is a further tension in local policies designed to support entrepreneurship per se. Policies which support anchor firms and their networks as they 'affect not only the creation of new organisations but also the transformation of existing ones' (FRIDA project)[1] and support competition between anchors, might be more effective than entrepreneurship policies per se.

Thus, the argument for the importance of entrepreneurship policies in RIS is that business activity is embedded in a socio-institutional and economic context. In other words there is an interrelationship between context—the regional environment—and entrepreneurial activities. This regional environment includes policy frameworks (national, regional, local). As Iammarino (2005) notes, citing Feldman and Martin (2005), firms' success and regional economic growth are mutually dependent. Threefold theory approaches are in effect embedded in the notion of entrepreneurship policies in RIS: theories about entrepreneurs, theories of the firm (e.g. Penrose 1959), and theories of innovation.

Against this context, the proposition being explored is that entrepreneurship policies themselves are a response to changes in an RIS. In effect a demand by entrepreneurs for policy has been created. In turn that collection of policies leads to further evolution of the RIS. This paper makes the case for entrepreneurs and hence for entrepreneurship policies in shaping RIS. The paper poses three questions. The first is why should the agency of both entrepreneurs and entrepreneurship policies be recognised in the RIS? The second is what is the rationale for entrepreneurship policies in RIS? The third is what do entrepreneurship policies look like in RIS? The focus here is on different stages in the emergence of RIS and of entrepreneurial firms, hence how a demand for policy changes over time. As Motoyama et al. (2014) recognise, entrepreneurs need different kinds of policy support at different stages in their development.

The paper proceeds by reviewing the literature in related to each of the three questions. This is in order to identify where there are gaps and inconsistencies in previous analyses and to provide evidence on both. The paper concludes that the lack of attention to entrepreneurs (and enterprises) and entrepreneurship policy means that the agency of both to bring about system change is underplayed in conceptualisations of RIS. However, recent evidence suggests that an increasing regional policy focus on entrepreneurship, enterprise and innovation in some places in Europe is bringing about beneficial systemic change.

2 Entrepreneurs in RIS

We first consider why the agency of both entrepreneurs and hence entrepreneurship policies should be recognised in the RIS literature. Since the RIS concept was developed by Cooke (1992) entrepreneurs and policy-making per are either implicit or explicit. In some formulations innovation policy implications are discussed.

Examples of where entrepreneurs are implicit in their analysis include Doloreux and Parto (2005) who identify three features of RIS. These are interactions between

[1] http://www.scoopproject.org.uk/1frida-anchor-firms-contribute-to-regional-development.aspx (accessed April 18, 2017).

different actors in the innovation process, the role of institutions, and the use of regional innovation systems analysis to inform policy decisions. Asheim and Coenen (2005, p. 1174) also focus on interactions and define RIS as “interacting knowledge generation and exploitation subsystems linked to global, national and other regional systems” that may stretch across several sectors in the regional economy. Entrepreneurs are implicit as being part of knowledge exploitation—as well as knowledge generation systems. Later (Asheim et al. 2011) defined RIS as ‘encompassing all regional economic, social and institutional factors that affect the innovativeness of firms’ (p. 48). In this version there is a central role for innovation policy in shaping the conditions for innovation and constructing regional advantage, but the focus is on firms rather than from entrepreneurs.

Howells (1999) earlier included the role of the public sector and innovation policy as one of the nine characteristics of a top down RIS but also without reference to entrepreneurs. They are implicit, however, in the discussion of the interdependent relationship between firms’ business environments and their success—hence the importance of policy being based on the identification of localised patterns of economic change (Iammarino 2005). Iammarino (2005), adapting from Howells identified a bottom-up approach to RIS with localised intervention as one of its six characteristics. These are, however, not mutually exclusive and are often interactive and reinforcing.

This analysis points to problems in theory in such interpretations of RIS. As Asheim et al. (2016) point out, different types of region face different types of systemic problems. This is because of structural differences in different contexts (Asheim et al. 2011) which present challenges for policy makers in formulating region-specific innovation policies. Differences include not only the primacy of the role of entrepreneurs, compared to other actors (e.g. large firms, the balance of large and small firms, universities see Braczyk et al. 1998) but also the extent to which they are Schumpeterian innovators or as is the case of most entrepreneurs, not innovative and likely to stay small (NESTA 2009; Storey and Greene 2010).

Further developments of the RIS concept in which entrepreneurs specifically have played a role in regional change have followed, either as advances in RIS thinking or as related concepts. Cooke (2004) focused on technological and political changes and associated market behaviour. He argued that the knowledge economy has posed new problems from the early model of three different RIS forms: grassroots, network and dirigiste. He distinguished an Institutional RIS from an Entrepreneurial RIS (ERIS). The latter offers good conditions for radical innovation and new industries to flourish, for example in countries such as the US and UK (Asheim et al. 2016). Cooke’s ERIS recognised the importance of entrepreneurs in the form of serial start-ups and by implication policy areas such as incubators and venture finance (Table 1).

The ERIS has a marked orientation towards individual actors and behaviour type of research, while the IRIS has more similarities with conventional innovation system research (Ylinenpas 2009). While the types of policy implications are different in building RIS, the two are not mutually exclusive and are not treated

Table 1 Knowledge economy problem tendencies: Co-ordinated markets to Liberal-markets

Institutional RIS (IRIS)	Entrepreneurial RIS (ERIS)
Research & development driven	Venture capital driven
User-producer relations	Serial start-ups
Technology-focused	Market-focused
Incremental innovation	Incremental & disruptive
Bank borrowing	Initial public offerings
External supply-chain networks	Internal Econets
Science parks	Incubators

Source: Cooke (2004)

here as definitive types rather as an example of a conceptualisation of how RIS may change over time.

Cooke (2016) suggests that the most obvious RIS to transmute into an ERIS more successfully, already by now a platform of intersecting clusters, is Silicon Valley. This is because it does not directly rely on the kind of public regional innovation policy strategising that is found in Europe and many "developmental states" like Singapore and Taiwan in Asia where he suggests that the IRIS system is more pronounced.

Moreover, the emphasis on the entrepreneur may be misplaced. Cooke (2016) for example prefers an emphasis on the enterprise in systems approaches. Defining entrepreneurship policy, however, is not straightforward as it overlaps with SME and enterprise policy (McCann and Ortega-Argilés 2015), discussed later. Further, while entrepreneurship is a local phenomenon it is subject to the influence of a multitude of policy measures that are either not local or are not identifiable as entrepreneurship policies (Acs et al. 2016).

Entrepreneurship policy, as Acs et al., argue, is often an outcome of other policies. These are often national but have geographical specific outcomes and are therefore not mutually exclusive with other policy scales. In the implementation of entrepreneurship policies, there further issues include whether new organisations are needed to fulfil new roles, whether ones that are seen to be lacking in the system need to be created or whether existing ones are adapted so that they address new realities (Uyarra and Flanagan 2013) and thus changing in the face of constantly evolving RIS (Tödtling and Trippl 2013). A further reality check is that most western policies for entrepreneurship have failed (Acs et al. 2016).

Later Isaksen et al. (2016), distinguished between organisationally thick and diversified RIS, organisationally thick and specialised RIS, and organisationally thin regions and RIS. In this conceptualisation, there is a different presence of entrepreneurs, their firms and activities and resources, available within a region. They make the distinction between system-based and actor-based policy approaches. They suggest that the former aims to improve the functioning of the RIS by targeting system failures, promoting local and non-local knowledge flows and adapting the organisational and institutional set-up of the RIS. This is through targeting improved coherence and communication within actor groups. Rather different are actor-based strategies which support entrepreneurs and innovation projects by firms and other stakeholders such as universities. They argue that both strategies will have only a limited impact on regional economic change when applied alone. This relates to Hudson's (2011) experience of policies in the UK's North East (below). They also miss the agency of entrepreneurs who through their presence create a demand for policies.

Qian et al. (2013) develop the concept of regional systems of entrepreneurship. Their aim is to develop a systematic investigation of regional variation in knowledge-based entrepreneurial activity. Their 'model is built upon the absorptive capacity theory of knowledge spillover entrepreneurship that identifies new knowledge as one source of entrepreneurial opportunities and human capital as the major source of entrepreneurial absorptive capacity' (p. 1). They propose a three-phase structural model for knowledge-based regional entrepreneurship systems, in which human capital attraction and knowledge production underpin a boom of new firm formation. Within this conceptual framework, they highlight regional factors that may interactively influence the creation, discovery and exploitation of entrepreneurial opportunities.

Spigel (2015) has sought to elaborate a related concept of entrepreneurial ecosystems. He argues that the attributes of entrepreneurial ecosystems are that they are combinations of social, political, economic, and cultural elements within a region that support the development and growth of innovative start-ups and encourage nascent entrepreneurs and other actors to take the risks of starting, funding, and otherwise assisting high-risk ventures. He identifies ten such cultural, social, and material attributes that compose entrepreneurial ecosystems that provide benefits and resources to entrepreneurs and such that the relationships between these attributes reproduce the ecosystem. Cooke (2016) finds the focus on the entrepreneur and entrepreneurship atomistic, undifferentiated (except in terms of "high-growth") locked into a profit-motive driven perspective.

More recently Lindholm-Dahlstrand et al. (2016) developed the concept of entrepreneurial systems of innovation. This is an analytical and conceptual approach designed to understand the workings of entrepreneurial experimentation in innovation systems, as well as how this experimentation feeds the systems' capacity to generate innovations and economic growth. They argue that entrepreneurial experimentation comprises both 'technical' and 'market' experimentation, and that entrepreneurship must be conceptualized in terms of its function in innovation systems rather than as an outcome. The central function of entrepreneurial experimentation is to foster creation, selection and scaling-up of innovations at the systems level. Examples of micro-mechanisms that feed into system-wide entrepreneurial experimentation include spinoffs and acquisitions. Moreover, interaction between established organizations and new innovative entrants, through spinoffs and acquisitions, is an important characteristic of vibrant entrepreneurial systems of innovation. These characteristics tend not to be dealt with in detail in the RIS concept.

In sum, entrepreneurs have become to assume a more explicit role in conceptualisations of RIS and related systemic approaches. Alongside this focus are implicit and sometimes explicit implications for theoretical bases of policy formation. Next we examine the rationale for entrepreneurial policies in RIS.

3 Entrepreneurship Policies in RIS: Rationale

Policy is intended to be enabling, empowering, and sustaining of the roles of entrepreneurship and enterprise policies in RIS. The proposition is that the policy role changes as the entrepreneurial base of a region, including its entrepreneurs, as individuals and in aggregate, develops. This change means that the nature of RIS become more dynamic, interactive and sustainable as policy advances, in principle to reflect changes in the economic base of a region and in the mindset of its population. Acs et al. (2016) suggest that, if it is accepted that entrepreneurship is a deeply ingrained feature of many Western economies, then it would be no surprise that successful policy measures are likely to involve subtle and pervasive policy initiatives that have the unintended consequences of changing people's minds about the costs and benefits of entrepreneurship. However, in practice there is the issue of whether or not entrepreneurship policy is an add-on to other policies, such as SME policy or other industrial policy (Stevenson and Lundström 2001). A further complication is the pattern that those regions which are entrepreneurial persistently tend to stay so independently of policy intervention (Fritsch and Storey 2014).

To illustrate the overlap between entrepreneurship and enterprise policies, McCann and Ortega-Argilés (2015) classify entrepreneurship policy as applying to the creation of new enterprises while SME policy applies to existing enterprises (Table 2).

Within this classification are different kinds of entrepreneurs which policy-makers might seek to target (see Acs et al. 2016). These include new entrepreneurs in particular sectors, female/male, academic, student, serial, high growth oriented (NESTA 2009). There is some common agreement in the literature as to areas where entrepreneurship policy might be targeted that would help develop and or sustain entrepreneurial regions. These include facilitating access to entrepreneurial resources which are assets, tangible and intangible and are mobilized by entrepreneurs in the process of building a business, organization, or other initiative key elements; finance; human resources including management skills; networks—contacts and advice, property and other infrastructure and equipment.[2] These must be instrumental in the development of a business. Another key target includes the fostering of an entrepreneurial culture. One interpretation of the role of policy is as a network broker to act as a facilitator and connector as in "entrepreneurial ecosystems" (Spigel 2015).

Sternberg and Müller (2005) suggest that new firms should be a priority target as they are crucial for a self-perpetuating process of renewal and restructuring of the knowledge base (see also Feldman 2001). Agency of entrepreneurs is recognised

[2] https://www.reference.com/business-finance/examples-entrepreneurial-resources-8ffc0345a58512be# (accessed Jan 2, 2017).

Table 2 Entrepreneurship and SME strategic policy framework

Entrepreneurship policy	SME policy
Reducing administrative and bureaucracy burden to starting firms	Reducing administrative and bureaucracy burden to sustaining and growing firms
Access to micro loans and seed funds	Access to capital/financing (risk reduction tools)
Provision of information services about start-up	Provision of information services about growth
Highlighting entrepreneurs as role models—gender, ethnicity, age	Exporting and marketing services
Entrepreneurship education	Public procurement
Facilitating network services	Technology transfer and innovation
Incubators and mentoring	Incubators, accelerators, science parks and mentoring
	Value chain development—anchor firms
	Skills development
	Succession planning
Tax incentives for R&D	Tax reduction, tax incentives for R&D

Source: Adapted from McCann and Ortega-Argilés (2015)

but here the focus is on novel Schumpeterian entrepreneurs rather than on more routine entrepreneurs (Acs et al. 2016). However, policy choices will be informed by options created/limited by different kinds of knowledge bases (Asheim and Coenen 2005) as well as the profile of the enterprises in a region.

The reality is that most entrepreneurs are in the service sector and are unlikely to innovate or conduct R&D. Moreover, most new firms do not generate employment other than for the entrepreneur, and have no interest in expanding. Thus an enabling environment might not be enough to change behaviour. Moreover, Acs et al. (2016) also find evidence of policies for example on labour markets and capital markets, that have simply failed to correct the market failures that they were designed so to do. They suggest instead that the interventions required are likely not to sound like entrepreneurship policy.

An application of how entrepreneurs might be best supported based on both points comes from Nauwelaers and Wintjes (2003). It is to classify regional innovation policies into two core types: system orientated (regional) which principally concern network building and brokering, cluster development, innovation system development, cooperation and mobility; and firm-oriented which principally concern access to human capital (e.g. business support and advice, financial capital or physical capital), and are generally aligned with a range of policies focused on entrepreneurship in its broadest context (Huggins and Thompson 2016).

Of the variety of targets for entrepreneurship policy, three interlinked resources provide illustrations of why they are important in supporting entrepreneurs: networks and associated ideas of an innovation and entrepreneurial culture; human capital; and the actual importance of universities in technology transfer. The implications for how each might in turn shape an RIS are considered.

Networks assume a central importance in discussions of regional innovation systems analyses and those which deal explicitly with entrepreneurship in different types of system. Huggins and Thompson (2016) find that successful regional economies have efficient innovation systems resulting from high levels of entrepreneurship and effective network mechanisms. Those with weaker economies are those with failing innovation systems and lower levels of entrepreneurship and less well developed networks. They contend 'that the nature of knowledge networks held by entrepreneurial firms is a key driver of regional rates of innovation and subsequent growth' (p. 14). They propose that a key determinant of regional innovation and growth is the capacity for entrepreneurial firms within regions to establish the network capital necessary for innovation. They point out that entrepreneurship has a regional dimension with differences in start-up rates, the success of start-ups and entrepreneurial attitudes. This suggests that the regional environment has a role in fostering entrepreneurship. Earlier Asheim et al. (2003) had argued that policy could make a difference because endogenous regional development is unlikely to occur without policy intervention to stimulate network formation.

Nauwelaers and Wintjes (2003) suggest that there is a clear requirement to ensure sufficient absorptive capacity and human capital within the regional base of entrepreneurial firms. A policy application of this idea is that more could be done to educate firms in key principles of network management, including a widening regional focus and extending networks to more spatially extensive network systems. Regional policy can play a role in empowering entrepreneurial firms by supporting their being equally treated when establishing joint knowledge-based ventures and strategic alliances with larger firms (p. 120).

Similarly Motoyama et al. (2014) advise that policymakers, entrepreneurship supporters, and entrepreneurs themselves should keep in mind the locally structured nature of entrepreneurial networks. Thus, it will be most effective to communicate with entrepreneurs within a local sphere. They suggest that when creating or promoting new entrepreneurship programmes, policymakers and entrepreneurship-supporters should consider what types of entrepreneur are already served by current existing programs and what types of entrepreneur are still underserved.

The location of high quality human capital is related both to the source of entrepreneurs and to performance of innovative firms, both of which have reinforcing effects. Growing firms create demands for labour which may or may not be supplied locally. However, the quality of labour markets for the highly skilled varies regionally, with some places more favoured than others. Lawton Smith and Waters (2011) for example, position the conceptualisations of the development and function of regional innovation systems with reference to flows of labour and individuals' knowledge and competences in and through geographical spaces.

Their empirical analysis, evidence from a study of scientific labour markets in Oxfordshire and Cambridgeshire in the UK, shows considerable mobility into each region. This supports the argument that the agglomeration of skills (Berry and

Glaeser 2005) is the key component of the making of RIS. It is high levels of human capital that are found to be the source of entrepreneurship (Fritsch and Schindele 2011). The two counties—places which started with higher levels of human capital than most of the rest of the UK—have attracted more skilled people over the last two decades, with demand created by local entrepreneurs, thus creating RIS of particular kinds i.e. those based on analytic knowledge with strong accumulations of codified knowledge.

Other work on mobility, in particular that of return migration, has been identified as being significant in creating an RIS and crucially important in institutionally thin RIS, which are those mainly in non-Western industrialised economies (Sternberg and Müller 2005). These authors report on the case of the biotech sector in China. There, entrepreneurial return migrants enable regions to create high-tech industries and real RIS which are open to inter-regional forces, and are characterised by increasingly inter-regional linkages and networks.

Smilarly, Qian et al. (2013) conclude that human capital attraction and knowledge creation directly promote high technology entrepreneurship. This implies that public policies should be made to encourage the development of high technology industries. They also recognise that this might not be effective for many regions, at least from the cost-benefit perspective relating to the point made by Asheim et al. (2016) on different types of contexts.

The interdependence of processes, hence the problems facing policy makers, is given by Hudson (2011). He found that in the North East region of the UK, regional policy centred on entrepreneurship and the creation of small firms, but the strategy failed to ensure that the necessary skill base was created in the labour force and so failed to bring about significant regional development. In other cases, it is high levels of human capital that are found to be the source of entrepreneurship (Fritsch and Schindele 2011). As Lawton Smith and Waters (2011) point out, compared to the North of England the rest of the UK has attracted more skilled people over the last two decades, in response to a demand created by local entrepreneurs.

Universities sometimes appear as key organisations in the making of RIS (Brown 2016) and other systems that focus on the entrepreneur. Spigel (2015) for example, is clear that policy (economic policies and regulatory frameworks) and universities are important pillars of an entrepreneurial ecosystem which combines social, political, economic and cultural elements within a region. Brown takes issue with this policy emphasis. He presents empirical evidence suggesting the entrepreneurial spillovers from universities have been greatly exaggerated, especially in some peripheral regions. The explanation offered for this poor performance hinges on the substantive disconnect between universities and their surrounding local entrepreneurial and innovation ecosystems. Despite their marginal economic contribution, the author claims that 'policy entrepreneurs' play a powerful role in cumulatively reinforcing the dominant role of universities through a process of 'institutional capture', the outcome of which results in a form of 'policy lock-in'.

A number of issues revealed in this section relate to the rationale (theory and evidence) of entrepreneurs and entrepreneurship policies in RIS, and the subsequent reshaping of RIS relates to differing targets of policy. These include the kinds of knowledge bases, different targets of policy (entrepreneurs versus enterprises (McCann and Ortega-Argilés 2015) (and the overlaps of both); and whether policies are aimed at the individual entrepreneurs or firms, or are based on an entrepreneur or system (Nauwelaers and Wintjes 2003) or system or actor based approaches (Isaksen et al. 2016). A further problem lies in the assumptions as to which organisations and organisational forms have the agency to bring about changes to RIS in relation to entrepreneurship, and the form that the choices then take.

4 Policy in Practice

One of the difficulties in exploring the relationship between entrepreneurship, entrepreneurship policies and the shaping of RIS is, as Cooke (2003) points out, that the innovation needs of the firms in the region (or entrepreneurs) have not been systematically assessed. Cooke (2003) argues that this results in an insufficient interaction between industry and the (innovation) support system. The effectiveness of the innovation support system, in terms of its economic contribution to growth, may be significantly improved when this mismatch is overcome.

The need for such analysis is made by Carlsson et al. (2002) who asked what is the appropriate level of analysis?, how is a system delineated and which actors form the components; what are the key relationships that need to be captured so that the important interaction takes place within the system rather than outside? The corollary is, how is the performance of the system to be measured? Is this measurement to be at system level rather than at the component level?

Some studies have attempted to measure entrepreneurial performance based on a theoretical underpinning of what contributes to performance. By implication they also consider the performance of entrepreneurship policies. General studies include Ahmad and Hoffman (2007) for the OECD[3] and the EU's Entrepreneurship indicator programme[4] (EIP) which 'aims to collect internationally comparable statistics to enable the "measurement" of entrepreneurship i.e. to measure entrepreneurial performance and its determinants and impact' and develop policy relevant indicators on entrepreneurship. Also providing detailed information and analysis on entrepreneurship is the Global Entrepreneurship Monitor.[5] GEM considers two elements: entrepreneurial behaviour and attitudes of individuals, and the national context and how that impacts entrepreneurship.

Next two reports which examine entrepreneurial performance at the regional level are considered in the light of what they contribute to understanding of

[3]http://search.oecd.org/std/business-stats/39629644.pdf (accessed April 23, 2017).

[4]http://ec.europa.eu/eurostat/web/structural-business-statistics/entrepreneurship/indicators (accessed April 23, 2017).

[5]http://www.gemconsortium.org/ (accessed April 23, 2017).

entrepreneurship policies and RIS. These are Santander (2014) and the European Entrepreneurial Regions project.[6]

Santander (2014) reports that entrepreneurial performance is driven by each of 'Attitudes', 'Ability', and 'Aspirations.' The Santander Enterprise Index (SEI) identifies bottlenecks to performance at regional level,[7] thence the performance of RIS. Based on this, regions are benchmarked. The index shows how effectively entrepreneurship is supported across the country and shows that overall the UK performs well, at least in the EU context, with its regions ranked between 2nd and 59th of 125 EU regions.

The analysis, which assesses factors within categories of ability, attitude and aspiration, reveals large variations between the performances of the different UK regions. This is primarily due to a greater premium being placed on aspiration in certain areas of the UK. Santander believes that boosting aspirations in the lower ranked regions will be vital in encouraging enterprise in those locations. London's strong performance in the SEI ranking is due to its 'aspiration premium'. While societal and economic infrastructure in the rest of the UK is strong, entrepreneurs and potential entrepreneurs do not appear to be displaying the same confidence to take advantage of it as their peers in London; too few are getting new products to market, adopting new technologies, or exporting their products and services overseas. The Global Entrepreneurship and Development Institute (GEDI), which did the analysis, believes that this relative weakness in aspirations may be acting as a bottleneck that is preventing many UK regions from performing to their maximum potential.

The European Entrepreneurial regions (EER) project[8] identifies and rewards EU regions which show an outstanding and innovative entrepreneurial policy strategy, irrespective of their size, wealth and competences. A key element is the vision put forward by the region in being granted the label "European Entrepreneurial Region" for a specific year (see Lawton Smith 2016). Thus entrepreneurial policies in shaping an RIS are both part of its organisation, a response to perceived local need, and a reflection of stakeholder engagement in producing that vision.

An evaluation report divided the EER regions into two main groups. The first, 'Group A' includes regions in the 'Imitative innovation area' and in the 'Smart and creative diversification area.' They base their innovation strategy on addressing a regional need or weakness in order to improve regional creativity and attractiveness. These regions—Marche, Northern Ireland, the Region of Valencia, Nord Pas de Calais and the Region of Murcia—have a prevalence of traditional sectors.

---

[6]Another study have explored how to measure entrepreneurial ecosystems at the regional level https://www.henley.ac.uk/files/pdf/research/papers-publications/CFE-2015-02_Szerb_et_al.pdf (accessed April 23, 2017).

[7]https://www.santander.co.uk/csdlvlr/BlobServer?blobtable=MungoBlobs&blobkey=id&blobcol=urldata&blobheader=application%2Fpdf&blobheadervalue1=inline%3Bfilename%3DSantander+Enterprise+Index+2014+FINAL.pdf&blobwhere=1314014342269&blobheadername1=Content-Disposition – accessed December 8 2017.

[8]http://cor.europa.eu/en/documentation/studies/Documents/Forstering_innovation_EER.pdf (accessed January 12, 2017).

The second, 'Group B', includes regions in the 'Smart tech application area', 'Applied science area' and 'European science-based area.' Their innovation strategies reflect their structural strengths. These regions—Brandenburg, Helsinki-Uusimaa, Lisbon, Southern Denmark and Styria—are comparatively better endowed with advanced clusters, research centres, a high level of R&D expenditure and an endogenous capacity of knowledge creation and receptivity, compared to the EU average.

In relation to the one of the three areas of policies examined in Sect. 3: networks and the associated idea of entrepreneurial culture, the finding is that they foster or address the 'culture of innovation'. EER strategies emphasise the importance of innovation in stakeholders. The second aspect concerns the adoption of a 'bottom-up' approach. In order to stimulate R&D and raise awareness about the importance of innovation, both groups have focused on involving the relevant stakeholders from the start.

There is a common willingness of all the EER regions to improve and support the relationship between universities or research centres and SMEs. A further characteristic, which is common to both groups, is the idea that each policy initiative for innovation should enhance human capital. The next element of the EER regions' policy vision is creating new market opportunities for SMEs through innovation initiatives. The last characteristic is a structured and comprehensive innovation policy in which initiatives and projects are implemented. Most EER regions are including their initiatives under the RIS3 strategy, which guides and monitors regional innovation and entrepreneurship policies.

The main achievements of EER both at SME and territorial level, identified by Committee of Regions (COR) (2015) are shown in Box 1.

Box 1 Main outcomes of EER strategy in selected regions

- The change in stakeholder behaviour.
  - All the EER experiences demonstrate important changes in stakeholder attitude towards innovation and investment in R&D.
- An increase in R&D investment, especially among SMEs.
- An increase in employment.
- Better collaboration between the research sector (universities in particular) and enterprises.
- An increase in the number of innovative start-ups.
- The creation of new business opportunities.
- Positive externalities for the territories. Innovation initiatives are an important policy instrument to combat the negative effects of the financial crisis.

Source: COR (2015).

These combine system elements (e.g. changes in attitude and aspirations, positive externalities, networks) and actor components (e.g. increase in the number of innovative start-ups). However, a tension between a conceptual and practical distinction between entrepreneurship, enterprise and innovation policies is clearly illustrated in the conclusions on the achievements of these policies.

Tödtling and Trippl (2013), like COR, identify how policy systems change alongside changing knowledge application systems, knowledge generation and supporting systems. In their framework, examples are given of new policy strategies which combine entrepreneurship and innovation foci e.g. promotion of networks, innovation policies, picking the winner approach e.g. BioRegio in Germany, to new funding agencies e.g. in Austrian regions, and reorganisation of existing policy networks e.g. in Styria.

Returning to Hudson (2011), this author effectively summarises key themes raised in the paper so far: the possibility of transformation of RIS through entrepreneurship and entrepreneurship policies, the importance of different kinds of knowledge bases, changes in policy agenda over time, and the policy recognition of the interdependence between different kinds of entrepreneurial resources, hence for broader policy capacity.

The two cases of successful transformation that he discusses both depend on the development of *related varieties* of the region's knowledge base (see Asheim et al. 2011). Hudson considers the changing character of knowledge in three phases of North East of England economy: (i) the creation of the workshop of the world; (ii) the branch plant economy; and (iii) the new-science-based industries and knowledge transfer from the region's universities. He argues that what is different is the changing significance of knowledge, the varying mixes and types of knowledge, and routes through which they flow into production of goods and services.

He argues that the potential lessons from the cases of successful transitions of the 1990s appear not to have played a major role in the development of the most recent strategy. The problem of transferring and translating analytic knowledge from the universities was not initially addressed, instead the strategy emphasised the promotion of Porterian clusters. Only later was the approach to technology transfer worked out. Hudson notes that it is too early to know how successful the strategy will be, not least because knowledge is only one form of capital and varieties of capital, most notably investment in fixed capital and human capital, are needed to sustain economic development and competitive advantage. As a consequence, entrepreneurship policy also needs to be sensitive to new demands and, following from Acs et al. (2016), they also need to take account of what other de facto entrepreneurship policies exist in the vision of what the RIS policy aims to achieve.

5 Conclusions

The purpose of this paper is to explore a series of issues relating to the role of entrepreneurs in an RIS entrepreneurship policy framework, both theoretical and practical. A basic problem is as Asheim et al. (2016) point out, that different types of regions face different types of systemic problems. These arise from basic structural differences in different contexts (Asheim et al. 2011) which present challenges for policy makers in formulating region-specific innovation policies.

To explore these issues, three main themes have been addressed. The first is why should the agency of both entrepreneurs and entrepreneurship policies be recognised in conceptualisations of RIS? An answer to this is that entrepreneurship is a regional event (Feldman 2001), and a significant one in economic development.

The second is the rationale for entrepreneurship policies in RIS. Here we suggest that policies are intended to be enabling, empowering and sustaining entrepreneurship, enterprise and innovation. We considered networking, human capital and technology transfer as three key elements in these processes. A related question is how entrepreneurship policies help build RIS and whether they are able to adapt over time? The evidence suggests that how RIS are shaped and reshaped relates to different targets of policy as well as policy assessment of what is needed to build on underlying knowledge bases.

The third issue relates to what do entrepreneurship policies look like in RIS and how are they evaluated as contributing towards an RIS? The focus here is on different stages in the emergence of an RIS and of entrepreneurial firms, and hence how the demand for policy changes over time, and how effective policy is. The proposition being explored is that entrepreneurship policies themselves are a response to changes in an RIS. As Motoyama et al. (2014) recognise, entrepreneurs need different kinds of policy support at different stages in their development. This aspect relates to the challenge for entrepreneurial policies of keeping up to date with developments thus possibly hindering the development of an RIS (Isaksen et al. 2016) that has entrepreneurship as a driving force. Their three RIS types require rather different combinations of actor-oriented and system-oriented policy measures.

A number of tensions have emerged in this brief summary. The first relates to defining entrepreneurs when they vary enormously (age, gender, sector and so on). A second is that there is the lack of a clear distinction between entrepreneur, enterprise and innovation policies in the literature and in policy documents e.g. EER. Third, enterprises vary considerable for example in the extent to which they are innovative and have intentions to grow (NESTA 2009; Acs et al. 2016).

Moreover, as Acs et al. pointed out, there is a problem in distinguishing entrepreneurship policies from other kinds of policy interventions. Evidence provided by Hudson (2011) highlights the problem of policy-makers needing to take account of the interdependencies between different kinds of policy processes. All of these lead to the problem of how such varied agenda on entrepreneurship can be successfully incorporated into the several different models of RIS. Specifying which policies are actor-based or system-based policies is a further challenge (Nauwelaers and Wintjes 2003; Isaksen et al. 2016).

Lastly, Fritsch and Storey (2014) show that there is a pattern that some regions which are entrepreneurial stay so for some time independently of policy intervention. Thus entrepreneurship policy has been absent in shaping some kinds of RIS, particularly those based on high-tech entrepreneurship. Thus there is a link between entrepreneurship and RIS, as identified by Feldman (2014) but not necessarily that of entrepreneurship policies and RIS.

In others, evidence from the EER initiative indicates that in some regions, entrepreneurship policies do make a difference in how regions operate. They do this by tackling a combination of entrepreneurship, enterprise and innovation polices which encompass economic, social and institutional factors (Asheim et al. 2011). These include entrepreneurial cultures and networks, human capital and technology transfer. It seems that a key factor in whether entrepreneurs shape an RIS is that of aspirations, both of individuals i.e. Schumpeterian entrepreneurs, and of the policy actors who are there to support them.

References

Acs, Z., Astebro, T., Audretsch, D., & Robinson, D. T. (2016). Public policy to promote entrepreneurship: A call to arms. *Small Business Economics, 47*, 35–51.

Asheim, B., Isaksen, A., Nauwelaers, C., & Tödtling, F. (Eds.). (2003). *Regional innovation policy for small-medium enterprises*. Cheltenham: Edward Elgar.

Asheim, B., & Coenen, L. (2005). Knowledge bases and regional innovation systems: Comparing Nordic clusters. *Research Policy, 34*(8), 1173–1190.

Asheim, B. T., Lawton Smith, H., & Oughton, C. (2011). Regional innovation systems: Theory, empirics and policy. *Regional Studies, 45*, 875–891.

Asheim, B., Grillitsch, M., & Trippl, M. (2016). Regional innovation systems: Past—present—future Paper 2. In R. Shearmur, C. Carrincazeaux, & D. Doloreux (Eds.), *Handbook of geographies of innovation* (pp. 45–62). Cheltenham: Edward Elgar.

Berry, C. R., & Glaeser, E. L. (2005). *The divergence of human capital levels across cities*. NBER Working Papers 11617, National Bureau of Economic Research Inc. Accessed January 30, 2017, from http://www.nber.org/papers/w11617

Braczyk, H., Cooke, P., & Heidenreich, M. (Eds.). (1998). *Regional innovation systems*. London: UCL Press.

Brown, R. (2016). Mission impossible? Entrepreneurial universities and peripheral regional innovation systems. *Industry and Innovation, 23*(2), 189–205.

Carlsson, B., Jacobsson, S., Holmén, M., & Rickne, A. (2002). *Innovation systems: Analytical and methodological issues*. Research Policy, 31, 233–245. https://pdfs.semanticscholar.org/3574/a1ea329193090bc2d6be9b82b4cf3dd8a05b.pdf

Cooke, P. (1992). Regional innovation systems: Competitive regulation in the New Europe. *Geoforum, 23*, 365–382.

Cooke, P. (2003). Editorial: The evolution of biotechnology in three continents: Schumpeterian or Penrosian? *European Planning Studies, 11*(7), 757–763.

Cooke, P. (2004). Regional innovation systems—an evolutionary approach. In P. Cooke, M. Heidenreich, & H.-J. Braczyk (Eds.), *Regional innovation systems: The role of governance in a globalized world*. London: Routledge.

Cooke, P. (2007). Regional innovation, entrepreneurship and talent systems. *International Journal of Entrepreneurship and Innovation, 7*, 117–139.

Cooke, P. (2016). The virtues of variety in regional innovation systems and entrepreneurial ecosystems. *Journal of Open Innovation: Technology, Market, and Complexity, 2*, 13. https://doi.org/10.1186/s40852-016-0036-x. Accessed January 13, 2016, from https://jopeninnovation.springeropen.com/articles/10.1186/s40852-016-0036-x

COR. (2015). *Fostering innovation at regional level: Lessons from the European Entrepreneurial Region (EER) experience*. Accessed January 13, 2017, from http://cor.europa.eu/en/documentation/studies/Documents/Forstering_innovation_EER.pdf

Dahlstrand, L., Andersson, M., & Carlsson, B. (2016). *Entrepreneurial experimentation: A key function in entrepreneurial systems of innovation*. Papers in Innovation Studies Paper No 2016/20.

Doloreux, D., & Parto, S. (2005). Regional innovation systems: Current discourse and unresolved issues. *Technology in Society, 27*, 133–153.

Feldman, M. (2001). The entrepreneurial event revisited: Firm formation in a regional context. *Industrial and Corporate Change, 10*, 861–891.

Feldman, M. P. (2014). The character of innovative places: Entrepreneurial strategy, economic development, and prosperity. *Small Business Economics, 43*, 9. https://doi.org/10.1007/s11187-014-9574-4

Feldman, M., & Francis, J. L. (2006). Entrepreneurs as agents in the formation of industrial clusters Paper 6. In B. Asheim, P. Cooke, & R. Martin (Eds.), *Clusters and regional development*. Abingdon: Routledge.

Feldman, M. P., & Martin, R. (2005). Constructing jurisdictional advantage. *Research Policy, 34* (8), 1235–1249.

Fritsch, M., & Schindele, E. (2011). The contribution of new businesses to regional employment—an empirical analysis. *Economic Geography, 87*(2), 153–180.

Fritsch, M., & Storey, D. J. (2014). Entrepreneurship in a regional context: Historical roots, recent developments and future challenges. *Regional Studies, 48*(6), 939–954.

Hekkert, M. P., Suurs, R. A. A., Negro, S. O., Kuhlmann, S., & Smits, R. E. H. M. (2007). Functions of innovation systems: A new approach for analysing technological change. *Technological Forecasting and Social Change, 74*, 413–432.

Howells, J. (1999). Regional systems of innovation? In D. Archibugi, J. Howells, & J. Michie (Eds.), *Innovation policy in a global economy* (pp. 67–93). Cambridge: Cambridge University Press.

Hudson, R. (2011). From knowledge based economy ... to knowledge based economy? Reflections on changes in the economy and development policies in the North East of England. *Regional Studies, 45*, 997–1012.

Huggins, R., & Thompson, P. (2016). Entrepreneurial networks and open innovation: The role of strategic and embedded ties. *Industry and Innovation, 24*(4), 403–435. ISSN 1366-2716.

Iammarino, S. (2005). An evolutionary integrated view of regional systems of innovation: Concepts, measures and historical perspectives. *European Planning Studies, 13*(4), 497–519.

Isaksen, A., Tödtling, F., & Trippl, M. (2016). *Innovation policies for regional structural change: Combining actor-based and system-based strategies*. Paper given at ERSA conference, Vienna, August 2016.

Lawton Smith, H., & Waters, R. (2011). Scientific labour markets, networks and regional innovation systems. *Regional Studies, 45*(7), 961–978.

Lawton Smith, H. (2016). Ch 20: Entrepreneurial regions in theory and policy practice. In R. Shearmur, C. Carrincazeaux, & D. Doloreux (Eds.), *Handbook of geographies of Innovation* (pp. 334–355). Cheltenham: Edward Elgar.

Malecki, E., & Spigel, B. (2013). *Innovation and entrepreneurship*. Paper presented at 60th North American Meetings of the Regional Science Association International.

McCann, P., & Ortega-Argilés, R. (2015). Smart specialization, regional growth and applications to European Union cohesion policy. *Regional Studies, 49*(8), 1291–1302.

Motoyama, Y., Konczal, J., Bell-Masterson, J., & Morelix, A. (2014). *Think locally, act locally: Building a robust entrepreneurial ecosystem*. Accessed January 12, 2016, from http://www.kauffman.org/what-we-do/research/2014/04/think-locally-act-locally-building-a-robust-entrepreneurial-ecosystem

Nauwelaers, C., & Wintjes, R. (2003). Towards a new paradigm for innovation policy? In B. Asheim, A. Isaksen, C. Nauwelaers, & F. Tödtling (Eds.), *Regional innovation policy for small—medium enterprises* (pp. 193–219). Cheltenham: Edward Elgar.

NESTA. (2009). *The Vital 6%*. Accessed January 30, 2016, from http://www.nesta.org.uk/publications/vital-6

Penrose, E. T. (1959). *The theory of the growth of the firm*. Oxford: Oxford University Press.

Qian, H., Acs, Z. J., & Stough, R. R. (2013). Regional systems of entrepreneurship: The nexus of human capital, knowledge and new firm formation. *Journal of Economic Geography, 13*, 559–587.

Santander Enterprise Index. (2014). Benchmarking the Regional Ecosystem for Entrepreneurs in the UK. Accessed December 8, 2017, from https://www.santander.co.uk/csdlvlr/BlobServer?blobtable=MungoBlobs&blobkey=id&blobcol=urldata&blobheader=application%2Fpdf&blobheadervalue1=inline%3Bfilename%3DSantander+Enterprise+Index+2014+FINAL.pdf&blobwhere=1314014342269&blobheadername1=Content-Disposition

Schumpeter, J. A. (1911/1934). *Theory of economic development*. Cambridge: Harvard University Press.

Schumpeter, J. A. (1942). *Capitalism, socialism and democracy*. New York: Harper & Row.

Spigel, B. (2015). The relational organisation of entrepreneurial ecosystems. *Entrepreneurship Theory and Practice, 41*, 49–72. https://doi.org/10.1111/etap.12167

Sternberg, R., & Müller, C. (2005). *Entrepreneurship in regional innovation systems—a case study of the biotechnology industry in Shanghai*. Accessed April 24, 2016, from http://www2.druid.dk/conferences/viewpaper.php?id=2707&cf=18

Stevenson, L., & Lundström, A. (2001). *Entrepreneurship policy for the future*. Stockholm: Swedish Foundation for Small Business Research.

Storey, D. J., & Greene, F. J. (2010). *Small business and entrepreneurship*. Harlow: Financial Times/Pearson Education.

Tödtling, F., & Trippl, M. (2013). Transformation of regional innovation systems: From old legacies to development paths. In P. Cooke (Ed.), *Reframing regional development* (pp. 297–317). London: Routledge.

Uyarra, E., & Flanagan, K. (2013). Reframing regional innovation systems: Evolution, complexity and public policy. In P. Cooke (Ed.), *Reframing regional development: Evolution, innovation & transition*. London: Routledge.

Ylinenpas, H. (2009). Entrepreneurship and innovation systems: Towards a development of the ERIS/IRIS concept. *European Planning Studies, 17*(8), 1153–1170.

Zahra, S. A., Sapienza, H. J., & Davidsson, P. (2006). Entrepreneurship and dynamic capabilities: A review, model and research agenda. *Journal of Management Studies, 43*, 917–955.

Regional Innovation System as a Framework for the Co-generation of Policy: An Action Research Approach

James Karlsen and Miren Larrea

Abstract

Policy makers in regional development often relate their policies to frameworks proposed by researchers in the field. Of these frameworks, the regional innovation system (RIS) has been one of the most influential. This chapter focuses on the difficulties that arise when policy makers try to enact the RIS and other related frameworks and proposes action research—and, more specifically, a co-generative approach—to help face these challenges. The starting point for this proposal is an analysis of the differences and similarities between the observer and co-generative research approaches. Most research in this field has been developed with researchers positioned as outside observers, and co-generation could help to generate complementary knowledge. In order to explore this complementarity, the chapter presents the co-generative framework for territorial development, which is proposed as a response to the challenges of RIS. These theoretical arguments are complemented with a case study based on an action research process with policy makers in Gipuzkoa (Basque Country, Spain) that has been ongoing since 2009. The discussion of theory and the case lead to the proposal of two relevant challenges for the integration of co-generative frameworks in the RIS community: the challenge of emergence and the challenge of ideology.

J. Karlsen (✉)
School of Business and Law, Department of Working Life and Innovation, University of Agder, Grimstad, Norway
e-mail: james.karlsen@uia.no

M. Larrea
Orkestra-Basque Institute of Competitiveness, University of Deusto, Donostia-San-Sebastian, Spain

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_13

Keywords
Regional innovation system · Action research · Co-generation of policy · Ideology

1 Introduction

Policy makers and researchers all over Europe are working with regional development issues. We use the term policy makers to refer to persons responsible for making policy, especially in governments, including both elected politicians and civil servants (Karlsen and Larrea 2014b). Policy makers are seeking solutions to challenges, and they often turn to the work of researchers for these solutions. Solutions usually involve the launch of new policy concepts. Examples of policy concepts launched in the last decade include *smart specialisation* (Foray et al. 2009, 2011; McCann and Ortega-Argilés 2015; Morgan 2013), *constructing regional advantage* (Asheim et al. 2011a; European Commission 2006), *platform policies* (Cooke 2007; Harmaakorpi 2006) and *place-based development* (Barca 2009). These are part of a trend of *new industrial policies* (Moodysson et al. 2017; Rodrik 2004), among which, at present, smart specialisation ranks at the top of public policy agendas in many European regions (Moodysson et al. 2017).

Putting these concepts into action is a complex challenge. Our main argument in this chapter is that the RIS research community can improve our capabilities to face this challenge by integrating co-generative frameworks into research methodologies. Policy makers need more than simply analysis and new concepts; they also need spaces for reflection that can help them make sense of challenges and construct decisions to face them. Through co-generation processes, action research can help construct these spaces, thus strengthening the RIS community's contribution to policy making.

Consequently, our proposal to the RIS research community in this chapter is to complement actual RIS research approaches with co-generation in order to find robust and sustainable solutions to regional challenges. *Co-generation* is a way of working together with policy makers that differs from the traditional linear knowledge transfer mode, sometimes called STI (Science, Technology and Innovation) mode. It is a form of interaction that might challenge the assumption that researchers should work together with policy makers solely as outsiders and neutral participants.

Co-generation is not a new concept. Rather, it is a concept we have adopted from action research—and, more specifically, from Greenwood and Levin (2007)—and adapted to territorial development challenges (Karlsen and Larrea 2014b). It is a form of interaction that we have tested in practice since 2009 via a research project together with the Provincial Council of Gipuzkoa, Basque Country, Spain. The outcomes of the co-generation process have been reported in earlier publications (see, for example, Karlsen and Larrea 2014a, b, 2016, 2017).

Following the previous arguments, the aim of this chapter is to provide a better understanding of what interaction between universities and academia implies, especially in the context of policy-making processes. The RIS approach tends to highlight the importance of interaction. However, interactions related to policy recommendations are often presented as black boxes (or boxes with arrows), with no insights or elaborations related to how they might look in the real world. By proposing the integration of action research and co-generation into the RIS approach, we propose opening this black box and incorporating insights from action research into the RIS exploration of how interactions happen.

In order to fulfil this aim, the chapter first presents relevant theoretical concepts about RIS and policy making, action research and the positionality of researchers in innovation policy research. These are complemented by a discussion of the co-generative framework. After that, we present the method, context and data used in this chapter, as well as the case, which has been divided into two parts in order to address two issues considered critical for co-generation. The first case addresses the emergent nature of territorial development strategies, and the second explores the acceptance of researchers' ideological positions. The chapter ends with a discussion of the cases and conclusions.

2 Conceptual Framework

2.1 The Regional Innovation System Approach and Policy Making

In the last three decades, the RIS approach has attracted increasing attention from the academic community (Asheim et al. 2011b), largely due to more advanced theoretical analyses and the need for new policy approaches and solutions to regional challenges. The strength of the RIS approach is its analytical approach, which can be used to describe and analyse innovation systems. Researchers have constructed different innovation system typologies, such as thin, fragmented and thick (Tödtling and Trippl 2005). Others have recently proposed change-oriented concepts of path development, such as path extension, path renewal, and new path creation (Isaksen 2015).

Despite the success of the RIS approach, it involves several challenges that need to be discussed. One such challenge is policy. Policy has been critical to the evolution of innovation system studies since the launch of the concept (Lundvall 1992). Policy-making is important for constructing a well-functioning RIS (Tödtling and Trippl 2005). Trippl and Tödtling (2007) illustrated the importance of policy by adding it as an explicit subsystem (in addition to knowledge generation and diffusion and knowledge application and exploitation) in the RIS approach.

The scarcity of studies of policy learning processes within the RIS approach (Borrás 2011) is, therefore, a surprise. Leading academics, such as Asheim et al. (2013), admit that evolutionary frameworks, such as the RIS approach, have a rather underdeveloped view of policy and are limited to normative assertions about what policy should look like. By integrating co-generative frameworks into the RIS approach, this chapter aims to contribute to the development of new perspectives on policy and policy learning in RIS.

2.2 Action Research

The term ‘action research’ was coined by American psychologist Kurt Lewin (1948) in the early 1940s (Bargal 2014). Over time, action research (AR) spread to a wide range of fields (Greenwood and Levin 2007). The field on which we have been working since 2008 is action research for territorial development (Karlsen and Larrea 2014b). This field is a combination of the RIS approach and the working life research tradition in Norway and is influenced by Pablo Freire and, in particular, his educational principles (Freire 1996, 2008a, b). The working life research tradition in Norway has a long history, beginning with Emery and Thorsrud (1969, 1976) in the 1950s. This tradition was later further developed by such as Greenwood and Levin (2007), Gustavsen (1992), Toulmin and Gustavsen (1996) and Pålshaugen (2004).

What unites the different action research approaches is their integration of action, research and participation through cyclical processes of reflection and action. The purpose of the cyclical process is to construct understanding and improvement step by step through processes involving the joint participation of both researchers and problem owners (e.g. policy makers, representatives of firms, labour organisations). AR is well suited for complex contexts in which how to do ‘best’ is a subject of discussion and negotiation (Bradbury 2015). This is why AR is the framework we propose to use to integrate co-generative processes into innovation policy research.

2.3 Observer and Co-generative Positions in Innovation Policy Research

In this section, we present our experience-based theoretical contribution at the intersection of RIS and AR. By participating in action research processes connected to innovation policies, researchers are able to affect rules, relational ties and the distribution of resources. This requires some reflection on the positionality of researchers, since no potential position should be taken for granted. Consequently, it is important to have a positionality discussion in order to understand the impact of research on policy. This chapter develops just such a discussion by examining two specific positions: *observer* and *co-generative*. Since most of the chapter focuses on co-generative positions, we use this section to share our experience with and perspective on observer positions.

The observer position is the most common position in RIS literature. We have worked as observers studying the phenomena of regional innovation and published research from this position (see, for example, Doloreux et al. 2012; Flåten et al. 2015; Isaksen and Karlsen 2011; Karlsen et al. 2011; Larrea 2000; Larrea et al. 2010; Navarro and Larrea 2007). Thus, we develop our argument on this position based on our own examples. The following citation is from a paper on the oil and gas cluster in the Agder region in Norway:

> *. . .our argument is that changes from one dominant mode of innovation towards another mode of innovation in a cluster [. . .] can change the relationship and the pattern of regional collaboration between cluster companies[. . .] not all cluster companies change their mode of innovation in the same way; e.g. that some companies do not manage to upgrade their mode of innovation to become more research based while others do.* (Isaksen and Karlsen 2011)

University and social researchers (e.g. the authors of the above paragraph) are part of the knowledge subsystem that can help companies struggling to upgrade their mode of innovation. However, this role is not discussed in either the preceding paragraph or the rest of the paper from which it was drawn. As the authors of this work, we observed clusters and companies in their efforts to upgrade, but did not introduce ourselves as part of their problem or their potential solution. As researchers, we were positioned outside the problem, not as problem-owning actors of the same territory.

This does not mean that there is no interaction or dialogue. However, though some studies require dialogue with territorial actors, this dialogue is mostly conducted to gather data for the researcher to analyse, describe or demonstrate something, and not to change the researchers or the actors. In other words, data are usually generated through surveys and personal interviews and then used to demonstrate a theoretical point, such as in this study:

> *Based on data from the Agder equipment supplier industry we demonstrate that mobility of labour, local buzz and inter-organizational linkages are key regional knowledge sources.* (Isaksen and Karlsen 2012)

In Table 1, distinctions between the observer and co-generation positions are identified for three types of outcomes (data, usefulness for research and outcomes) of a research process.

Concerning data, the main difference is that, as co-generators, researchers have access to processes as they unfold in real time. In interviews, practitioners often share their perspectives on specific issues. In co-generation, such perspectives are constructed jointly practitioners and researchers, allowing researchers to engage with perspectives not only as products, but as processes. Therefore, while researchers who are outsiders can give policy recommendations and even offer feedback on them, they cannot participate in the reflection processes of policy makers or discuss and internalize their contributions to transform them into potential actions. As co-generators, however, researchers continue working with policy makers after their concepts, frameworks and recommendations have been delivered.

The last outcome, codified research, is, in our experience, similar across both approaches. Academic production based on co-generation usually takes a different form and content than production based on observer positions. There are journals that publish papers based on action research processes and co-generation, but they

Table 1 The differences and similarities between the observer and co-generation positions

Position outcomes	Observer	Co-generation
Data	Generated from surveys, interviews and secondary data	Generated from direct participation and long-term dialogue with practitioners, as well as from surveys, interviews and secondary data
Usefulness for policy	Policy recommendations	Emergence of policy
Codified research	Peer-reviewed research articles and books	Peer-reviewed research articles and books

Source: Self-elaboration of own data

remain scarce in the RIS field. The challenge is to generate academic environments that accept a variety of positionalities, as long as the findings are interesting for the field.

This section departed from observer positions to compare them with co-generative ones. The rest of the paper focuses on sharing an action research framework that helps to introduce co-generation into RIS.

3 Co-generation of Policy

In this section, we will discuss the basic principles of policy co-generation between researchers and policy makers (see Fig. 1). We begin by defining what the co-generation of knowledge is *not*: an elastic or rhetoric term for any form of working together (i.e. any form of interaction). Rather, it is a specific form of working together for creating knowledge. It requires, on the one hand, a well-prepared design, and on the other, a learning approach, since the process will generate non-expected outcomes. It is a long-term process and an intense form of interaction. Furthermore, it requires the goodwill of both policy makers and researchers to work together under conditions of insecurity about process outcomes, particularly given the intensity and potential for failure of co-generation.

The co-generative framework presented in Fig. 1 was inspired by the co-generative framework developed by Greenwood and Levin (2007), which we adapted into a new framework (Karlsen and Larrea 2014b). The new framework begins with the concept of regional complexity. First, a policy process involves a series of actors (e.g. representatives from firms, policy makers and researchers) who share the same challenge but have potentially different interpretations of what the main policy problems are and what their solutions could be. Second, these actors all have partial knowledge of the challenge, and nobody knows what the right actions are to solve the challenge. Third, none of the actors is in a position to instruct others on what to do. Fourth (and because of previous sentence), the actors have to collaborate in order to solve the challenge (Karlsen 2010; Karlsen and Larrea 2014b).

The process of moving from an awareness of regional complexity to the development of collective knowing is not necessarily simple or straightforward. A

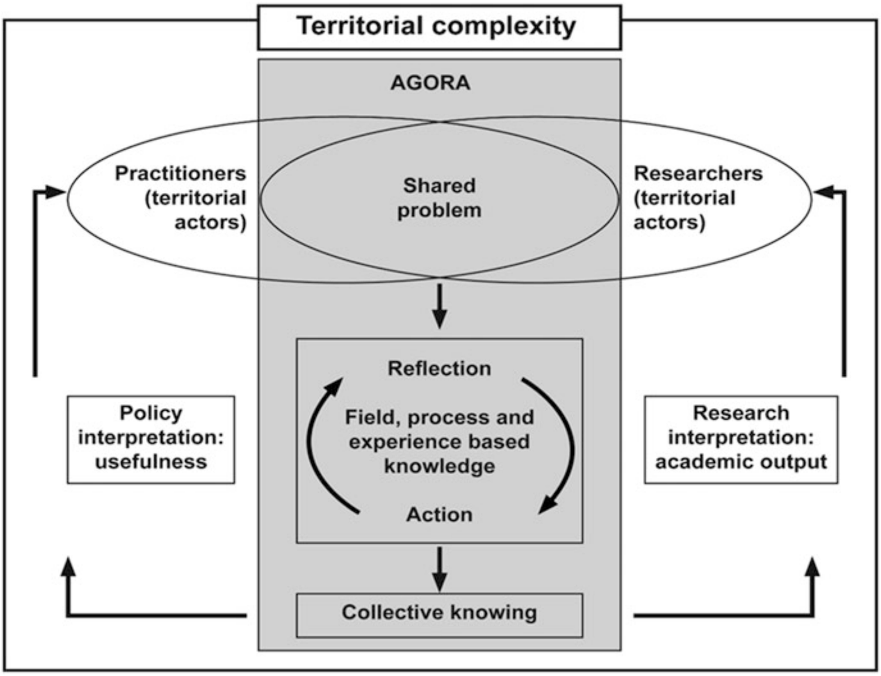

Fig. 1 Co-generative framework for territorial development. Source: Karlsen and Larrea (2014b, p. 100)

co-generation process consists of three distinct phases, which are developed cyclically and which are not as clearly separated one from another in practice as the analytical framework suggests. These phases are: the definition of a shared problem, reflection and action and, finally, the construction of collective knowing (Karlsen and Larrea 2014b). In the following, we present these different stages in more detail.

The first phase is about discussing and defining the problem that researchers and policy makers are going to address together. This is a process of negotiation, since it is important for the issue at this stage to be relevant to both policy makers (as a problem to solve) and researchers (as an issue to research). This process is often mediated by a discussion of how the policy co-generation process will be funded. The co-generation of knowledge has a long-term perspective, since it takes time to reach a shared understanding of *what* a problem actually is and *how* representatives are going to work together to find a solution to a situation of regional complexity. In this first phase, it is important for the participants to acknowledge that there is no quick fix to the problem and that the participating actors have to work together to generate a solution to the problem. When this shared understanding is reached, the participants can begin concrete reflection and action processes. Thus, while a shared vision of long-term challenges is developed, it is important to generate short-term decisions that align with the long-term vision, but also create the possibility to act and learn from action.

The second phase combines three types of knowledge. One is *field knowledge* (i.e. theoretical knowledge); the second is *experience-based knowledge* generated through the work–life experiences of the various participants (Gustavsen 1992); and the third is *process knowledge*, which is a type of experience-based knowledge connected to the role of the facilitator.

The results of the co-generative process include not only the specific policy solutions derived from the policy makers' decisions or the researchers' data, but also, in the long-term *collective knowing*. We define collective knowing as a capability: a learned pattern of collective action that helps policy makers and researchers systematically modify their actions over time through a shared learning process (Karlsen and Larrea 2014b).

As these cycles develop, there are moments when policy makers and researchers must distance themselves from one another. Policy makers evaluate the usefulness of a process and whether they are willing to continue with it, and this may lead to a redefinition of the shared problem or even a decision to end the process. On the other hand, researchers develop their academic output and share it in academic communities, where the knowledge generated is tested. Again, this step can lead to a redefinition of shared problems and a questioning of the value of the process.

4 Method, Context and Data

Gipuzkoa Sarean (GS) is a research project that was initiated in 2009 by the Provincial Council of Gipuzkoa and has followed the previously proposed framework for co-generative policy. The research team from the Orkestra-Basque Institute of Competitiveness entered the process at the beginning with the agreed goal to develop an action research approach.

Though action research and the co-generative framework have been involved in the process from the beginning, their relevance has varied over time. At the time of this chapter's writing, action research is the project's main research approach, and the co-generative framework is extensively shared between the policy makers and researchers as their pattern of relationship and process perspective. Table 2 shows the main features of the project's trajectory.

Both of the authors of this chapter have been part of the GS team since 2009, one as a research coordinator with nearly full-time dedication to the project, and the other as an outsider, who has continuously debriefed on the process and elaborated its academic output. The data used for the chapter were collected via a systematization of the dialogues with policy makers through diaries, reports and minutes.

In the following two sections, we present two features of the co-generation framework that we consider critical for materializing the potentiality of RIS co-generation: the emergence of strategy in the policy process and the ideological positions of co-generation researchers.

Table 2 Stages of Gipuzkoa Sarean

Period	Policy goal	Main academic concepts used	Results
2009–2011	Increase social capital to improve competitiveness	Social capital, competitiveness, values, community	Reports diagnosing social capital; knowledge of how to work together
2011–2013	Propose a new territorial development model for Gipuzkoa	Territory, territorial development, complexity, participation, action research, facilitators	A document with the agreed government proposal, including a new model for territorial development; establishment of a new territorial development directorate with the aim of proposal implementation
2013–2015	Implement a new relationship pattern to sustain the new territorial development model for Gipuzkoa	Governance, strategy, capabilities, shared vision, trust	Establishment of two spaces for dialogue between the Provincial Council and county development agencies[a]; two decrees defined in participatory processes
2015 and onwards	Develop more efficient policies for SME competitiveness based on the new collaborative governance constructed between the council and county development agencies	Multilevel governance, efficiency, SME competitiveness, Industry 4.0	A formal agreement between the Provincial Council and county development agencies on how to work together (inspired by AR and based on the spaces for dialogue created in the previous phase)

[a]Counties are supra-municipal and sub-provincial territorial units in which county development agencies owned by various municipalities operate. Gipuzkoa is home to eleven counties, each with an agency

Case 1: Emergence of a new territorial development strategy. The GS phase that lasted from 2011 to May 2013 was used to develop cycles of reflection and action that led to a government proposal to other territorial actors concerning a new model of territorial development based on participatory processes. In May 2013, a new Directorate for Territorial Development was established for the purpose of implementing the proposal.

In the period prior to the creation of this new directorate, the dialogue between the policy makers and the researchers focused on how the newly conceptualized territorial development approach could be connected to practice. In the middle of these discussions, a researcher publicly criticized the Provincial Council's lack of strategy. This public critique initiated a process of reflection within the co-generative process that led to the decision for GS to have no strategic plan (since the government did not believe in using such an instrument for this process), but to continue to have a strategy (Aranguren and Larrea 2015). The government had won elections with a very strong discourse favouring participatory policy making, and it felt that having a government plan describing policy for regional development would be contradictory. Instead, it sought to build a new governance mode in which other territorial actors could participate and through which the government and other actors could collectively decide what was to be done (i.e. develop a shared strategy). We will now describe how this shared strategy was developed.

GS researchers have proposed several concepts and frameworks in their discussions with policy makers. Though some of these were not integrated into the process (e.g. smart specialisation, which is, at the time of this chapter's writing, being reconsidered), others helped to shape the project's sense-making and are integrated into the shared language of the policy makers and researchers. These concepts have all become part of the co-generation of policy. With respect to the development of a shared strategy, the policy makers drew on Mintzberg et al.'s (1998) strategy book, which proposes ten approaches to strategy. The book argues that the most influential approach is the planning approach, but that there are other approaches which, when used in a complementary way, can improve strategy formation.

After some dialogue between policy makers and researchers, three of the schools—the learning, power and cultural schools—were integrated into the process. Building on these reflections, the strategy for the new territorial directorate was anchored in the cornerstones of learning, negotiation and collaboration, inspired by Mintzberg et al. (1998) and reinterpreted by the participants to respond to the specific context of GS. The government's decision to not have a strategic plan for the project was being criticised by the media, which argued that not having a plan meant not having a strategy. Mintzberg et al.'s (1998) work helped the government illustrate that it was possible to have a strategy without having a strategic plan.

The first cornerstone, *learning*, required structured meeting places in which different territorial actors met to learn every 1 week to 2 months. The meetings were facilitated by researchers and, in some cases, consultants, who contributed with their process knowledge. Field knowledge was contributed mainly by the researchers, and all participants offered experiential knowledge. The dialogue focused on decisions for action. The second cornerstone, *negotiation*, was integrated into the dialogue process by making the participants aware that the dialogue was also a process of negotiation mediated by power and leading to a potential agreement to act (inspired by the power school) (Mintzberg et al. 1998). The territorial actors participating in the learning spaces had already integrated the concept of regional complexity (e.g. different interpretations of the problems and their potential solutions) into their shared language and working methods, and negotiation was assumed to be a natural way to solve such complexity. In some of the learning spaces, negotiation became so relevant that the spaces were renamed spaces for negotiation; yet, the negotiation was still always combined with learning. This meant that the actors were not only learning together, but doing so in a context in which each defended his or her own interests and influenced the process in the direction(s) they felt right for such interests.

The third cornerstone, *collaboration*, sought to help the territorial actors co-generate shared goals (inspired by the cultural school) that would be meaningful for all of them. The shared goals mainly involved making the economic development policy processes more democratic and efficient. In the vein of Mintzberg et al. (1998), it was suggested that the highest potential for collaboration would emerge if the participants were capable of connecting the process to their beliefs and values. This led to exercises in which, for instance, policy makers reflected on the role that *utopia* could play in the change process—a topic that would have been more difficult to approach before the discussion of the relevance of beliefs and values.

Case 2: Acceptance of the ideological positions of the researchers. Following the creation of the new Directorate in May 2013, a training process was developed for the staff of the 11 county development agencies involved in GS. The goal was to generate the agencies' capabilities to implement a new model of territorial development. The training process was developed for nearly 1 year through workshops connecting theory (mostly contributed by the researchers) and reflections from practice (mostly contributed by agency staff).

When the time came to decide on activities for 2014, the researchers suggested that it made no sense to continue analysing and reflecting. The staff from the agencies had already reflected on the concepts and the situation, and it was important to give them the opportunity to act. In other words, without action, there was no possibility to continue learning. This perspective was closely linked to the researchers' belief that the way to proceed was to intertwine reflection and action. This idea was not immediately accepted by policy makers, but researchers maintained their position and, eventually, the Provincial Council and the agencies signed a collaboration agreement. A funding program was defined in which each agency had the opportunity to present a project to develop one of the five critical challenges the staff had identified in the previous training process. Using this approach, the 11 agencies defined a project, which was accepted. These projects were the responsibility of the staff participating in the GS meetings, and they offered a way to balance the reflection and action required by action research.

The main theoretical contribution to the discussion between the policy makers and the researchers was the action research co-generative framework, presented earlier in this chapter. The main argument referred to the cyclical process of reflection and action at the framework's core.

When the GS researchers maintained their position against the policy makers' perspective and negotiated the next step in the process, they did so by firmly defending the research methods that had been agreed upon. Still, their positions on research influenced policy to the extent that a new program was defined and funded. This shows how researchers were not only facilitators, but also actors involved in the process (researcher–actor)—and, as such, process influencers. We now take this argument one step further: a step that is often difficult to accept in research environments. Researchers influenced the process based on their ideological positions, since the choice for action research—with all its meanings related to knowledge construction and participation—is, ultimately, an ideological position.

Table 3 Summary of the main findings from the cases

Period	Change	Challenge related to co-generation of policy	Main theoretical influence
2011–2013	Shift from planning approaches to emergent ones (learning, negotiation, collaboration)	The government's aim to build a new governance mode without having a strategic plan	Mintzberg et al. (1998)
2013–2015	Explicit acceptance of the ideological positions of the researchers	Clearer definition of the roles of the researchers and policy makers	Freire (1996, 2008a)

These reflections, when shared with policy makers in an explicit way, helped develop the understanding that the research team was not a service bought or allocated by the government, but a strategic ally in the development of policy. In other words, the researchers were not just instrumental, but other territorial actors with their own positions in the dialogue process. This learning process took time, but was made explicit in the press release that the Provincial Council sent to local newspapers 5 months later:

[Gipuzkoa] Sarean means learning how to share, it is territorial development based on counties. In order to start this new model, we have had to create it in collaboration. And, no doubt, Orkestra has been critical to help us have the scaffold on which we have defined the model that has later been transformed into the participatory governance (Press release of the Provincial Council of Gipuzkoa, 21 May 2014).

5 Summary of the Cases

Table 3 synthetizes the main findings from the cases. It lists the period, the main change, the co-generation challenge faced and the main theoretical influence in the dialogue process. We will now use this presentation to discuss how action research, as an approach to the co-generation of policies, can contribute to the development of the RIS framework.

6 Discussion: The Challenges of Co-generative Policy Making in RIS

6.1 The Challenge of Emergence

The first challenge is what we call *the challenge of emergence*, described in the first case. The case illustrates how the researchers and policy makers had to collaboratively adapt their working styles to respond to the specific governmental situation. The challenge was that the planning perspective, which the policy makers wanted to discard, was deeply rooted in how most of the participants (policy makers and researchers alike) conceived of the policy process. We realized that, though we were following the action research framework of the discourse on cyclical reflection and action, our perspectives of the process were shaped by the planning principles. Most of the policy makers would have felt safer having a strategic plan, since this would have made it easier to communicate that the government had a strategy. Similarly, the researchers would have felt safer elaborating diagnoses and recommendations to show that we had done our job. However, when the policy required emergent strategies, the policy makers and researchers had to adapt to respond to the challenge of emergence by walking on untrodden ground.

Our argument is that situations requiring emergent policy processes are common in the RIS framework. One example in the recent literature on smart specialisation is the entrepreneurial discovery process, which is defined as a process that informs new activities of exploration and transformation that are likely to be prioritized (Coffano and Foray 2014). A government cannot plan how entrepreneurial discovery will happen, yet governments still need a strategy to support entrepreneurial discovery.

In order to support emergent processes, researchers need emergent research strategies. Action research contributes to this with the concept of praxis, which breaks with linear approaches in which researchers first read, then gather data, analyse, reach conclusions and propose recommendations and tool kits for policy makers. Praxis is influenced by the philosophical tradition of pragmatism, which argues that action is the only way to generate and test new knowledge (Greenwood and Levin 2007). The pragmatist tradition claims that the value of knowledge is equal to its practical use. Thus, praxis proposes a type of interaction in which concepts, frameworks, data are continuously shared and tested in action.[1] In other words, it is the process through which theoretical concepts are continuously tested in practice so that they are either discarded or made more robust, contributing to both the academic development of conceptual frameworks and the practical solution of problems. What researchers share in an action research process are not solutions constructed by researchers and offered to policy makers in terms of recommendations; rather, researchers join the process of co-generating solutions with policy makers, so that the result—in terms of both practical solutions and new theoretical contributions—belongs, in a way, to all of them.

In a nutshell, interaction does not happen as a way to share knowledge that has already been produced, but as a way to produce knowledge. Integrating action research into the RIS framework could allow this type of praxis-based approach to develop more systematically and with greater process awareness. The co-generative

[1]Using the term *praxis* can be problematic, since the ordinary use of the term can be quite different from what we mean. For example, the Academy of the Spanish language defines praxis as practice, rather than theory. This is radically different from what we mean by this term in this chapter, since we refer to a specific relationship between theory and practice that is in no way the absence of theory.

framework proposed in this chapter is not a recipe for co-generation, but a guide for the dialogue created by actors when designing policy co-generation.

6.2 The Challenge of Ideology

The second challenge we faced in the co-generation process was the ideological discussion. Important policy documents, such as *smart specialisation, constructing regional advantage, platform policies* and *place-based development,* as mentioned in the introduction, have been developed by leading academics within the RIS approach. These frameworks and concepts are meant to guide policy and have been created at the request of policy makers. They have then been used by researchers to interact with policy makers in the organizations that have requested these developments (often the European Commission or the OECD), as well as with a significant number of regional policy makers. Still, in most of the academic papers in which these researchers describe situations, processes and cases, the researcher is not presented as part of the story, since it is taken for granted that the researchers take an observer position and do not influence the process. However, many do, often in ways that are not made explicit.

Our argument is that an awareness of the influence of researchers is relevant because every researcher has an ideological position (Diesing 2012; Herr and Anderson 2005). According to Diesing (2012), having an ideological position means having a standpoint and a perspective. A standpoint is a position in society with which a researcher identifies or relates, while a perspective is the angle of vision from the standpoint. Methodological differences are one expression of more fundamental differences in standpoint and perspective (Diesing 2012).

Co-generation supports the generation of different types of knowledge, which we find to be useful for both policy makers and the academic discussion of RIS. However, in order to accomplish this knowledge generation, it is important to discuss the underlying ideological position, which we connect to a specific interpretation of researchers' legitimacy to influence the policy process.

The GS experience illustrates a case in which researchers were recognized as having the legitimacy to influence policy due to a process of negotiating and agreeing with policy makers concerning the methodological approach. We see action research as the ideological position in the case's co-generative processes and suggest that, by negotiating our participation in GS as action researchers, we encouraged the policy makers to recognize our legitimacy to influence policy. These continuous negotiations between the policy makers and researchers on the role of action researchers and their methodologies led to a combination of reflection and action and the testing of theoretical concepts in practice, as proposed by the action research concept of praxis. The researchers' argument was that, in order to maintain co-generation, it was necessary for the participants to implement the discussed concepts in practice.

We can, therefore, argue that, though the researchers in the case did not replace policy makers in the political decision making process, they did influence policy from their ideological positions, which were made explicit in terms of the methodological requirements of action research. This means that, when action research is negotiated as a method of co-generation between policy makers and researchers, policy makers legitimize researchers to influence policy. However, this legitimation is restricted to the rules of the game of action research, and researchers must avoid influencing the process in ways that have not been agreed. In our practical experience, such rules of the game were primarily agreed through the discussion of the co-generative framework presented in this chapter.

There is a final reflection on this discussion. By recognizing their legitimacy to influence the process of policy creation, policy makers accepted researchers as non-neutral insiders to the co-generation process. This legitimation was limited by boundaries, such as the understanding that the researchers would not supplant the policy makers in their decision-making process. However, the researchers could work around these boundaries through the ongoing dialogue, which allowed them to influence the reflections that preceded all decision making.

For this reason, to avoid manipulation, it is crucial to implement one critical feature of the dialogue process: specifically, action researchers must continuously empower policy makers to work with the concepts and frameworks researchers propose, developing their capability to be critical of what researchers contribute to the dialogue. What legitimizes the researchers' role in the co-generation process is the policy makers' ability to make better decisions based on research itself, rather than researchers' proposals. This does not mean that policy makers do not ask for researchers' opinions; rather, it means that such insights must be integrated as additional inputs in the co-generative process, without the expectation that policy makers will implement researchers' exact suggestions. Avoiding this last perspective requires both researchers and policy makers to learn their respective roles in co-generative processes.

7 Conclusion

In this chapter, we have examined the co-generation of policy as a specific form of interaction between researchers and policy makers. Though action research is little known within the RIS approach among both policy makers and researchers, our argument is that it suits the regional development challenges to which researchers are often asked to contribute. In the case of GS in Basque Country, we have demonstrated that this approach is possible to implement in practice. This summary emphasizes three theoretical lessons from the aforementioned discussion.

The first contribution was presented in the theoretical section and relates to *positionality*. Both researchers and policy makes can have positions as either insiders or outsiders to the policy process. These positions must be clear and explicit. In a co-generative approach, the researcher is no longer an observer, but an active participant. In this position, the researcher both influences and is influenced by the process. Compared to an observer position, a participant position is more challenging because, as a participant, the researcher must make research decisions in-action (Schön 1983), rather than simply observing and discussing other actors' actions after these actions have been completed.

The other two lessons come from the discussion of the case. The first is the *challenge of emergence*. By this, we mean that new policy *can* emerge out of a co-generative policy process between researchers and policy makers. However, for many researchers and policy makers, co-generation implies changing a very deeply rooted framework: the planning approach, which is connected to the linear mode of knowledge production. This change in the framework of knowledge production can be challenging because the knowledge production framework is deeply embedded among both policy makers and researchers as *the* norm for knowledge production—and, consequently, is often taken for granted. To achieve successful co-generation, it is crucial to remember that the knowledge production framework is a socially constructed norm that can be changed, as the case of GS shows.

The third lesson has to do with *ideological positions*. Every school of research has a societal standpoint and perspective with which researchers identify. In a co-generative policy process, it is crucial for the standpoint and perspective of action research to be made explicit to participants. It is important that researchers, as active participants, present the co-generative framework clearly and agree on it with policy makers. This process of making their position explicit will generate the legitimacy that will later allow the researchers to defend their positions in situations of conflict, making it clear that they are not supplanting policy makers in the decision making process, but, rather, playing their own role.

References

Aranguren, M. J., & Larrea, M. (2015). Territorial strategy: Deepening in the 'how'. In J. Valdaliso & J. Wilson (Eds.), *Strategies for shaping territorial competitiveness* (pp. 55–72). Abingdon: Routledge.

Asheim, B. T., Boschma, R., & Cooke, P. (2011a). Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies, 45*, 893–904.

Asheim, B. T., Smith, H. L., & Oughton, C. (2011b). Regional innovation systems: Theory, empirics and policy. *Regional Studies, 45*, 875–891.

Asheim, B. T., Bugge, M., Coenen, L. and Herstad, S. (2013). *What does evolutionary economic geography bring to the policy table? Reconceptualising regional innovation systems.* CIRCLE working paper series. Lund University, CIRCLE – Center for Innovation, Research and Competences in the Learning Economy.

Barca, F. (2009). *An agenda for a reformed cohesion policy. A place-based approach to meeting European Union challenges and expectations*. Independent report prepared at the request of Danuta Hübner, Commissioner for Regional Policy.

Bargal, D. (2014). Lewin, Kurt. In D. Coghlan & M. Brydon-Miller (Eds.), *The Sage encyclopedia of action research*. Los Angeles: Sage.

Borrás, S. (2011). Policy learning and organizational capacities in innovation policies. *Science and Public Policy, 38*, 725–734.

Bradbury, H. (2015). Introduction: How to situate and define action research. In H. Bradbury (Ed.), *The Sage handbook of action research* (3rd ed.). Los Angeles: Sage.

Coffano, M., & Foray, D. (2014). The centrality of entrepreneurial discovery in building and implementing a smart specialisation strategy. *Scienze Regionali-Italian Journal of Regional Science, 13*, 33–50.

Cooke, P. (2007). To construct regional advantage from innovation systems first build policy platforms. *European Planning Studies, 15*, 179–194.

Diesing, P. (2012). *Science and ideology in the policy sciences*. New Brunswick: Transaction Publishers.

Doloreux, D., Isaksen, A., Karlsen, J., & Dionne, S. (2012). Constructing regional advantages in peripheral regions: Analysis of two localised productive systems. *Norsk Geografisk Tidskrift, 66*, 144–154.

Emery, F. E., & Thorsrud, E. (1969). *Form and content in industrial democracy*. London: Tavistock Publications.

Emery, F. E., & Thorsrud, E. (1976). *Democracy at work—the report of the Norwegian industrial democracy program*. Leiden: Martinus Nijhoff Social Sciences Division.

European Commission. (2006). *Constructing regional advantage: Principles—perspectives—policies*. Final DG Research Report. Brussels: European Commission

Flåten, B.-T., Isaksen, A., & Karlsen, J. (2015). Competitive firms in thin regions in Norway: The importance of workplace learning. *Norsk Geografisk Tidsskrift—Norwegian Journal of Geography, 69*, 102–111.

Foray, D., David, P. A. and Hall, B. H. (2009). *Smart specialisation—The concept* (Knowledge Economists Policy Brief No. 9), European Commission, DG Research, Brussels.

Foray, D., David, P. A., & Hall, B. H. (2011). *Smart specialization. From academic idea to political instrument, the surprising career of a concept and the difficulties involved in its implementation,* MTEI working paper, École Polytechnique Fédérale de Lausanne.

Freire, P. (1996). *Pedagogy of the oppressed*. London: Penguin Books.

Freire, P. (2008a). *Pedagogía de la Autonomía. Saberes necesarios para la práctica educativa*. Buenos Aires: Siglo XXI.

Freire, P. (2008b). *Pedagogía de la Esperanza. Un reencuentro con la pedagogía del oprimido*. Siglo XXI: Buenos Aires.

Greenwood, D., & Levin, M. (2007). *Introduction to action research* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Gustavsen, B. (1992). *Dialogue and development. Theory of communication, action research and the restructuring of working life*. Assen: Van Gorcum.

Harmaakorpi, V. (2006). Regional Development Platform Method (RDPM) as a tool for regional innovation policy. *European Planning Studies, 14*, 1085–1114.

Herr, K., & Anderson, G. L. (2005). *The action research dissertation: A guide for students and faculty*. Thousand Oaks, CA: Sage Publications.

Isaksen, A. (2015). Industrial development in thin regions: Trapped in path extension? *Journal of Economic Geography, 15*, 585–600.

Isaksen, A., & Karlsen, J. (2011). Changing regional collaboration relations in a global economy—A case study of the oil and gas equipment cluster in Agder. In H. C. G. Johnsen & R. Ennals (Eds.), *Creating collaborative advantage: Innovation and knowledge creation in small open economies* (pp. 151–159). Gower: Surrey.

Isaksen, A., & Karlsen, J. (2012). What is regional in regional clusters? The case of the globally oriented oil and gas cluster in Agder, Norway. *Industry and Innovation, 19*, 249–263.

Karlsen, J. (2010). Regional complexity and the need for engaged governance. *Ekonomiaz, 74*, 91–111.

Karlsen, J., & Larrea, M. (2014a). The contribution of action research to policy learning. *International Journal of Action Research, 10*, 129–155.

Karlsen, J., & Larrea, M. (2014b). *Territorial developmement and action research: Innovation through dialogue*. Farnham: Gower.

Karlsen, J., & Larrea, M. (2016). Collective knowing. In H. Johnsen, E. S. Hauge, M. Magnussen, & R. Ennals (Eds.), *Applied social science research in a regional knowledge system* (pp. 75–89). London and New York: Routledge.

Karlsen, J., & Larrea, M. (2017). Moving context from the background to the forefront of policy learning: Reflections on a case in Gipuzkoa, Basque Country. *Environment and Planning C: Government and Policy, 35*(4), 721–736.

Karlsen, J., Isaksen, A., & Spilling, O. R. (2011). The challenge of constructing regional advantages in peripheral areas. The case of marine biotechnology in Tromsø, Norway. *Entrepreneurship and Regional Development, 23*, 235–257.

Larrea, M. (2000). Competitividad y empleo en los sistemas productivos locales de la CAPV. *Ekonomiaz, 44*, 144–173.

Larrea, M., Mujika, A., & Aranguren, M. J. (2010). Access of small firms to knowledge networks as a determinant of local economic development. In H. Lenihan, B. Andreosso-O'Callaghan, & M. Hart (Eds.), *SMEs in a globalised world: Survival and growth strategies on europe's geographical periphery* (pp. 47–66). Cheltenham: Edward Elgar.

Lewin, K. (1948). Action research and minority problems. In G. Lewin (Ed.), *Resolving social conflicts. Selected papers on group dynamics*. New York, NY: Harper and Row (Original work published 1946).

Lundvall, B.-Å. (Ed.). (1992). *National systems of innovation: Towards a theory of innovation and interactive learning*. London: Pinter.

Mccann, P., & Ortega-Argilés, R. (2015). Smart specialisation, regional growth and applications to EU Cohesion Policy. *Regional Studies, 49*, 1291–1302.

Mintzberg, H., Lampel, J., & Ahlstrand, B. (1998). *Strategy safari a guided tour through the wilds of strategic management*. New York: Free Press.

Moodysson, J., Trippl, M., & Zukauskaite, E. (2017). Policy learning and smart specialization: Balancing policy change and continuity for new regional industrial paths. *Science and Public Policy, 44*(3), 382–391.

Morgan, K. (2013). The regional state in the era of smart specialisation. *Ekonomiaz, 83*, 103–125.

Navarro, M., & Larrea, M. (2007). Indicadores y análisis de competitividad local en el País Vasco. In *Dok Ekonomiaz*. Vitoria-Gasteiz: Servicio Central de Publicaciones del Gobierno Vasco.

Pålshaugen, Ø. (2004). How to do things with words: Towards a linguistic turn in action research? *Concepts and Transformation. International Journal of Action Research and Organizational Renewal, 9*, 181–203.

Rodrik, D. (2004). *Industrial policy for the twenty-first century*. Cambridge, MA: John F. Kennedy School of Government.

Schön, D. A. (1983). *The reflective practitioner—How professionals think in action*. New York: Basic Books.

Toulmin, S., & Gustavsen, B. (1996). *Beyond theory: Changing organizations through participation*. Amsterdam: John Benjamins Publishing.

Trippl, M., & Tödtling, F. (2007). Developing biotechnology clusters in non-high technology regions—the case of Austria. *Industry and Innovation, 14*, 47–67.

Tödtling, F., & Trippl, M. (2005). One size fits all? Towards a differentiated regional innovation policy approach. *Research Policy, 34*, 1203–1219.

The Heroic Assumptions of Smart Specialisation: A Sympathetic Critique of Regional Innovation Policy

Pedro Marques and Kevin Morgan

Abstract

The financial crisis of 2008, and the economic crisis that ensued, have exposed even further the persistent pattern of uneven development which has plagued the European Union (EU) for decades, despite decades of Cohesion Policy funding and many national and subnational initiatives. In the current funding cycle (2014–2020), the EU hopes to address this pattern through a fine tuned regional policy, which places greater emphasis on innovation and competitiveness, rather than investments in infrastructure. This policy is guided by the concept of smart specialisation strategies (S3). However, despite its ambition and potential benefits, S3 is likely to be hindered by low institutional capacity precisely in those regions that need the most help. Consequently, this chapter argues that the policy is stymied by several implicit 'heroic assumptions' which will limit its effectiveness and impact in reducing regional disparities. The chapter will also draw on some practical examples to discuss the realities of policy-making in the peripheral regions of Europe.

Keywords

Smart specialisation · Quality of government · Institutions · Lagging regions · Triple Helix · Multi-scalar policy

P. Marques (✉)
INGENIO (CSIC-UPV), Universidad Politécnica de Valencia, Valencia, Spain
e-mail: p.marques@ingenio.upv.es

K. Morgan
School of Geography and Planning, Cardiff University, Cardiff, UK
e-mail: morgankj@cardiff.ac.uk

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_14

1 Introduction

In a secretive late night session on 31 January 2017 the Romanian government adopted Emergency Ordinance 13, ostensibly to reform the criminal code and reduce the prison population. Citizens responded by organising the biggest street demonstrations since the fall of communism in 1989 because they perceived that its real aim was to decriminalise official misconduct. Protesters argued that the ordinance would cripple Romania's fight against corruption, which until then had been the largest and most systematic crackdown on graft in central and Eastern Europe. In total 18 ministers from governments that have been in power since 2004, including in 2015 the then Prime Minister Victor Ponta, have been charged or convicted, along with thousands of lower-level politicians, media moguls, judges and business people. Importantly, the anti-corruption drive had the full support of President Klaus Iohannis, who addressed the demonstrators by saying: "People have a right to be outraged as a gang of politicians facing criminal problems want to change the legislation and weaken the rule of law. It's unacceptable to change laws just to close files on hundreds of politicians who are in trouble with the law" (Byrne 2017).

Why is this civic protest movement in Romania of relevance to a discussion of public policies for innovation and development? The short answer is because the *quality of institutions*—formal and informal—is now widely accepted to be of major significance for the pace of innovation and the scope of development. Their significance is even higher in the context of less developed regions (Rodríguez-Pose and Di Cataldo 2015), which is the focus of this chapter. This conceptual starting point will lead us to question if the current wave of innovation policy in the European Union (called smart specialisation) pays enough attention to institutional issues and to how they constrain the design and implementation of development strategies.

In terms of national development trajectories, we can now point to a burgeoning literature that has convincingly demonstrated that institutional quality—rather than natural resources, climatic conditions or geographical location—is the most powerful driver of economic development (North 2005; Rodrik et al. 2004; Acemoglu and Robinson 2012). In one of the most ambitious and compelling institutional interpretations of economic history, Acemoglu and Robinson (2012) draw a fundamental distinction between inclusive and extractive institutions to explain the main contours of economic and political development since the Neolithic Revolution, a distinction which they claim can account for the origins of power, prosperity and poverty in the world economy. Central to their theory is the interplay between inclusive institutions and economic prosperity and their argument runs as follows:

> Inclusive economic institutions that enforce property rights, create a level playing field, and encourage investments in new technologies and skills are more conducive to economic growth than extractive economic institutions that are structured to extract resources from the many by the few and that fail to protect property rights or provide incentives for economic activity. Inclusive economic institutions are in turn supported by, and support, inclusive political institutions, that is, those that distribute political power widely in a

> pluralist manner. Similarly, extractive economic institutions are synergistically linked to extractive political institutions, which concentrate power in the hands of a few, who will then have incentives to maintain and develop extractive economic institutions for their benefit and use the resources they obtain to cement their hold on political power (Acemoglu and Robinson 2012: 429/430).

Furthermore, Acemoglu and Robinson (2012) argue that politics are fundamental in determining the inclusiveness of institutions, which is a welcome antidote to the dominant tradition in development studies, where economistic concepts and theories have held sway for too long. This allows the authors to move beyond the tendency for researchers to focus on "best practice" and "getting it right", and instead ask: why do so many countries "get it wrong"? To understand this problem, they argue, one has to explore how decisions get made, who gets to make them and who benefits from them: "This is the study of politics and political processes. Traditionally economics has ignored politics, but understanding politics is crucial for explaining world inequality" (Acemoglu and Robinson 2012: 68).

These two propositions—the positive correlation between inclusive institutions and prosperity on the one hand and the primacy of politics in explaining why countries get it wrong on the other—can be applied to other spatial scales to explain the uneven development of cities and regions within nation states. The first one, the seminal role of institutions, has in fact been recognised and widely accepted in the *sub-national* literature on innovation and development (Asheim and Isaksen 1997; Cooke and Morgan 1998; Farole et al. 2011; Morgan 1997; Pike et al. 2017). However, the second one, the primacy of politics, has been far less explored at this scale even though it can help us to better understand territorial inequalities (Charron et al. 2013, Nistotskay et al. 2015).

Within the sub-national literature the most celebrated example of the institutionalist approach is the Regional Innovation Systems (RIS) concept, which emerged in the 1990s (Asheim and Gertler 2005; Cooke 1992; Cooke et al. 2004; Doloreux and Gomez 2017), and which builds on the earlier concept of *national systems of innovation* (Freeman 1987). According to two of its leading exponents, the RIS concept "represents an attempt by students of the geographical economy to understand better the central role of institutions and organisations in promoting innovation-based regional growth. The regional innovation system can be thought of as the institutional infrastructure supporting innovation within the production structure of a region" (Asheim and Gertler 2005: 299). The two central components of a RIS are the *knowledge generation* sub-system (consisting of universities and other research generating bodies) and the *knowledge exploitation* sub-system (consisting of firms and industries) and regional innovative performance was often attributed to how well (or badly) these two sub-systems were aligned and performed (Cooke et al. 2004).

Although it is very influential among economic geographers and regional scientists, the RIS concept is not without its critics. Firstly, it was claimed that the RIS framework makes for an inventory-like description of key institutions that populate a relatively static landscape of actors, an approach that neglects the dynamics of an actor-centred perspective and the empirical heterogeneity of regional contexts (Morgan 2004; Uyarra 2010a). More recent work has addressed this issue through two main lines of enquiry: a first line draws on evolutionary economic geography and on the concept of related variety, and debates how regional economies evolve by the emergence of economic sectors which are technologically close to previous specialisations (Boschma and Frenken 2011; Frenken et al. 2007). A second line of work has sought to identify how the characteristics of RIS influence processes of path renewal or path emergence, for instance (Isaksen and Trippl 2016; Tödtling and Trippl 2013). Both these approaches demonstrate how institutional settings interact with economic conditions in a dynamic and mutually reinforcing fashion. However, what is still lacking is a specific focus on how political processes shape the institutional environment, since the latter is still treated implicitly as a value-free context without normative consequences (e.g. regarding the redistribution of resources).

A second critique aimed at the RIS literature was that it underplayed the *primary role of the firm* as the key site of knowledge development and innovation because, under the influence of Triple Helix type models, it afforded parity of esteem to the knowledge sub-system. More recent work has tried to address these concerns namely by distinguishing between different types of region and their different needs (Asheim and Gertler 2005; Todtling and Trippl 2005). These contributions stress that depending on the context, the presence, quality and interconnectedness of organisations changes, which in turn justifies shifting the focus of both research and policy interventions (Asheim et al. 2011). Therefore, though in some regions it might make sense to treat universities as primary actors, in others the locus of research and practice should fall on the absorptive capacity of firms or the skill level of workers (Marques 2017).

Thirdly, it was argued that the original RIS concept was too parochial and tended to neglect the dynamic role of *extra-regional linkages*, a critically important source of novelty and diversity (Coenen et al. 2017). This was another point that later work has sought to address, by focusing on the interplay between different scales, both at the institutional and organisational levels, through comparative research in multiple environments (Asheim et al. 2011; Cooke et al. 2000, 2004; Tödtling et al. 2013). In this chapter, we will focus specifically on the issue of multi-scalar coordination in policymaking. Both the EU (Barca 2009) and supra-national institutions such as the OECD (2011) have argued for the need to achieve such coordination, though its practical implications have not been sufficiently discussed. The RIS concept has also been enormously influential in policy and practice circles around the world, having been embraced by the European Commission, the OECD and the World Bank among other international bodies. In the EU, where it resonates most of all, it has informed successive iterations of regional innovation policy: from the Regional Technology Plans of the 1990s, through a wave of RIS schemes, to the current Smart Specialisation Strategies (S3).

The S3 programme is now the largest and most ambitious programme of regional innovation policy anywhere in the world, commanding a budget of some 80 billion euro in the 2014–2020 programming period. Nevertheless, one of its most remarkable aspects is that it is predicated on a theoretical concept—smart specialisation—which had never been piloted in practice and which had not therefore generated any empirical evidence to draw upon (Foray 2015; Morgan 2015). Possibly for this reason, the S3 programme contains a number of hidden assumptions about the political dynamics of regional innovation policy, some of which we call "heroic" because they are so challenging, particularly for public authorities in less developed regions. Though the discussion in this chapter is specifically about S3, we would argue that the points made here are also valid for a wider debate on the future of RIS, since the two concepts are so closely aligned.

In the remainder of this chapter the analysis consists of a twin-track approach. Section 2 is largely theoretical as it explores these heroic assumptions in the context of a sympathetic critique of the Smart Specialisation programme. Section 3 is more granular as it presents an empirical analysis of the challenges of the S3 programme in the context of two regions—in Greece and Romania—that are part of the EU's Lagging Regions project. This section will be based primarily on secondary sources while also drawing on the experience of the authors in doing research in these contexts. Section 4 distils the analysis and assesses the implications for theory, policy and practice.

2 The Heroic Assumptions of Smart Specialisation: A Sympathetic Critique

Smart specialisation strategies (S3) are the latest incarnation of a regional innovation policy that dates back to 1990, when the EC launched the STRIDE (Science and Technology for Regional Innovation and Development in Europe) programme. The goal of S3 is to improve the delivery of innovation policy by ensuring that it is targeted to the strengths of each region. It does so through a dual strategy of identifying current strengths and potential new specialisations, through a process of entrepreneurial discovery process (EDP) (Foray 2015). One of the novelties of the S3 is precisely this latter point, as it encourages wide stakeholder consultations and bottom-up policy making across all regions or nations of the European Union (EC 2016). In theory, the S3 should also reflect the systemic nature of innovation, as it encourages the participation of agents from the private, public and research sectors, the broad nature of innovation, by stimulating instruments that go beyond science, technology and innovation (STI) approaches, and the emergence of new forms of innovation, such as social innovation (McCann and Ortega-Argilés 2014). Although S3 is undoubtedly the most sophisticated version of regional innovation policy in the EU, it is predicated on a number of highly challenging assumptions to which we will now turn.

2.1 Regional Elites Are Universally Committed to Innovation

This is such a pervasive assumption in much of the official regional policy literature that it was rarely addressed as a specific issue until recently. But there are (at least) two reasons for thinking that some regional elites (essentially representatives from governments, business and potentially from Universities or research centres) have little or no commitment to the kind of innovation policy agenda embodied in the S3 programme: first because incumbent elites can occasionally attach a higher premium to *control* than to innovation; and second, because they are in some contexts embroiled in *irregular* political behaviour that varies in severity from clientelism, at one end of the spectrum, to corruption at the other end. Acemoglu and Robinson (2012) discussed how national elites had fashioned such extractive institutional arrangements that there was little or no scope for innovation to take place because it is inherently disruptive of the status quo and its interests. At the sub-national level, one of the reasons why regional innovation policy has had such a limited impact is precisely because some regional governments feel threatened by the kind of transparent and inclusive bottom-up process embodied in the S3 programme (Landabaso 2014).

Among the ways in which regional elites can constrain economic development, corruption, defined as "abuse of power for private gain" (EC 2014: 2) is the most obviously debilitating behaviour, as it shifts resources away from legitimate activities towards illegitimate ones. Although some countries and regions are more prone to corruption than others, it is important to note that corruption is perceived to be a problem throughout the EU. Indeed, in all but five members states (the three Nordic countries, the Netherlands and Luxembourg) over 60% of the population see corruption as a major problem, the proportion varying from 61% in Germany to 99% in Romania (EC 2014). Addressing corruption requires concerted action from within and without: by civil society from within each member state and by external intervention from national and supra-national levels as the Barca Report recommended (Barca 2009). In the past, however, the EC has been too coy to engage with national and sub-national corruption because it was perceived to be a member state responsibility and supra-national intervention would have compromised the principle of subsidiarity.

Besides corruption, regional elites can constrain innovation and regional development through the incentives that they create and the ways in which they allocate public resources. It is true that not much is known yet about the mechanisms through which this happens at the sub-national level, since most research has focused on the national scale as discussed. However, in recent years a growing number of research papers has demonstrated that quality of governance in the EU's regions does have an impact on innovation (Rodríguez-Pose and Di Cataldo 2015), on entrepreneurship rates (Nistotskay et al. 2015) or on returns to public investment (Rodríguez-Pose and Garcilazo 2013). In fact, one of these papers argued that institutional reforms to combat rent seeking and corruption should now be considered to be "de facto innovation policies for the regions in the periphery of Europe" (Rodríguez-Pose and Di Cataldo 2015: 693).

2.2 The State Is Smart Enough to Meet the S3 Challenge

The issue of quality of governance (QoG) is strongly connected to that of state capacity, since countries or regions with low QoG also tend to offer lower quality public services (Charron et al. 2013). This was in fact the rationale for measuring QoG in Europe using a survey that asks a sample of the population about the quality of public services in education, healthcare and law enforcement (Charron et al. 2013). The connection between both issues is important because S3 makes enormous demands on the public sector at a time when many member states inside and outside the Eurozone are in thrall to a pre-Keynesian creed of austerity that aims to cut budget deficits and shrink the state (Morgan 2017). However, the capacity to convene a wide range of stakeholders and collect their opinions in a systematic and thorough manner, to integrate the qualitative dimension of the EDP with quantitative analysis of economic strengths and to turn all these data into appropriate policy instruments is far from available in all regions of Europe. This of course says nothing about the capacity to implement these policies at a later date and to learn from experience, which requires yet another set of skills and competencies. Recognising the significant variability in state capacity across the EU has led the European Commission to acknowledge that it affects the delivery of cohesion policy (EC 2014).

One neglected, yet highly relevant, area where public sector competence can effect economic outcomes is in the area of public procurement, since the spending power of the state has enormous potential to effect social, economic and environmental change. Within the state, sub-national organisations—regional governments, municipalities and decentralised public authorities in health, education or social services—are key economic actors, not just in the EU but across the OECD and beyond. For this reason public procurement has been described as the "sleeping giant" of regional innovation policy, due to its untapped potential to provide a place-based and demand-led impetus to innovation and development (Morgan 2017). Although it varies across the EU, sub-national bodies on average accounted for 33.6% of public expenditure, 45.9% of all public procurement and 65.8% of direct investment in 2012. Also, as we can see from Fig. 1, the significance of public procurement lies in the fact that it accounts for nearly 20% of total GDP in the EU economy. Also, almost half of all EU funds are processed through the public procurement process, which helps to explain why it is the single most important source of technical errors and corrupt practices in the implementation of regional aid programmes. According to the EC (2015a) technical errors are mostly the result of lack of knowledge and insufficient administrative capacity.

2.3 The Linear Model of Innovation Is Dead and Buried (When It Is Alive and Well)

Below the level of governance, there are also important issues in what concerns the innovation system itself. Our third heroic assumption is based on the realisation that

PUBLIC PROCUREMENT GUIDE

•Low cost still dominates the practice even though the guidelines allow public bodies to seek **values for money** and not just value for money.

•Power of purchase is stymied by **poor skills** and **low political commitment.**

•Public procurement is the **sleeping giant** of regional innovation policy.

Fig. 1 The promise and practice of public procurement. Source: EC (2015b)

the linear model of innovation continues to be predominant in policymaking. Although it has many variants, the linear model of innovation is essentially a science-push model in which knowledge is assumed to flow uniformly from basic scientific research at one end of the process to technological innovations in products and services at the other end. As one critic put it: “The belief that scientific advances are converted to practical use by a dynamic flow from science to technology has been a staple of R&D managers everywhere. . .Together with its equally linear static corollary, the basic-applied spectrum, this dynamic linear image provided a general paradigm for interpreting the nature of research, one that is remarkably widespread in the scientific and policy communities and in popular understanding even today” (Stokes 1997: 10–11).

Although the linear model of innovation was buried in the academy 30 years ago by eminent scholars like Freeman (1987), Rosenberg (1994), and the many contributors to the RIS literature (e.g. Cooke et al. 2004), the fact remains that the model is alive and well in the worlds of policy and practice. This is due to a continuing belief that scientific inputs will automatically generate innovation outputs. The tenacity of the linear model outside the academy creates a number of problematic policy positions, such as: (i) the privileging of “upstream” scientific knowledge over other forms of “downstream” knowledge (like engineering and marketing for example); (ii) the neglect of doing, using and interacting (DUI) models of innovation, which are not captured by conventional science-driven metrics; and (iii) the perpetuation of the regional innovation paradox (Oughton et al. 2002).

The regional innovation paradox refers to the fact that the regions with the greatest need of innovation funds—namely the lagging regions—are precisely the regions with the lowest capacity to utilise such funds on account of their weak absorptive capacity (Hassink and Marques 2016; Oughton et al. 2002). One of its consequences is that funds intended for innovation in lagging regions tend to remain "locked" in the science silos of universities because the demand-side in such regions is so weak that there are no agents to exploit the knowledge that may have been generated. The solution to this problem is not to reduce investments in basic research, but rather to invest in translational research mechanisms on the supply-side and to enhance the absorptive capacity of firms on the demand-side—in other words to fashion regional innovation ecosystems in which supply and demand can be calibrated (Uyarra 2010b). A very influential model for addressing the problem of the regional innovation paradox is the Triple Helix, which leads us to our next assumption.

2.4 Regions Are Assumed to Have a Triple Helix Coalition in Place

One of the most pervasive ideas in the RIS school—common among theorists and policymakers alike—is that a Triple Helix coalition (between university, business and government) is either already in place or can be readily assembled for the purpose of promoting innovation and enhancing the knowledge economy. According to one of the main popularisers of this concept "In a knowledge-based society, the university attains equal status with government and industry, the two leading institutional spheres from the eighteenth century, moving from its role as a secondary supporting institution into a primary institutional sphere. The university is increasingly central to discontinuous innovation in knowledge-based societies, superseding the firm as the primary source of future economic and social development" (Etzkowitz et al. 2007: 14).

There are two fundamental problems with this conception. First and foremost, the metaphor itself is problematical because there are many reasons why the Triple Helix may not materialize in practice, particularly in institutionally challenged lagging regions, because in most cases "the three actors do not align their goals, overlap their meanings, and move together. They constitute separate *corners of a triangle*, not strains in a dynamically active helix. Actors stay at their own corner and pull forces in their direction" (Bonaccorsi 2009: 6). Second, the idea that the university has supplanted the firm as the primary institutional agent in the knowledge economy is both wrong and dangerous: wrong because firms continue to account for the largest share of R&D expenditure and they remain the key actors in valorising knowledge; dangerous because it implies that universities need to become more centrally involved in the innovation process (i.e. beyond knowledge generation) when they have neither the skills nor the time to do so.

Regional innovation policies like S3 are prone to assume that universities, businesses and government have forged a common cognitive outlook and aligned their interests to such an extent that they are able to collaborate for mutually beneficial ends. However, the reality is far removed from the rhetoric of the Triple Helix because the difference in values, mandates and timescales that characterise the three sectors means that a well-organised tripartite coalition tends to be the exception rather than the norm (Uyarra 2010b).

2.5 Multi-scalar Co-ordination Is at the Heart of S3 Design and Delivery

Up to this point we have discussed assumptions regarding regional governance and the dynamics of innovation systems in the context of S3. However, this programme also requires an unprecedented degree of multi-scalar co-ordination among supra-national, national and sub-national actors in the EU (EC 2016). For that reason S3 brings to the fore a problem that the European Commission has wrestled with for many years—the need to strike a judicious balance between central control and local ownership of Cohesion Policy projects, a problem it strives to manage through the mechanism of shared management.

The need for multi-scalar governance of regional policies, or multilevel in the language of the OECD (2011), was well articulated in the Barca report (2009), which sought to identify the principles that should underpin Cohesion Policy during the funding cycle of 2014–2020. Barca (2009) argued that Cohesion Policy's aim was to unlock resources from poorer regions, which are currently being underutilised from an economic point of view. In order to do so, regions and localities should design place-based policies, which not only target the specific needs of each territory, but also draw on the knowledge and skills concentrated in those places, in a bottom-up process. The author nonetheless acknowledged that in some contexts the lack of capacity in the public sector might hinder the design and implementation of effective strategies, which should be solved by coordinating across different scales of administration. Also, recognising the need to avoid strategies from being taken hostage by local rent-seeking coalitions, the Barca report called for the European Commission to have more authority over Member States and Regions in defining overall goals. This led to the introduction of ex-ante conditionality clauses in the S3 programme, where receipt of cohesion funds was dependent on regions or countries having a strategy approved that met the guidelines of the Commission.

Barca's call for place-based approaches combined with stronger authority at the central level highlights the challenges of multi-scalar coordination. As Hooghe and Marks (2001) pointed out almost 20 years ago, the neat theoretical model of coordination across different levels of government on the basis of negotiation and respect for subsidiarity is not observed in practice. In fact, the reality is one of constant tension and conflict, not only between the EC and the member states, but also within member states themselves. Apart from countries such as Germany, where the constitution sets clear rules for the functioning of the federal state, decentralisation across Europe is a fluid process, driven by politics (primarily different national identities within a country), the belief that it might improve economic management or even different programmatic beliefs between political parties (Rodríguez-Pose 2002). A stark example of the latter was the creation in England of regional development agencies in 1998 by the Labour government, which were subsequently abolished in 2010 by the Conservative government. In fact, such tensions exist even within the commission, for instance between different directorates general regarding jurisdictional control. The assumption that multi-scalar can be achieved is therefore be far from a foregone conclusion.

3 Lagging Regions and the S3 Challenge: Governance, Institutional Synergy and Austerity

Nowhere is the S3 challenge as great as in the institutionally challenged lagging regions. For this reason the European Commission launched a specific project called RIS3 Support in Lagging Regions, which is managed by the Joint Research Centre's (JRC) S3 Platform in Seville (JRC 2016). The Lagging Regions project has three main aims:

- "Improve understanding of slow and limited growth in EU regions and links to macro-economic framework conditions, taking S3 as an entry point;
- Develop and disseminate lessons and a tool box for other EU regions; and
- Contribute to advancing relevant theory on (implementation of) smart specialisation by codifying hands-on experiences" (JRC 2016)

The project covers two types of lagging region—low growth regions in Southern Europe and low income regions in Eastern Europe—and these are shown in Fig. 2 below. In essence the Lagging Regions project is a multi-scalar collaboration between the European Commission, Member States and the Regional Authorities to help less developed regions to implement their S3 plans, with a special focus on Greece and Romania. The project was launched in 2015 in the northern Greek region of Eastern Macedonia and Thrace (EMT) and it ran for 15 months.

An early assessment of the multi-scalar initiative in EMT came to the following conclusion:

> A key outcome of the preparatory action has been its role as an exercise in trust building, understanding and commitment towards RIS3, both within the Region of Eastern Macedonia and Thrace and beyond. Over its 15 month duration, the preparatory action has developed an enhanced understanding of the realities of the RIS3 process, and how it relates to the political and economic context, at regional, national and EU levels. The emphasis on the EDP, through the organisation of focus groups and project development labs, has been important for the mobilisation and engagement of regional stakeholders to explore opportunities, gaps and barriers. It has also been very much a shared learning process, through which to catalyse closer collaboration and build trust in the stakeholder community with concrete outcomes. This has contributed to the development of a codified methodology to support EDP, for wider replication and adaptation (Boden et al. 2016: 19).

This is a fair conclusion as far as it goes because the regional participants in the EMT region were generally very positive about the initiative. Although the assessment was drafted by the same officers who managed the project—and EC officials are obliged to be both measured and diplomatic in their public pronouncements—the report does acknowledge some of the deeper challenges facing the Greek region when it refers to the "significant legal and administrative challenges" facing S3 implementation (Boden et al. 2016: 14). Most of these legal and administrative challenges stem from a common source—the fact that Greece is a highly centralised state in which the regional administrations have little or no real autonomy to

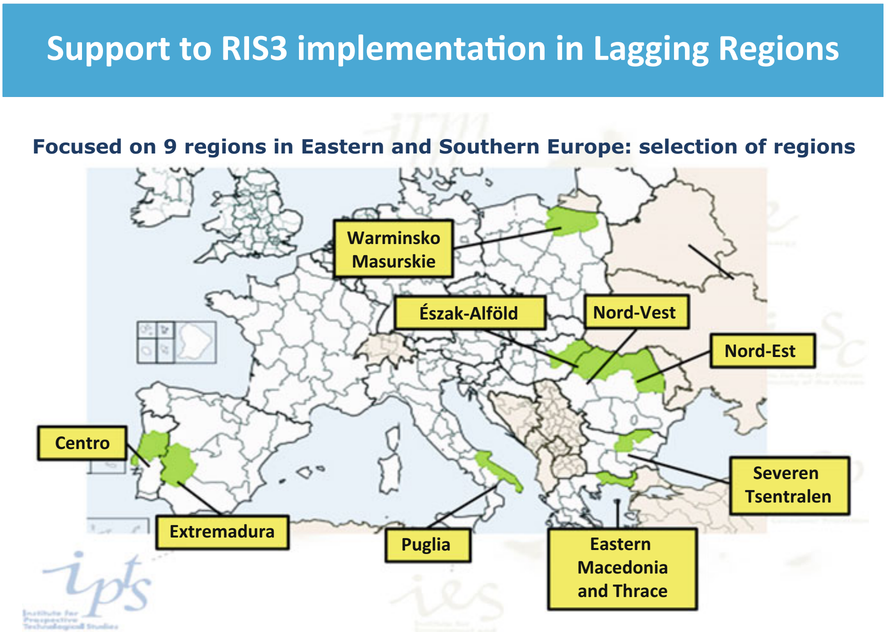

Fig. 2 Regional profile of the lagging regions project. Source: JRC (2016)

implement their S3 plans without securing the approval of central government in Athens, where the GSRT controls the entire research and innovation agenda. In total fourteen RIS3 plans were drafted in Greece—one national strategy and thirteen regional strategies—but there is very little co-ordination between them in practice even though they are meant to be complementary.

But there is an even deeper challenge which is barely mentioned in the official assessment and that is the unprecedented socio-economic cataclysm in Greece, a country that has borne the brunt of the eurozone crisis. Never before has an OECD country been subjected to such a deep and prolonged crisis as the Greek crisis. Greece has been mired in recession for the best part of a decade, with the result that the economy has shrunk by a quarter; debt stands at a staggering 180% of GDP; official unemployment is close to 25%, with youth unemployment even higher; nearly 40% of Greeks are suffering from poverty and social exclusion; and the people who are best equipped to reverse attrition, the highly educated professional strata, have voted with their feet and emigrated in huge numbers. When Greece's 86 billion euro aid programme officially ends in the summer of 2018, there are serious doubts about whether Athens will regain access to international markets and avoid a fourth bailout without a radical restructuring of Greek debt. However, Eurozone governments led by Germany have been resolutely opposed to debt relief, in sharp contrast to the IMF, which supports debt relief to render the remaining debt more sustainable. Such conflict among the creditors is now the main cause of uncertainty surrounding the Greek predicament and it is having a debilitating effect on economic confidence, so much so that it is perversely making any meaningful recovery even more elusive.

Although the macro-economic crisis in Greece does not explicitly feature in the Lagging Region assessment of S3 implementation, it is probably the biggest single barrier to the S3 strategy in every Greek region. The regional dimension is often overlooked in debates about how best to revive the Greek economy even though it could help to alleviate one of the central problems in Greece—the lack of trust in and the lack of competence of the central government in Athens. A regionally nuanced economic renewal strategy would help to create a more polycentric state in Greece, where the regional governments and their partners in business and civil society could design and deliver locally-attuned strategies for innovation and regional development, providing they were empowered to do so. Far from being immaterial or irrelevant to the goal of national economic renewal, regional devolution of power could help to empower local knowledge beyond Athens and compensate for the lack of trust in the institutions of central government. In other words, the potential of S3 could be helped by giving Greek regions the powers to tap their local knowledge and design policies that are attuned to their needs, but this would require a transformation in territorial governance for Greece to make the transition from a centralised state to a polycentric state. Of course decentralisation by itself is not sufficient to deliver better economic outcomes (Rodríguez-Pose and Ezcurra 2009), unless there is an investment in the quality of institutions.

The Lagging Regions project has also prioritised Romania, a more extreme example of an imbalanced governance system because the "regions" were created by central government for purely transactional purposes:

> Government authority in Romania remains highly centralized, reflecting the legacy of the socialist era. This is particularly pertinent in the field of smart specialisation, where research and innovation policies are directed by national Ministries and national bodies. The three primary tiers of government in Romania are: national, county and local (municipality, city or commune). The regional tier is purely administrative, consisting of eight development regions (equating to the NUTS2 level) and four macro-regions (NUTS1). Neither have legal status and both exist primarily for the purpose of co-ordinating development projects. This regional governance gap presents a real challenge for securing the development of regional innovation systems in Romania (Healy 2016: 1530).

North East Romania (NER) has been the main regional focus of the Lagging Regions project because, though it is one of the largest regions in Romania in terms of land mass and population, it is one of the poorest regions in the country, with a GDP per capita of 34% of the European average (Eurostat 2016). Regional development agencies have been created in each of the eight development regions and, even though they were primarily designed by central government as a means to administer EU Structural Funds in their jurisdictions, some of them have been capable of developing some measure of autonomy. One of the exemplars of this approach has been the North East Romania RDA, which was one of the first RDAs in Romania to begin the process of developing a regional RIS3 even though central government had decided to design a national RIS3 strategy with little or no input from the regions. But the RDA was emboldened to act in this semi-autonomous way because it was able to draw on a history of participating in European regional networks and securing EU funds to promote regional innovation approaches, including the first Regional Innovation Strategy of the North-East Region in 2008. The RDA has traditionally adopted a consultative and bottom-up approach, seeking to engage with key regional actors, as well as using financial resources to import techniques and expertise from western European regions to assist in the analysis of SME needs and the supply-side capacity of research and innovation actors in the region (Healy 2016).

Perhaps the most remarkable aspect of this story is the fact that one of the poorest regions in the country, as measured by conventional economic indicators, proved to be one of the most pro-active in terms of mobilising what little institutional capacity it possessed and this is partly explained by the calibre of the RDA within the region and the quality of its network connections outside the region, particularly with the EC in Brussels. Even so, the most important lesson from NER is the near impossibility of implementing a RIS3 strategy at the regional level without radical changes in the territorial governance system and without equally radical changes in the national innovation system.

A highly centralised territorial governance system is the reason why the regional RIS3 strategy in NER—a wholly voluntary exercise that was animated by the region's pro-active RDA—has no official status in the national programmes for research, innovation and development in Romania. Furthermore, the national innovation system is an institutional testament to the linear model of innovation, because it extols science over all other forms of knowledge investment. Another problematical feature of the national innovation system in Romania is the disconnected university. Until recently, universities and firms in NER displayed a mutual indifference to one another: firms were in low value sectors and had little or no need to access external sources of knowledge, while universities had neither the time nor the inclination to engage with their regional economy because academics were (and are) overloaded with teaching duties, while researchers tend to look to the national level where science budgets are located and allocated. Even when universities are inclined to engage with regional firms they face enormous cultural and institutional barriers as the following analysis demonstrates:

> Within the Universities and Research Institutes traditional practices also militate against stronger collaboration with businesses. Many academics have high teaching loads, which limit their ability to undertake research. Where research is undertaken, incentive structures reward basic research leading to academic publications rather than applied research working alongside companies. Even where academics wish to work with companies, senior academics report that administrative structures within the University have historically hindered this and that many academics lack the contacts to develop connections with small and medium-sized firms. In other examples, respondents report that the lack of formal certification for university laboratories (such as Good Laboratory Practice, ISO9001 or ISO17025), limits the acceptability of applied research results in the international market owing to Quality Assurance procedures in international markets and value chains. For many academics, securing such accreditation is not a priority as the time and effort involved does not progress their research agendas (Healy 2016: 1539).

This picture of mutual indifference between universities and firms is beginning to change in NRE thanks in no small part to the pro-active stance of the RDA and the S3 process, both of which have been nurtured by external support from the EC—particularly through the Lagging Region project and the Higher Education for Smart Specialisation (HESS) project. Although NER has put its limited institutional capacity to good use, this is nowhere near enough to make a tangible difference in one of the poorest regions in the EU. "Learning alone is not enough" in other words, "as knowledge without power does not result in practical outcomes. North East Romania offers a salutary lesson that solutions to the regional innovation paradox may require behavioural changes at the national level as much as in building the capacity of regions" (Healy 2016: 1541). Behavioural changes at the national level are precisely what the protests on the streets of Romania are designed to achieve. But civil society protests from below need to be complemented by more formal support from above and the EC could and should take the lead in furnishing such support as we argue in the following section.

4 Conclusions and Implications (For Theory, Policy and Practice)

The RIS3 programme is probably the most ambitious spatially focused innovation programme in the world, a programme that makes enormous demands on the stakeholders involved in it, especially public sector institutions like the regional state. In this chapter we have presented a sympathetic critique of the RIS3 approach. *Sympathetic* because of its ambition and the fact that it recognises innovation for what it really is, namely a collective social endeavour; and a *critique* because it makes some unwarranted assumptions—heroic assumptions—about the institutional capacity of lagging regions to design and deliver such a sophisticated regional innovation policy. In this final section we suggest that these unwarranted policy assumptions have arisen in part because of two problematical trends: (i) the uncritical embrace of empirically challenged conceptual models and (ii) the intellectual bias that extols policy design over policy delivery, with the result that the prosaic world of *implementation* is either neglected or ignored.

Regarding the first point, as one of its leading proponents argued, "policymakers would probably have been better off proceeding first to clinical trials and pilot experiments before applying the treatment to the whole population of regions" (Foray 2015: 7). The uncritical embrace of the concept in policy circles was most pronounced in the EU, where it became a central pillar of Cohesion Policy, a rapid transition from academy to polity that owed much to the zeitgeist sweeping through the corridors of power in Brussels, where the EC was receptive to ideas that fortified its "smart growth" agenda (Morgan 2015).

It is no coincidence that the concepts and methods embodied in S3 have been most forcefully challenged in regions with less developed research and innovation (R&I) systems, triggering questions about the universal applicability of its concepts and methods. Two types of problem have been exposed by researchers: firstly, the

STI model of innovation is deemed to be singularly inappropriate for highly fragmented innovation systems in which the dominant features are public research and development (R&D) institutes and the production-oriented facilities of foreign-owned companies. This means that RIS3 policy needs to be less STI-centric and more attuned to the heterogeneity of local conditions; and, in the specific case of the EU-13 countries, more open to incorporating foreign direct investment (FDI) and global value chains (GVCs) into its conceptual discourse and its policy prescriptions (Radosevic and Stancova 2015).

The second trend is the debilitating tendency in development practice towards strengthening policy design rather than policy delivery. According to a recent analysis of state capacity, the key determinant of performance is not the design of policies, programme and projects, but the *capability for implementation* (Andrews et al. 2017). However, many states have skewed capabilities: the capability to propose policies, programmes and projects but "not the capability to implement them" (Andrews et al. 2017: 12). The argument here runs counter to the conventional policy paradigm, which involves identifying and importing "good governance" and "best practice" from elsewhere, and proposes instead an approach which involves "solving problems" locally and not "importing solutions" from afar, because success builds capacity not vice versa.

Though most of this debate happened in the field of international development studies, it is equally relevant to the analysis of RIS3 implementation, because the institutional base on which it is predicated is deemed to be lacking or missing in many parts of the EU-13 members states. For example, the entrepreneurial discovery process implicitly assumes a mature institutional framework, which is hardly realistic in the case of regions with less developed R&I systems (Blazek and Morgan 2017). State-of-the-art regional development theories highlight the important role of informal institutional factors such as trust, responsibility, professionalism, partnership and shared leadership for regional development (McCann and Ortega-Argilés 2014). This contrasts sharply with the under-developed institutional framework in such regions, which together with risk-averse or "play it safe" mentality limits the space for experimentation, manoeuvre and flexibility in decision-making and public initiatives (Landabaso 2014). Therefore, even though S3 strategies across the EU have now been approved by the European Commission, there are many doubts about whether they will be implemented with the same care that was put into their design.

A potential solution to this problem lies in the improvement of multi-scalar coordination (Asheim et al. 2011; Tödtling et al. 2013). This type of coordination would allow policies to draw on local knowledge and strengths, as requested by the place-based agenda (Barca 2009), while benefiting from the state capacity that often only exists at higher levels of government. It would also create opportunities for cross-learning across spatial contexts while respecting the importance of context. This is however far from a simple task. Particularly in unstable or less mature political contexts, where the strength and nature of decentralisation is unreliable and might change as a result of election cycles, it is more likely that the relationships between scales of government will be fractious and competitive.

Also, a multi-scalar approach does not guarantee that the policy process can escape capture by economic or political elites. In fact, by moving the decision making process to a level where there is less public scrutiny, because it does not correspond to a specific administrative jurisdiction, it might even be counterproductive, as it becomes easier for vested interests to manipulate the allocation of public resources (Dubnick and Frederickson 2011).

We began this chapter with the mass protests in Romania, where citizens mobilised on the streets to challenge the corrupt practices of their politicians and the extractive institutions of which they are a symptom. To be effective, however, street protests need to be synchronised with supra-national political pressure from the EC to broaden the ex-ante conditionality that already applies to the RIS3 programme so that it includes a strong steer for power to be devolved in highly centralised member states like Romania. This is another lesson that the regional innovation policy community can learn from its international development counterpart, where it is recognised that transformative development requires more "thinking and working politically" and fewer heroic assumptions about how change really happens.

References

Acemoglu, D., & Robinson, J. (2012). *Why nations fail: The origins of power, prosperity, and poverty*. London: Profile Books.

Andrews, M., Pritchett, L., & Woolcock, M. (2017). *Building state capability: Evidence, analysis, action*. Oxford: Oxford University Press.

Asheim, B. T., & Gertler, M. S. (2005). The geography of innovation: Regional innovation systems. In J. Fagerberg, D. C. Mowery, & R. Nelson (Eds.), *The Oxford handbook of innovation*. Oxford: Oxford University Press.

Asheim, B. T., & Isaksen, A. (1997). Location, agglomeration and innovation: Towards regional innovation systems in Norway? *European Planning Studies, 5*(3), 299–330.

Asheim, B. T., Boschma, R., & Cooke, P. (2011). Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies, 45*(7), 893–904.

Barca, F. (2009). *An agenda for a reformed cohesion policy: A place-based approach to meeting European Union challenges and expectations*. Brussels: European Commission.

Blazek, J., & Morgan, K. (2017). The institutional worlds of entrepreneurial discovery: Finding a place for less developed regions. In A. Mariussen et al. (Eds.), *Unpacking the entrepreneurial discovery process*. Abingdon: Routledge.

Boden, M., dos Santos, P., Haegeman, K., Marinelli, E., & Valero, S. (2016). *Implementing RIS3 in the region of Eastern Macedonia and Thrace* (Policy Brief No. 20/2016). Seville: Joint Research Centre, European Commission.

Bonaccorsi, A. (2009). *Towards better use of conditionality in policies for research and innovation under structural funds: The intelligent policy challenge*. Working Paper, University of Pisa

Boschma, R., & Frenken, K. (2011). Technological relatedness and regional branching. In H. Bathelt, M. Feldman, & D. Kogler (Eds.), *Beyond territory. Dynamic geographies of knowledge creation, diffusion, and innovation*. London: Routledge.

Byrne, A. (2017). Romanians protest against government plans to weaken graft laws. *Financial Times*. Retrieved from https://www.ft.com/content/d5e69204-e156-11e6-8405-9e5580d6e5fb

Charron, N., Dijkstra, L., & Lapuente, V. (2013). Regional governance matters: Quality of government within European Union member states. *Regional Studies, 48*(1), 68–90.
Coenen, L., Asheim, B., Bugge, M. M., & Herstad, S. J. (2017). Advancing regional innovation systems: What does evolutionary economic geography bring to the policy table? *Environment and Planning C: Government and Policy, 35*(4), 600–620.
Cooke, P. (1992). Regional innovation systems – Competitive regulation in the New Europe. *Geoforum, 23*(3), 365–382.
Cooke, P., & Morgan, K. (1998). *The associational economy: Firms, regions, and innovation*. Oxford: Oxford University Press.
Cooke, P. N., Boekholt, P., & Tödtling, F. (2000). *The governance of innovation in Europe: Regional perspectives on global competitiveness*. London: Pinter.
Cooke, P., Heidenreich, M., & Braczyk, H.-J. (2004). *Regional innovation systems: The role of governances in a globalized world*. London: UCL Press.
Doloreux, D., & Gomez, I. P. (2017). A review of (almost) 20 years of regional innovation systems research. *European Planning Studies, 25*(3), 371–387.
Dubnick, M., & Frederickson, H. G. (2011). *Public accountability: Performance measurement, the extended state, and the search for trust*. Washington: National Academy of Public Administration and The Kettering Foundation. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1875024
EC. (2014). EU anti-corruption report. Brussels: European Commission. Retrieved from https://ec.europa.eu/homeaffairs/sites/homeaffairs/files/e-library/documents/policies/organized-crime-and-humantrafficking/corruption/docs/acr_2014_en.pdf
EC. (2015a). *Public procurement guidance for practitioners*. Brussels: European Commission.
EC. (2015b). *Infographic: Public procurement – Guidance for practitioners*. Retrieved April 02, 2017, from http://ec.europa.eu/regional_policy/en/policy/how/improving-investment/public-procurement/guide/
EC. (2016). *Implementing smart specialisation strategies: A handbook*. Luxembourg: Publications Office of the European Union.
Etzkowitz, H. et al. (2007). The triple helix model of innovation. *Tech Monitor*, Jan-Feb, pp.14–23.
Eurostat. (2016). Eurostat. Retrieved April 20, 2016, from http://ec.europa.eu/eurostat
Farole, T., Rodríguez-pose, A., & Storper, M. (2011). Human geography and the institutions that underlie economic growth. *Progress in Human Geography, 35*(1), 58–80.
Foray, D. (2015). *Smart specialisation: Opportunities and challenges for regional innovation policy*. Abingdon: Routledge.
Freeman, C. (1987). *Technology policy and economics performance: Lessons from Japan*. London: Pinter Publishers.
Frenken, K., Van Oort, F., & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional Studies, 41*(5), 685–697.
Fukuyama, F. (2012). Review: Acemoglu and Robinson on why nations fail. *The American Interest*, March 26.
Hassink, R., & Marques, P. (2016). The regional innovation paradox revisited. In U. Hilpert (Ed.), *Routledge handbook of politics and technology*. Abingdon: Routledge.
Healy, A. (2016). Smart specialization in a centralized state: Strengthening the regional contribution in North East Romania. *European Planning Studies, 24*(8), 1527–1543.
Hooghe, L., & Marks, G. (2001). Types of multi-level governance. *European Integration Online Papers (EIoP), 5(11)*. http://eiop.or.at/eiop/texte/2001-011a.htm%0D
Isaksen, A., & Trippl, M. (2016). Path development in different regional innovation systems. In M. Parrilli, R. Fitjar, & A. Rodriguez-Pose (Eds.), *Innovation drivers and regional innovation strategies*. London: Routledge.
JRC. (2016). *RIS3 support in lagging regions*. http://s3platform.jrc.ec.europa.eu/ris3-in-lagging-regions
Landabaso, M. (2014). Guest editorial on research and innovation strategies for smart specialisation in Europe. *European Journal of Innovation Management, 17*(4), 378–389.

Marques, P. (2017). From toys to automobiles: Foreign investment, firm heterogeneity and intermediaries in a Portuguese industry. *European Planning Studies, 25*(8), 1375–1393.
McCann, P., & Ortega-Argilés, R. (2014). Smart specialisation in European regions: Issues of strategy, institutions and implementation. *European Journal of Innovation Management, 17*(4), 409–427.
Morgan, K. (1997). The learning region: Institutions, innovation and regional renewal. *Regional Studies, 31*(5), 491–503.
Morgan, K. (2004). The exaggerated death of geography: Learning, proximity and territorial innovation systems. *Journal of Economic Geography, 4*(1), 3–21.
Morgan, K. (2015). Smart specialisation: Opportunities and challenges for regional innovation policy. *Regional Studies, 49*(3), 480–482.
Morgan, K. (2017). Nurturing novelty: Regional innovation policy in the age of smart specialisation. *Environment and Planning C: Government and Policy, 35*(4), 569–583.
Nistotskay, M., Charron, N., & Lapuente, V. (2015). The wealth of regions: Entrepreneurship and wealth in Europe. *Environment and Planning C, 33*(5), 1125–1155.
North, D. (2005). *Understanding the process of economic change*. Princeton: Princeton University Press.
OECD. (2011). *Regions and innovation policy*. Paris: Organisation for Economic Co-operation and Development.
Oughton, C., Landabaso, M., & Morgan, K. (2002). The regional innovation paradox: Innovation policy and industrial policy. *The Journal of Technology Transfer, 27*(1), 97–110.
Pike, A., Rodriguez-Pose, A., & Tomaney, J. (Eds.). (2017). *Local and regional development*. Abingdon: Routledge.
Radosevic, S., & Stancova, K. C. (2015). Internationalising smart specialisation: Assessment and issues in the case of EU new member states. *Journal of the Knowledge Economy*, Advanced online access: https://doi.org/10.1007/s13132-015-0339-3
Rodríguez-Pose, A. (2002). *The European Union: Economy, society and polity*. Oxford: Oxford University Press.
Rodríguez-Pose, A., & Di Cataldo, M. (2015). Quality of government and innovative performance in the regions of Europe. *Journal of Economic Geography, 15*(4), 673–706.
Rodríguez-Pose, A., & Ezcurra, R. (2009). Does decentralization matter for regional disparities? A cross-country analysis. *Journal of Economic Geography, 10*(5), 619–644.
Rodríguez-Pose, A., & Garcilazo, E. (2013). *Quality of government and the returns of investment: Examining the impact of cohesion expenditure in European regions*. OECD Regional Development Working Papers, (No. 2013/12).
Rodrik, D., Subramanian, A., & Trebbi, F. (2004). Institutions rule: The primacy of institutions over geography and integration in economic development. *Journal of Economic Growth, 9*(2), 131–165.
Rosenberg, N. (1994). Exploring the black box : technology, economics, and history. In *Cambridge England*. New York: Cambridge University Press.
Stokes, D. E. (1997). *Pasteur's quadrant: Basic science and technological innovation*. Washington D.C.: Brookings Institution Press.
Tödtling, F., Asheim, B., & Boschma, R. (2013). Knowledge sourcing, innovation and constructing advantage in regions of Europe. *European Urban and Regional Studies, 20*(2), 161–169.
Todtling, F., & Trippl, M. (2005). One size fits all? Towards a differentiated regional innovation policy approach. *Research Policy, 34*(8), 1203–1219.
Tödtling, F., & Trippl, M. (2013). Transformation of regional innovation systems: From old legacies to new development paths. In P. Cooke (Ed.), *Reframing Regional Development*. London: Routledge.
Uyarra, E. (2010a). What is evolutionary about 'regional systems of innovation'? Implications for regional policy. *Journal of Evolutionary Economics, 20*, 115–137.
Uyarra, E. (2010b). Conceptualizing the regional roles of universities, implications and contradictions. *European Planning Studies, 18*(8), 1227–1246.

Policies for New Path Development: The Case of Oxfordshire

Helen Lawton Smith, Michaela Trippl, Rupert Waters, and Elena Zukauskaite

Abstract

This chapter reflects on how evolutionary economic geography (EEG) can be extended to incorporate public policy in its explanations of path development. A weakness of EEG is the poor conceptualisation of the role of the state (central, regional, local) in regional path development. It is therefore argued that a multi-scalar perspective of policy is required and that a large set of policies deserve attention. Oxfordshire in the UK is used to explore the link between public policy and path development.

Keywords

New path development · Public policy · Oxfordshire · Evolutionary economic geography · Smart specialisation · Regional innovation systems

H. Lawton Smith (✉)
Department of Management, Birkbeck, University of London, London, UK

Oxfordshire Economic Observatory, Oxford University, Oxford, UK
e-mail: h.lawton-smith@bbk.ac.uk

M. Trippl
Department of Geography and Regional Research, University of Vienna, Vienna, Austria
e-mail: michaela.trippl@univie.ac.at

R. Waters
School of Business, Engineering and Science, Halmstad University, Halmstad, Sweden
e-mail: rupert.waters@tiscali.co.uk

E. Zukauskaite
School of Health and Welfare, Halmstad University, Halmstad, Sweden
e-mail: elena.zukauskaite@hh.se

A. Isaksen et al. (eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*,
https://doi.org/10.1007/978-3-319-71661-9_15

1 Introduction

Recent progress made in evolutionary economic geography (EEG) has led to new insights into how regional economies develop over time and how new industrial growth paths emerge. A weakness of EEG is the poor conceptualisation of the state's (central, regional, local) role in regional path development (MacKinnon et al. 2009; Pike et al. 2009, 2016; Dawley et al. 2015). Advocates of the EEG perspective have thus far only offered some policy prescriptions that follow from their conceptual endeavours. We suggest that several other frameworks, notably regional innovation systems (RIS) (Cooke 1992; Coenen et al. 2016) and more recently the EU's smart specialization (S3) approach (Foray 2015) could complement EEG in various ways, casting light on factors that are underplayed in the EEG framework. The RIS framework in particular has innovation policy embedded in its various formulations, although can be criticised for its neglect of entrepreneurship and enterprise policies (see Lawton Smith chapter "Entrepreneurship Policies and the Development of Regional Innovation Systems: Theory, Policy and Practice", this volume).

The aim of this chapter is to engage in discussions about how the EEG approach might incorporate public policy in its explanations of new path development. We advance the idea that a multi-scalar perspective of policy is required and that a larger set of policies (i.e. not only those that target firm spin-offs, labour mobility and regional networking) deserve attention. The challenge for regional/local policy makers is to capitalize on complementary and reinforcing policy processes at other levels and identify contradicting ones in regional policy making (Zukauskaite 2015). We argue that due attention should be given to agency of different actors (public and private), sometimes acting together and sometimes in parallel, bringing about sub-national industrial change. This raises issues of leverage through the capacity (or not) both to resource activity and to bring about engagement of other parties (Lawton Smith 2012), particularly in innovation-led economic development.

The multi-scalar policy environment comprises a complex range of co-existing policies operating at sub-national (local or regional depending on context), national and international levels. It includes policies targeted at the sub-national level, designed to deliver localised outcomes by local actors [for example the UK's Local Enterprise Partnerships (LEPs)]. It includes policies on entrepreneurship, skills, infrastructure (roads, science parks, connectivity etc.) and business support. It also includes non-spatial policies with spatial outcomes, for example extensive central government spending on research for instance in the fields of biotechnology, energy and defence that disproportionately benefits some regions rather than others.

In the empirical part, we draw on a series of studies on the growth of Oxfordshire's high-tech economy since the mid-1980s (for example Lawton Smith 1990; Garnsey and Lawton Smith 1998; Lawton Smith et al. 2012). These studies provide an historical perspective on local economic evolution in the context of national, regional and local policy agendas. While Oxfordshire is a special case having the advantages of a central location, a world-leading university and massive state investment in its science base, it is illustrative of issues of the ways policy intervention at various spatial levels demonstrably shapes local economic development.

2 How Has Evolutionary Economic Geography Treated Policy?

In essence, EEG "explains the spatial evolution of firms, industries, networks and cities and regions from elementary processes of entry, growth, decline and exit of firms, and their locational behaviour" (Boschma and Frenken 2011, 295). Evolutionary theory is inherently tied up with notions such as interdependence among actors and the ways in which interdependencies and spillover effects create histories and render certain kinds of developments more likely to occur than others.

EEG highlights the importance and impact of historical preconditions on regional economic development (Boschma and Frenken 2011; Martin and Sunley 2006; Martin 2012). New development paths are considered as being "rooted in the historical economic structure of a region" (Neffke et al. 2011, 261); they are portrayed as outcome of endogenous branching (related diversification) processes, by which existing firms and industries diversify into related fields. Such path branching processes are facilitated by "related variety", i.e., the presence of different but technologically related industries (Boschma and Frenken 2011).

Path branching represents only one form of path development, albeit a centrally important one. Other development routes such as new path creation (Martin and Sunley 2006; Isaksen and Trippl 2016), or what Boschma (2017) calls unrelated diversification (i.e., the rise of entirely new growth paths with weak or no linkages to the pre-existing industrial structure) also need to be taken into account.

Boschma (2007) distinguishes different mechanisms through which knowledge spills over from one local firm to the other, contributing to knowledge accumulation, regional growth and new path development. These are the spin-off process,[1] labour mobility and social networking between (related) sectors. They work better in regions that already have stronger industrial bases (see Fritsch and Wyrwich 2014).

2.1 Policy and Path Development

Boschma (2009) outlined policy prescriptions to promote new growth paths by targeting the underlying mechanisms outlined above. He argues that policy should aim to connect complementary (that is, technologically related) sectors to exploit related variety. There is also scope for policy to help firms diversify into new sectors. Here we are interested in policy mechanisms and actions that promote these processes. We first briefly consider Boschma's prescriptions. We then expound a

[1] One can distinguish between the spin-off model and the agglomeration model. The former suggests that the region grows firm by firm through spin-off dynamics. The spin-off process also includes firms formed by established firms as a process of internal diversification and university spin-offs. The latter implies that the more start-ups enter a region, the stronger the growth. In both cases firms tend to stay close to their home organisation, which can lead to new growth paths. As most spin-offs locate in the immediate surroundings of the parent organisation, the knowledge transfer mechanism contributes to localised knowledge formation as well as regional growth.

set of additional elements that need to be taken into consideration to understand the actual role of policy at various levels (multi-scalar perspective) in shaping new growth paths.

First, the spin-off dynamic is not just about quantitative change (Boschma 2009). It is also about qualitative change through the provision of the conditions for entrepreneurship through various spin-off processes to emerge. This has a distinctive theoretical significance and would mean provision of public or private, support for new and early stage firms i.e. 'support region specific assets'. However, the timing of this is also conceptually and empirically important: at what stage is this recognised as a demand for policy intervention (Garnsey 1998; Feldman et al. 2005)? Therefore at what stage do such interventions become part of new path development?

Second, labour mobility and skills are both local and non-local phenomena.

New employees bring new knowledge to firms through inter-firm mobility. This takes place largely at the local level but extra-local mobility (Breschi and Lissoni 2009) also matters. Innovative places tend to have highly mobile populations (Lawton Smith and Waters 2011). Where policy does often intervene is to encourage/allow inter-country mobility (for example Canada's entrepreneurship scheme) or to discourage it (see 2017 debates in the UK on migration following the Brexit vote). Developing skills needed for new path development provides a key role for policy and educational institutions in designing programmes that match local skill needs. Boschma (2009) states that there is little or no understanding of the types of labour needed by new industries when they emerge and develop. Nevertheless, countries such as Australia, the US and the UK have established policy frameworks for addressing such issues.

Third, Boschma and Frenken (2010) in their evolutionary perspective on the geography of innovation networks point to the proximity paradox—where stronger innovation performance does not necessarily arise from spatial proximity. This presents both a conceptual problem and a policy dilemma. Indeed, other authors have challenged the importance of local networking between firms as well as between firms and other organisations suggesting that non-local linkages are essentially important for innovation and new path development (Huggins and Prokop 2017; Trippl et al. 2017).

2.2 Towards a Broader Understanding of the Role of Policy in New Path Development

The role of policy in sub-national (local and regional) innovation-led economic development has been poorly conceptualized in EEG, when compared with other approaches. In particular, EEG pays little attention to multi-scalarity in policy making thus neglecting the relative impact of national policies and institutions (for example the regulatory environment, the financial system etc.) on regional development and growth (see also Dawley et al. 2015). Here we begin by discussing regional innovation systems (RIS) (Cooke 1992; Coenen et al. 2016) and the EU's smart specialization (S3) agenda (Foray 2015) which we suggest are well equipped to complement the EEG perspective, and could lead to a better understanding of the role of policy in new path development.

The RIS approach suggests that regional development is driven by systemic innovation processes, requiring interaction between firms, research institutes and support organisations, which are embedded in the institutional structure of a region (Asheim and Gertler 2005). RIS has served as an analytical focusing device helping scholars and policy makers to formulate and implement innovation policy that is sensitive to specific conditions found in a region (Tödtling and Trippl 2005).

Smart specialization is specifically a policy concept, arguing for innovation-based development and growth in all types of regions (Foray 2015). The main rationale behind smart specialisation is the identification of several priority policy areas, representing current strengths and future possibilities as well as the development of policy-mixes needed to support these areas. The areas are to be identified in a collective manner including regional policy makers, firms, universities and civil society representatives.

It is beyond the scope of this chapter to detail how these concepts have contributed to the development of innovation policy. We focus only on a few aspects that are particularly relevant in relation to new path development and the case under study.

In different conceptualizations of RIS, the region is understood as an open system interacting with national and global levels (Cooke 2004; Asheim et al. 2011). Similarly, awareness of processes taking place outside the region is also one of the central elements of smart specialization which argues for a stronger emphasis on external knowledge connections of regional economies (Radosevic and Stancova 2015) and multi-level governance processes (European Commission 2012).

While EEG recognises that institutions co-evolve with technologies and markets (Boschma and Frenken 2011), its position regarding the possibilities for regional policy to bring institutional change and mobilize local leverage remains unclear. Boschma and Frenken (2009) suggest that supportive institutions come into being through state intervention after a new industry has been established. Boschma (2009) argues that there is a need for flexibility when it comes to institutions and organizations in the regions, so they can respond quickly to the needs of newly emerging industries. However, in some cases supportive institutions at national and regional levels are crucial preconditions for new paths to emerge rather than the other way around.

This is not to say that policy makers alone can identify future industry trends and the best ways to support them. Early studies on smart specialization practices suggest that by introducing collective governance practices, regional policy makers have contributed to increasing the interest in regional matters of previously disinterested actors such as universities, SMEs and multinationals as well as increased legitimacy of policy intervention (Trippl et al. 2016). Thus, regional policy makers act as mobilizers of other actors and through a collective process support new path developments in the region.

The RIS literature provides an array of tools that regional policy makers can use in order to implement regional innovation strategies. They can target individual organizations/system components or the system as a whole (Nauwelaers and Wintjes 2002; Isaksen et al. 2016). Funding as a direct investment by the government in funding concrete innovation projects, supporting collaborative efforts, providing public innovation procurement together with indirect efforts aiming at attracting investors and business angels to the region are among important tools for policy making. Due attention should be directed to government's own spending power. Where there are sub-national tax raising powers and retention of existing tax revenue (Perry and May 2007) regions have more options for new path development. For example this might relate to infrastructure projects through the establishment of business incubators, business innovation centres and science parks (Nauwelaers and Wintjes 2002). While the evidence of the impact of such infrastructure is mixed, its absence can lead firms to relocate thus removing possibilities for new path development.

This suggests that, although the regional context might provide opportunities it also sets limits to the freedom for governments to pursue effective policy or for powerful special-interest organisations to take over an economy and slow down the capacity of a region to adopt new technologies. The capacity for intervention designed to shape technological and innovation trajectories through a co-opted alignment of stakeholders at regional and international scales may be limited by resource availability.

3 The Oxfordshire Context

The key elements of the framework for the analysis of the Oxfordshire case illustrating the potential role of policy in evolutionary economic geography are spin-off dynamics, labour mobility and network formation (see Sect. 2.1) together with the elements identified in Sect. 2.2.

The analysis reveals the co-existence of multi-scalar policy processes in both economic development and in policy formulation and delivery in Oxfordshire over time. The multi-scalarity focus demonstrates how national policies might further reinforce, complement or contradict/oppose the efforts undertaken at the regional or local level. This is visible in outcomes such as sectoral composition, skills, and the composition of the science base as well as the propensity of universities to undertake 'third stream' activities related to local economic development.

3.1 The Science Base and the Role of Policy

Studies have shown that national spend on science, defence and education have uneven geographies of path development. The disproportionate regional effects of funding for scientific research can be seen in the science regions (Perry and May 2007) such as the 'golden triangle' in the UK (Oxford, Cambridge and London). In the case of premier universities such as Oxford and Cambridge, scientific research always has a local or contextualised component. It contributes to the "glocalisation" of the region with universities becoming internationally recognised attraction poles for research and commercial activities[2] rather than because of systemic path dependent local engagement.

UK universities have been incentivized by science and technology policy, and later by regional policy agents, by successive governments. From sticks and exhortations in the 1980s and 1990s, to carrots (monies such as the Higher Education Innovation Fund 1999) and from 1997 onwards more exhortations to be entrepreneurial for example through working with industry, activities including spinning off firms and patenting have become the norm (Lawton Smith and Bagchi-Sen 2012).

Oxfordshire's science base comprises nationally and internationally funded big science laboratories and private sector R&D laboratories and two universities, the University of Oxford and Oxford Brookes (Table 1). Their importance appears in several mechanisms for path development at different stages in the growth of the county's high-tech economy.

Innovation-led path development through the spin-off process in the new sectors can in part be related to the impact of national funding of big-science, national government-funded research laboratories research in public sector laboratories such as nuclear energy and space dating back to the post WWII period (Lawton Smith 1990). They were first established to service the UK's nuclear energy programme (UK Atomic Energy Authority, UKAEA, first nuclear fission and now only fusion research). Later they included space, environment and medical research. The laboratories are in two districts to the south of the county: the Vale of White Horse and South Oxfordshire (nuclear fusion laboratories).

Since the 1990s, the composition, its ownership and orientation have changed as successive governments introduced policies on the commercialisation of research. Later, in the 2000s land owned by the atomic energy authority was developed as a science campus. The Harwell site operates as the Harwell Science and Innovation Campus, one of the UK's two National Science and Innovation Campuses. It is a public-private partnership, and operates as a combined research and innovation park which in 2013 hosted 150 organisations and companies, employing over 4500 people. The campus forms part of a sub-region to the south of the county which is known as 'Science Vale UK' and has become an important part of the county's high-tech infrastructure.

University science parks and incubators (both private and public) also form part of the county's high tech economy infrastructure, similarly supporting new path development. Both the Oxford Science Park (Magdalen College 1990) (a private sector partnership) and Oxford University's own Science Park at Begbroke established in 2000 have incubators. Begbroke combines space with outreach and

---

[2]Oxfordshire has recently attracted a £115 million insulin research centre in collaboration with Novo Nordisk (https://www.ft.com/content/8db89d84-e650-11e6-893c-082c54a7f539) (accessed March 9, 2017).

Table 1 Main elements in the Oxfordshire's science base

Universities
Oxford University
Oxford Brookes University
Big Science
Harwell
RAL (Rutherford Appleton Laboratory) STFC materials and structures, light sources, astronomy and particle physics. – Space science – Diamond Light Source Facility (Synchrotron Radiation) – ISIS (physical and life sciences)
ESA UK Harwell Centre (space research) European Space Agency (ESA)
National Radiological Protection Board laboratory
Medical Research Council Radiation and Genome Stability Unit
Medical Research Council MRC Harwell (Mouse genetics)
NERC (National Environment Research Council) Centre for Ecology and Hydrology
UKAEA Culham (nuclear fusion)
JET (Joint European Torus) EU—European Fusion Development Agreement

entrepreneurship activities including the Centre for Innovation and Enterprise, the Enterprise Fellowship scheme and the development of new courses with the Department of Continuing Professional Development. National policies in science spending thereby further reinforce and complement such local processes.

3.2 Industrial Structure and the Role of Policy

Oxfordshire's high tech economy dates back to the mid-1980s. Its growth provides an example of entrepreneur-led new path creation and more recently of regional branching. No new sectors (both manufacturing and services) have their origins based directly in the county's older manufacturing sectors food manufacture, blankets and particularly in the post-war period, automobile manufacture (some 28,000 jobs were lost in the automobile industry in the 1970s). Now only the BMW Mini plant which employs some 4300 people and a number of component manufacturers and suppliers remain but does not interact with the high tech sectors of the city.

In 2010, the highest locational quotients (LQs) for high tech manufacturing are new industries: computing of various kinds, instrumentation and irradiation equipment. Data show a close match of the service sector with both the manufacturing sector and the science base with specializations in computer related activity and scientific R&D.

Oxford University has directly contributed to new path development in the high technology economy through the spin-off process (Boschma 2009). It, rather than the firms, is responsible for a large number of spin-offs, many of which are located in the county, particularly in biotech and instrumentation.

The biopharma sector is one of the county's four main clusters. It is underpinned by massive state investment and by the mainly state funded demand side (the NHS). In 2011 OBN estimated that there were around 163 biotech firms in the county, up 14% since the start of 2008. The majority were local start-ups or spin-offs (86%). Only four were either new branches of larger companies or companies moving into the county. The trend has been for more start-ups and fewer relocations or new branches of larger companies. Although the cluster reflects high levels of research in Oxford University in biomedical science, most entrepreneurs in the sector have no connection with the university (Lawton Smith and Bagchi-Sen 2010).

The growth of a cluster of instrumentation firms has a long history in the county for example in irradiation, cryogenics and medical instrumentation dating back to the 1940s and 1950s. This has developed through both spin-off and agglomeration effects. They are strongly related to national public policy in the form of funding of research in the universities and national laboratories. The clustering has two elements: the connection between local firms and the science base and subsequent spin-offs from first generation firms, especially Oxford Instruments (Lawton Smith 1991). Oxfordshire is now arguably the world capital of cryogenics, having pioneered cryogenic-enabled developments like MRI scanners, and is playing a leading role in the new technologies.[3]

The publishing sector is rather different. Some of this is local. For example Oxford University Press, formed by the university dates to 1586 when the university was given the right to print books. It is Oxford University's earliest spin-off company and the largest university publishing company in the world. Blackwell (publisher and retailer) can be dated back to the nineteenth century while in 2002 Routledge moved its journal division from London to Milton Park part of Science Vale UK (see below).

3.3 Labour Mobility and Skills and the Role of Policy

The link between the presence of a highly-skilled workforce and the level of new firm formation (Fritsch and Schindele 2011) leading to new path development can be seen in Oxfordshire. Both Oxfordshire, and in particular the City of Oxford's workforce, have a high percentage of people with higher education and professional skills. In 2014, some 60% of Oxford's residents were qualified to NVQ level 4 or above (degree and professional qualifications). This is significantly higher when compared with the South East (39%), and England (36%).[4]

[3] http://www.oxfordshirebusinesssupport.co.uk/content/cryogenics (accessed August 3, 2016).

[4] https://www.oxford.gov.uk/info/20238/oxfords_economy/943/oxfords_labour_market (accessed August 2, 2016).

The presence of the public sector science base as well as R&D intensive firms has also underpinned the evolution and the strength of the county's scientific labour market, a key evolutionary factor in a number of ways. Firm growth has been supported by technicians trained in the laboratories and to a lesser extent in the local universities. However, there is currently a shortage of technicians. The science base has attracted highly qualified people into the county, many of whom either started companies or who were recruited into the high tech sector (Lawton Smith and Waters 2011).

Oxfordshire's weakness at lower levels of qualification including technicians has been identified as an important field of local policy interventions (Lawton Smith and Waters 2011). There are available frameworks at the local level (colleges, schools, universities and public sector bodies) that can used to lever responses to local skill shortages. In some cases their efforts are influenced by national policy e.g. national skills policies.

The Oxfordshire skills strategy is a co-ordinated approach[5] that attempts to identify skill needs for emerging industries. The Oxfordshire Skills Board brings together many public and private employers, secondary, further and higher education skills providers and stakeholder groups. No evaluation about how effective this has been has yet been undertaken.

3.4 Networks and the Role of Policy

The logic for networks is that they exist to provide events and other contact points for people with similar business and professional interests (Lawton Smith et al. 2012). Networking bodies which organise support for entrepreneurship and innovation include Chambers of Commerce and local branches of the Federation of Small Businesses. In 2008 Oxfordshire had 65 formal networks, ranging from large and highly specialised networks to smaller networks, for example breakfast clubs. They were particularly effective in developing economic relationships, for example with new customers. In evolutionary terms, networks embody the notion of interdependence between actors and create spillover effects.

Networking in the biotech sector has been supported by public and private sector policy intervention at the local level. This is because of its specialist resource requirements (skills, knowledge, funding) which in part can be met through local relationships. National funding supported Oxfordshire BiotechNet (established in 1987) and the regional development agency (RDA) for South East England (SEEDA). The Oxfordshire Bioscience Network (OBN) has replaced the Oxfordshire BiotechNet as the formal network for the life science sector. It is OBN[4] acting as a convener of firms, investors and suppliers that is making a difference through inter-regional, inter-firm linkages. It does this by networking, holding events and organising economic transactions through coordinating elements in the

[5] http://www.oxfordshireskillsboard.org/ (accessed August 2, 2016).

supply chain. Its original base was Oxfordshire but has expanded its scope. Its nearly 400 member companies are located across the Golden Triangle and beyond to Nottingham, Manchester and Scotland.

Such networks, hence local interdependencies, are therefore strongly influenced by policy intervention and are part of the story of new path development. Very early in Oxfordshire's high tech development, in 1985, The Oxford Trust established itself as the focal point for high-tech networking. At this time, there were fewer than 200 high-tech companies (Lawton Smith 1990). It started with half a dozen incubator units, held networking events, started a business angel network (the Oxford Investment Opportunity network OION), and the Oxfordshire BiotechNet.

Through its own spin-off company Oxford Innovation (OI) set up Europe's first innovation centre, Oxford Centre for Innovation (OCFI), was pioneered by Oxford Innovation in 1987. OI went on to manage other innovation centres. In 2006, Oxford Innovation became part of SQW Group, then in 2010, SQW Group acquired the business development function of Fasset, a specialist operator of regional technology parks, positioning Oxford Innovation as the UK's leading operator of Business & Innovation Centres, widening its geographical scope of its support for path development processes.[6]

3.5 Local (and Regional) Policy Capacities in the Context of UK's National Policy Framework

We earlier suggested that EEG neglects multi-scalarity in policy making, overlooking the relative impact of national policies and institutions (for example the regulatory environment, the financial system etc.) on regional development and growth (see also Dawley et al. 2015). Here we address in which ways local policy has the capacity to influence innovation-led new path development) within an overall national policy framework. This encompasses the broader role of the state in the economy through for example regulation and large scale infrastructure such as roads, rail and airports as well as decisions on local policy strategies. The complexity of changes in delivery highlights problems of conceptualising policy intervention at the sub-national level from an EEG perspective within multi-scalar polities. Moreover, the agency of individuals in decision-making as well as action (Feldman et al. 2005; Autio et al. 2014) is important. Indeed the *Oxfordshire Innovation Engine* (SQW 2013, 6) identified the perception 'that Oxfordshire has lacked the strong leadership and consistent messaging that have benefitted some competitor locations, not least Cambridge'.

The significance of the regional rather than the local scale is that localities that rely on strong intermediate or regional authority to stimulate national state action, are better off than localities which cannot rely on such an authority (Dawley et al. 2015). In the UK, the background to policy which sets the possibilities for current

[6]http://www.oxin-centres.co.uk/our-history (accessed October 14, 2015).

local leverage is the abolition in 2012 of the eight regional authorities, RDAs, for England (plus London) which covered large, multiple administrative areas, which had an annual budget of some £1.4 billion. RDAs had been responsible for the application of central government policy at the regional level and each had its own innovation-led economic growth strategies (Waters and Lawton Smith 2002). Oxfordshire was one of the RDA SEEDA's eight counties. It has been estimated that some £18 million was spent in Oxfordshire by SEEDA. While no evaluation has been undertaken of the effectiveness of this particular spend, an assessment of the nine RDAs showed a positive impact on economic development.[7]

The 2010 change of government from the Labour Party to the Coalition (Conservatives and Liberal Democrats) changed agency in science, innovation and entrepreneurship policy processes at local levels. Evidence of this is the announcement that this marks "a change from top down initiatives that ignore the varying needs of different areas" (Deputy Prime Minister 2010, introduction to Local Growth White Paper[8]). The regional scale was then replaced by the local with 39 LEPs (now 38), partnerships between local authorities, businesses, civic, educational and community leaders. Some 20 local authorities belong to more than one LEP, for example Cherwell in Oxfordshire belongs to the South East Midlands LEP which has recently merged with the Northamptonshire LEP. They have a mandate to drive economic growth involving Local Economic Assessment (Local Authorities); their Strategic Economic Plan (SEP); European Structural and Investment Funds (ESIF)—Strategy; Enterprise Zones, City Deals, Science and Innovation Audits but not now the EU's Europe 2020 Smart Specialisation S3 agenda. The ESIF programme including the Smart Specialisation Strategy for England was submitted in April 2015.[9]

LEPs have taken on increased responsibility for significant amounts of central government funding (National Audit Office, NAO 2016) and have been set a considerable challenge: 'to unite 'multi-level, cross-sector interests in a way that enables the regeneration and growth of places' (Pugalis and Shutt 2012, 1). These include actions such as transport and infrastructure developments that have visible outcomes. In 2014, the government announced that it had agreed Growth Deals with each of the 39 LEPs, through which it indicatively allocated £6.3 billion of the Local Growth Fund. Each LEP's Growth Deal was awarded based on the strength of their multi-year strategic economic plans. A further £1 billion was allocated in January 2015, making the total allocation to date £7.3 billion (NAO 2016).

---

[7] http://webarchive.nationalarchives.gov.uk/+/http:/www.berr.gov.uk/whatwedo/regional/regional-dev-agencies/Regional%20Development%20Agency%20Impact%20Evaluation/page50725.html (accessed March 8, 2017).

[8] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/32076/cm7961-local-growth-white-paper.pdf (accessed October 27, 2013).

[9] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/436242/bis-15-310-smart-specialisation-in-england-submission-to-european-commission.pdf (accessed August 2, 2017).

However, LEPs' capacity to affect local path development is constrained by their own limited resources and by the requirements of central government in designing local strategies. The existence and then subsequent abolition of well-resourced RDAs and the establishment of under-resourced LEPs (a budget of £500,000 p.a.) has created a situation where LEPs unlike RDAs are not accountable for strategy implementation and cannot meet demands placed on them. Their powers and leverage are constrained by their very limited resources, and a lack of strategic and statutory planning powers (Witty 2013). Moreover, NAO (2016) points out, evaluations of achievements are limited as the government has not set specific quantifiable objectives for what it hopes to achieve through Growth Deals. NAO (2016, 6) finds that, 'The English devolution landscape is changing considerably and it is not yet clear how LEPs fit into it. The government regards LEPs as central to its plans for English devolution. However, LEPs are often uncertain of their role within a more devolved landscape, particularly in areas where their economic geography does not align with that of the combined authority'. Moreover, NAO finds that there is a risk that LEPs do not possess the resources necessary to deliver Growth Deal projects.

The proposed introduction of the national industrial strategy (Green Paper 2017)[10] in the context of Brexit, further complicates the policy landscape. It is designed to improve living standards and economic growth by increasing productivity and driving growth across the whole country (page 9). It is not clear what role the LEPs will have as it appears that decisions will be made at the national level even though the Green Paper spells out that the government will work with LEPs 'to review their role in local growth' (page 22). This does not sound like a RIS approach, rather more a national innovation systems approach.

Table 2 provides an overview of recent national policies designed to deliver resources to support local intervention. It also offers an account of key actors of local delivery.

The dirigiste nature of the allocation of funding is evident from the requirement that LEPs strategic plans are to be consistent with national priorities, and will be the basis on which Government negotiates with each LEP. LEPs are also a vehicle for bidding for relevant central government programmes. The majority of resources that directly fund the LEP come from Oxfordshire County Council. District councils, business and academia provide in-kind support.

The Oxfordshire LEP established in 2011 is countywide and includes the four district councils and the City of Oxford. Over the period 2008 to 2015, which covers the economic downturn and subsequent recovery, Oxfordshire LEP (3.9%) and London LEP (3.8%) had the highest average annual growth rates for nominal GVA. The strong growth in Oxfordshire has been due to above average growth in information and communication technology (ICT).[11] However, the context is at

[10]https://beisgovuk.citizenspace.com/strategy/industrial-strategy/supporting_documents/buildingourindustrialstrategygreenpaper.pdf (accessed May 17, 2017).

[11]https://www.ons.gov.uk/economy/grossvalueaddedgva/articles/gvaforlocalenterprisepartnerships/1997to2015 (accessed March 8, 2017).

Table 2 National and local policy framework operating in Oxfordshire (2011/2012)

National regional policy	Objectives	Local delivery in Oxfordshire
National funds available at local level		
Regional Growth fund, 2011	£1 billion fund primarily designed to support economic growth in parts of England hit by public sector cutbacks[a]	April 2011 OION was one of five partners in the successful bid submitted by Capital for Enterprise Ltd (CfEL) for a £50 million co-investment fund for supporting small firms.
Growing Places funds 2011	Provides £500 million to enable the development of local funds to address infrastructure constraints[b]	2012 allocated £6 million to Oxfordshire for short-term infrastructure delivery associated with housing and employment.
Local/cluster scales of policy delivery		
Enterprise Zones 2011	support new and expanding businesses by offering incentives. businesses are eligible for a business rates discount of up to £55,000 a year for five years. Currently 24 Enterprise Zones across England[c].	Science Vale UK
Local Enterprise Partnerships	Growth through partnerships	Oxfordshire LEP
City Deals 2012	Give participating areas the ability to use budgets better for local needs such as training and skills, roads and other developments. Areas must demonstrate a strong plan for local growth. (infrastructure, entrepreneurship)	Oxford and Oxfordshire City Deal initial award in February 2013, vision is to '[a]ccelerate the growth of the city region's knowledge-based economy'.

Source: Authors' survey
[a]http://www.telegraph.co.uk/finance/yourbusiness/7861813/Regional-growth-fund-to-launch-as-public-sector-job-cuts-bite.html (Accessed March 15, 2013)
[b]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7521/2024617.pdf (Accessed March 15, 2013)
[c]http://enterprisezones.communities.gov.uk/about-enterprise-zones/ (Accessed March 15, 2013)

the national level, Oxfordshire's favourable position within the country's research base is related to its innovation-led economic performance.

Given this favourable background, the LEP is seen as a 'light-touch' body with the overarching aim to be a catalyst for realising Oxfordshire's economic and commercial potential. It is led by a board including members from business, local government and other organisations and universities, has a head start on other regions. Universities as institutions are seen as having a pivotal role in the social and economic development of their regions and in principle in developing smart specialisation strategies. Both Oxford University and Oxford Brookes universities are represented at Pro-Vice Chancellor level on the LEP. However, Oxford's universities have traditionally not been part of the local policy-making system (Lawton Smith 1991; Lawton Smith and Bagchi-Sen 2012). Now their representatives are expected to feed into decisions made on supporting new path development.

In contrast in Cambridge, the Chamber of Commerce, Cambridge University and local councils (11 organisations altogether) produced 'The case for Cambridge' which set out why urgent [central] government action in the form of 'five asks' is needed to enable the city to thrive. As in Oxford and London, the other two cities in 'the golden triangle' key problems are inequality, unaffordable housing and congested roads.[12] The over-arching theme is the need for devolved powers, and can be likened to both RIS and smart specialisation approaches. The Cambridge example illustrates that concerted local action bringing in regional stakeholders (Lawton Smith 2012) creates the possibility of a dialogue with central government to address local path development issues.

Path development is not articulated as being through the spin-off route (Boschma 2007, 2009) in the 2016 Oxfordshire LEP Strategic Economic Plan (SEP).[13] The vision is of Oxfordshire as being innovation-led economic development, 'as a vibrant, sustainable, inclusive, world leading economy, driven by innovation, enterprise and research excellence' consistent with a RIS agenda and to some extent smart specialisation. However, the county is not officially a 'smart region' in the sense that it is not registered as joining an S3 platform[14] as the UK as a whole is not registered.

Four programme elements of the SEP are **People**—delivering and attracting specialist and flexible skills at all levels, across all sectors (a particular focus of growth fund spending); **Place**—ensuring a strong link between jobs and housing growth, and providing a quality environment that supports and sustains growth; **Enterprise**—emphasising innovation-led growth, underpinned by the strength of Oxfordshire's research, business collaboration and supply chain potential; recognising and reinforcing the significant contribution made by all sectors, in all parts of Oxfordshire and all types of business; and **Connectivity**—enabling people, goods and services to move more freely, connect more easily; improving broadband and mobile coverage and capacity. The elements of a RIS are stated as ensuring that inter-relationships and opportunities across these programmes are fully exploited having previously recognised a lack of coordination in the enterprise and innovation elements of the SEP.

However, in comparison with Cambridgeshire, Oxfordshire is under-resourced and lacks leadership and a united strategy with local partners (Cambridge City Council, Cambridgeshire County Council, South Cambridgeshire District Council, University of Cambridge, Greater Cambridge Greater Peterborough Local

[12] http://www.cambridgeahead.co.uk/the-case-for-cambridge/ (accessed July 24, 2016).

[13] http://www.oxfordshirelep.com/sites/default/files/Oxfordshire-SEP-2016-Final-with-images.pdf (accessed May 12, 2017).

[14] http://s3platform.jrc.ec.europa.eu/s3-platform-registered-regions (accessed May 12, 2017).

Enterprise Partnership). The Greater Cambridge's City Deal is worth £600 million. Oxfordshire's £24.2 million (January 2017) from the third round of the Local Growth Fund is little slender by comparison.[15]

In Oxfordshire, Science Vale UK (SVUK) has had a demonstrable impact on path development processes. This has elements of both RIS and S3. It is a public-private collaboration between Harwell, Milton Park (the largest business/science park in the county), two adjacent local district councils which now share a common management structure and services (Vale of White Horse and South Oxfordshire),[16] the Oxfordshire LEP, Oxfordshire County Council and the Science and Technology Facilities Council (STFC) RAL.

Its impact so far is that it has attracted national funding in the form of a UK Government Enterprise Zone (EZ). These EZ's offer flexible planning regimes and 100% business rate discounts for up to 5 years. The SVUK EZ is designed to deliver 200,000 m^2 of new employment land at Milton Park (an important local business park) and Harwell. In March 2017 it was announced that a new £24 million development would include offices and two high tech laboratories and create an extra 1000 jobs. Previous Growth Deal Investments have been used to fund the Centre for Applied Superconductivity. This is a new centre of innovation designed 'to coordinate the interaction between key industry players, Oxford University, cryogenics companies and end users (including SMEs) on the Harwell campus and at the Culham Centre for Fusion Research Campus'.[17]

This is an example of where policy intervention, in conjunction with the private sector, at the local level has addressed resource and infrastructure issues including leveraging national funding. Local targets here are thereby more likely to be realized than in other policy-fragmented parts of the county. Indeed at county level, at the same time there is no agreement on plans for a single unity authority.

The practices adopted in SVUK are consistent with good practice identified in the evaluation of COR (2015) on the European Entrepreneurial Regions (EER) project. This was based on successful innovation policies in 11 of the 15 EER regions. The main achievements of EER both at SME and territorial level, identified by Committee of Regions (COR) (2015) include amongst others: change in stakeholder attitude towards innovation; an increase in R&D investment (especially among SMEs); an increase in employment; better collaboration between the research sector and firms; an increase in the number of innovative start-ups; and, positive externalities for the territories (innovation initiatives are an important policy instrument to combat the negative effects of the financial crisis).

[15]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/589197/170202_Oxfordshire_LEP_GD_factsheet.pdf (accessed May 17, 2017).

[16]http://www.sciencevale.com/ (accessed January 13, 2013).

[17]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/589197/170202_Oxfordshire_LEP_GD_factsheet.pdf (accessed May 17, 2017).

4 Conclusions

The purpose of this chapter is to engage in discussions about how the EEG approach might incorporate the role of public policy in relation to path development processes. We have extended Boschma's (2007, 2009) EEG approach by other frameworks (RIS, S3) to provide a comprehensive and practical approach to understanding the role of policy in shaping new path development. Oxfordshire is used to point to elements that need to be taken into consideration in addition to elements highlighted by EEG, i.e., spin-offs, labour mobility and networks.

The relevance of the Oxfordshire case for other types of regions (high-tech or less favoured regions) is to demonstrate multiple path dependencies operating alongside isolated events and policy actions. Some of these match the RIS approach—which has advantage of providing a framework for analysis of the presence and—absence—of systemic processes. However, the concept of new path development in the EEG approach is conceptually important, even though the three processes identified by Boschma (2009) are not necessarily consistent with policy targets. It is argued that the possibility of change in local paths of development should be analysed within a context of multi-level governance. This is missing in the EEG approach and therefore the RIS approach is complementary for developing 'smart' policies.

In Oxfordshire instead of a coherent RIS strategy, several elements of interconnected but not orchestrated path developments can be found. Some of these are private sector led but have to be seen in the context of a very strong (mainly nationally funded) science-base. This complexity inevitably has inbuilt tensions due to conflicting priorities (e.g. national versus local), confusion as to delivery and actual spend.

The chapter has cast light on three themes. The first is that path development is not confined to local processes of public and private sector intervention and therefore that spillover effects and outcomes are multi-scalar. Agency (Boschma et al. 2017), particularly policy agency is also multiscalar. It is not just the co-existence of multiple scales that matters, it is the interplay between them, even between the national and local level, that is important in determining under what conditions and in which ways public policy can make a difference. Although recent developments in EEG have considered agency, including institutional entrepreneurs (Boschma et al. 2017), the issue of multi-scalarity has not been adequately conceptualised.

Second, the time dimension in relation to the changing targets of policy in relation to economic development needs to be emphasised. This is not only in relation to the consequences of political change in path dependent processes but also in the changing role of key local organisations e.g. universities and local innovation support bodies, and whether they chose, or are incentivised, to act together with others in order to be able to make local problems more resolvable by local intervention (as in the Science Vale UK case, where a RIS approach is embedded in this institutional structure).

The UK case provides examples of national funding initiatives which in principle offer local policy organisations the power to adapt policies to local needs, strategic plans still need to be consistent with national policies, rather than form the basis of an RIS. Hence there are examples where national governments are pushed to devolve more powers for example on skills development, or in Cambridge where agency of collective actors at the local level is being used to request help to deliver more effective local policies.

Finally, the national state is very significant in shaping regional policy in the UK. Its impact is felt through science spending by which £1 of public funding will give rise to an increase in private funding of between £1.13 and £1.60 (BIS/Economic Insight 2015)[18] and through priorities which determine the allocation of national funds to be used at the local level. Future work should seek to further conceptualise and empirically investigate the complexity of economic development and policy processes using both EEG and RIS frameworks to increase our knowledge about the role of policy in new path development.

References

Asheim, B., & Gertler, M. (2005). The geography of innovations: Regional innovation systems. In J. Fagerberg, D. C. Mowery, & R. R. Nelson (Eds.), *The Oxford handbook of innovation* (pp. 291–317). Oxford: Oxford University Press.

Asheim, B., Smith, H. L., & Oughton, C. (2011). Regional innovation systems: Theory, empirics and policy. *Regional Studies, 45*, 875–891.

Autio, E., Kenney, M., Mustar, P., Siegel, D., & Wright, M. (2014). Entrepreneurial innovation: The importance of context. *Research Policy, 43*, 1097–1108.

Boschma, R. (2007). Path creation, path dependence and regional development. In J. Simmie & J. Carpenter (Eds.), *Path dependence and the evolution of city regional economies* (pp. 40–55). Oxford: Oxford Brookes University.

Boschma, R. (2009). *Evolutionary economic geography and its implications for regional innovation policy*. http://econ.geo.uu.nl/boschma/OECD.pdf

Boschma, R. (2017). Relatedness as driver of regional diversification: A research agenda. *Regional Studies, 51*(3), 351–364.

Boschma, R., & Frenken, K. (2009). Some notes on institutions in evolutionary economic geography. *Economic Geography, 85*, 151–158.

Boschma, R., & Frenken, K. (2010). The spatial evolution of innovation networks. A proximity perspective. In R. A. Boschma & R. Martin (Eds.), *Handbook of evolutionary economic geography* (pp. 120–135). Cheltenham: Edward Elgar.

Boschma, R., & Frenken, K. (2011). The emerging empirics of evolutionary economic geography. *Journal of Economic Geography, 11*(2), 295–308.

Boschma, R., Coenen, L., Koen, F., & Truffer, B. (2017). Towards a theory of regional diversification: Combining insights from evolutionary economic geography and transition studies. *Regional Studies, 51*, 1.

Breschi, S., & Lissoni, F. (2009). Mobility of skilled workers and co-invention networks: An anatomy of localized knowledge flows. *Journal of Economic Geography, 9*, 439–468.

[18]https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/438763/bis-15-340-relationship-between-public-and-private-investment-in-R-D.pdf (accessed May 21, 2017)

Coenen, L., Asheim, B., Bugge, M., & Herstad, S. (2016). Advancing regional innovation systems: What does evolutionary economic geography bring to the policy table? *Environment and Planning C, 35*(4), 600–620. https://doi.org/10.1177/0263774X16646583

Cooke, P. (1992). Regional innovation systems: Competitive regulation in the New Europe. *Geoforum, 23*(3), 365–382.

Cooke, P. (2004). Regional innovation systems – an evolutionary approach. In P. Cooke, M. Heidenreich, & H.-J. Braczyk (Eds.), *Regional innovation systems: The role of governance in a globalized world*. London: Routledge.

Dawley, S., Mackinnon, D., Cumbers, A., & Pike, A. (2015). Policy activism and regional path creation: The promotion of offshore wind in North East England and Scotland. *Cambridge Journal of Regions Economy and Society, 8*(2), 257–272.

European Commission. (2012). *Scoreboard for monitoring Multilevel Governance (MLG) at the European Union level*. http://cor.europa.eu/en/activities/governance/Documents/scoreboard-2012-executive-summary.pdf. Accessed August 2, 2016.

Feldman, M. P., Francis, J., & Bercovitz, J. (2005). Creating a cluster while building a firm: Entrepreneurs and the formation of industrial clusters. *Regional Studies, 39*, 129–141.

Foray, D. (2015). *Smart specialization: Opportunities and challenges for regional innovation policies*. Abingdon: Routledge.

Fritsch, M., & Schindele, Y. (2011). The contribution of new businesses to regional employment—an empirical analysis. *Economic Geography, 87*(2), 153–180.

Fritsch, M., & Wyrwich, M. (2014). The long persistence of regional levels of entrepreneurship: Germany, 1925-2005. *Regional Studies, 48*(6), 955–973.

Garnsey, E. (1998). The genesis of the high technology milieu: A study in complexity. *International Journal of Urban and Regional Research, 22*(3), 361–377.

Garnsey, E., & Lawton Smith, H. (1998). Proximity and complexity in the emergence of high technology industry: The Oxbridge comparison. *Geoforum, 29*(4), 433–450.

Huggins, R., & Prokop, D. (2017). Network structure and regional innovation: A study of university-industry ties. *Urban Studies, 54*(4), 931–952.

Isaksen, A., & Trippl, M. (2016). Path development in different regional innovation systems. In M. D. Parrilli, R. D. Fitjar, & A. Rodriguez-Pose (Eds.), *Innovation drivers and regional innovation strategies* (pp. 66–84). New York: Routledge.

Isaksen, A., Tödtling, F., & Trippl, M. (2016). *Innovation policies for regional structural change: Combining actor-based and system-based strategies* (SRE-Discussion 2016/05). Vienna University of Economics and Business.

Lawton Smith, H. (1990). *The location and development of advanced technology in Oxfordshire in the context of the research environment*. Unpublished DPhil thesis, University of Oxford.

Lawton Smith, H. (1991). The role of incubators in local industrial development: The cryogenics industry in Oxfordshire. *Entrepreneurship and Regional Development, 3*(2), 175–194.

Lawton Smith, H. (2012). The health technologies sector in the Thames Valley: Evolution or optimism in regional development?, Chap. 6. In P. Cooke (Ed.), *Re-framing regional development* (pp. 125–145). London: Routledge.

Lawton Smith, H., & Bagchi-Sen, S. (2010). Triple helix and regional development: A perspective from Oxfordshire. *Technology Analysis and Strategic Management, 22*(7), 805–818.

Lawton Smith, H., & Bagchi-Sen, S. (2012). The research university, entrepreneurship and regional development: Research propositions and current evidence. *Entrepreneurship & Regional Development, 24*(5–6), 383–404.

Lawton Smith, H., & Waters, R. (2011). Scientific labour markets, networks and regional innovation systems. *Regional Studies, 45*(7), 961–978.

Lawton Smith, H., Romeo, S., & Virahsawmy, M. (2012). Business and professional networks: Scope and outcomes in Oxfordshire. *Environment and Planning A, 44*(8), 1801–1818.

MacKinnon, D., Cumbers, A., Pike, A., Birch, K., & McMaster, R. (2009). Evolution in economic geography: Institutions, political economy, and adaptation. *Economic Geography, 85*(2), 129–150.

Martin, R. (2012). (Re) Placing path dependence: A response to the debate. *International Journal of Urban and Regional Studies, 36*, 179–192.

Martin, R., & Sunley, P. (2006). Path dependence and regional economic evolution. *Journal of Economic Geography, 6*(4), 395–437.

Nauwelaers, C., & Wintjes, R. (2002). Innovating SMEs and regions: The need for policy intelligence and interactive policies. *Technology Analysis & Strategic Management, 14*(2), 201–215.

NAO. (2016). https://www.nao.org.uk/report/local-enterprise-partnerships/. Accessed December 8, 2017.

Neffke, F. M. H., Henning, M., & Boschma, R. A. (2011). How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. *Economic Geography, 87*, 237–265.

Perry, T., & May, B. (2007). Governance, science policy and regions: An introduction. *Regional Studies, 41*(8), 1039–1050.

Pike, A., Birch, K., Cumbers, A., MacKinnon, D., & McMaster, R. (2009). A geographical political economy of evolution in economic geography. *Economic Geography, 85*(2), 175–182.

Pike, A., MacKinnon, D., Cumbers, A., Dawley, S., & McMaster, R. (2016). Doing evolution in economic geography. *Economic Geography, 92*(2), 123–144.

Pugalis, L., & Shutt, J. (2012). After regions: What next for local enterprise partnerships? *Regions, 286*(2), 23–25.

Radosevic, S., & Stancova, K. C. (2015). Internationalising smart specialisation: Assessment and issues in the case of EU new member states. *Journal of the Knowledge Economy*. https://doi.org/10.1007/s13132-015-0339-3

SQW. (2013). *The Oxfordshire innovation engine*. http://www.sqw.co.uk/files/2613/8690/7243/Oxford_engine.pdf. Accessed August 2, 2016.

Tödtling, F., & Trippl, M. (2005). One size fits all? Towards a differentiated regional innovation policy approach. *Research Policy, 34*(8), 1203–1219.

Trippl, M., Zukauskaite, E., & Healy, A. (2016). *Smart specialisation: Opportunities and challenges in different types of European regions*. Paper presented at the EuSpri Conference, Lund, Sweden, 7–10 June, 2016.

Trippl, M., Grillitsch, M., & Isaksen, A. (2017). Exogenous sources of regional industrial change: Attraction and absorption of non-local knowledge for new path development. *Progress in Human Geography*. https://doi.org/10.1177/0309132517700982

Waters, R., & Lawton Smith, H. (2002). RDAs and local economic development: Scale and competitiveness in Oxfordshire and Cambridgeshire. *European Planning Studies, 10*(5), 633–649.

Witty, A. (2013). *Final report and recommendations encouraging a British invention revolution: Sir Andrew Witty's review of universities and growth*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/249720/bis-13-1241-encouraging-a-british-invention-revolution-andrew-witty-review-R1.pdf. Accessed October 27, 2013.

Zukauskaite, E. (2015). Organizational change within medical research in Sweden: on the role of the individuals and institutions. *Environment and Planning C*. https://doi.org/10.1177/0263774X15612339