New Avenues for Regional Innovation Systems and Policy

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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

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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 Transfor mative 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 "Insti tutional 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.

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