System Failures, Knowledge Bases and Regional Innovation Policies

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Roman Martin and Michaela Tripl

Abstract

Regional innovation strategies rank on the top of public policy agendas today. There is a widespread consensus in both academic and policy circles that standardised “best practice” innovation policy models suffer from severe limitations and major shortcomings. The recent literature is replete with claims that regional innovation policies should be place-based and context-sensitive, taking into consideration the specificities of regions and their distinctive preconditions and capacities for innovation. Various conceptual approaches and theories support such a view. This paper discusses two concepts, which have a particularly strong potential for informing a differentiated regional innovation policy approach; the regional innovation system (RIS) theory and the knowledge base concept. The RIS literature highlights the importance of the organisational and institutional setting of a region and suggests that system deficiencies or failures should constitute the starting point for designing regional innovation policies. The differentiated knowledge base approach stresses that regional industries differ strongly in the underlying knowledge bases and, as a consequence, in their policy needs. We elaborate on the policy implications that originate from these concepts and argue that tailor-made regional innovation policies should consider both region-specific institutional set-ups and knowledge bases.

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Keywords: regional innovation policy, regional innovation system, differentiated knowledge bases

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Abstract

Regional innovation strategies rank on the top of public policy agendas today. There is a widespread consensus in both academic and policy circles that standardised “best practice” innovation policy models suffer from severe limitations and major shortcomings. The recent literature is replete with claims that regional innovation policies should be place-based and context-sensitive, taking into consideration the specificities of regions and their distinctive preconditions and capacities for innovation. Various conceptual approaches and theories support such a view. This paper discusses two concepts, which have a particularly strong potential for informing a differentiated regional innovation policy approach; the regional innovation system (RIS) theory and the knowledge base concept. The RIS literature highlights the importance of the organisational and institutional setting of a region and suggests that system deficiencies or failures should constitute the starting point for designing regional innovation policies. The differentiated knowledge base approach stresses that regional industries differ strongly in the underlying knowledge bases and, as a consequence, in their policy needs. We elaborate on the policy implications that originate from these concepts and argue that tailor-made regional innovation policies should consider both region-specific institutional set-ups and knowledge bases.
1 Introduction

Regional innovation strategies have become a key priority of policy actors in many countries and regions (OECD 2011). A growing body of work suggests that there is no standardized “one-size-fits all” innovation policy approach that could be applied to all types of regions. Indeed, there is a widespread agreement in the scientific community (Isaksen 2001, Nauwelaers and Wintjes 2003, Tödtling and Trippl 2005, Boschma 2009, Asheim et al. 2011a, Camagni and Capello 2012) and in policy circles (in particular in the form of smart specialisation strategies advocated by the EU (2011) and the OECD (2011)) that policies should be “fine-tuned” and place-based, taking into account the specificities of regions and their respective innovation potentials, assets and capabilities. What remains, however, less clear is how such a context-sensitive, differentiated regional innovation policy approach should look like. Scholarly contributions to this debate are based on a variety of theoretical frameworks including amongst others insights from evolutionary and institutional schools of thought, leading to partly very different conclusions about the nature of a fine-tuned regional innovation policy approach.

It is far beyond the scope of this paper to recapitulate the core arguments of all approaches and to discuss how they can add to the formulation of a differentiated regional innovation policy approach. The aim of this paper is to contribute to the debate about the nature of tailor-made regional innovation strategies by examining which policy implications can be drawn from two core concepts, that is, the regional innovation systems (RIS) theory and the notion of knowledge bases. Both concepts have essentially advanced one’s understanding of the complexity of innovation processes, moving the discussion beyond the too simple views that have dominated innovation theory and policy discourses in the past. The RIS literature has shown that not only well-developed and institutionally thick core areas but all types of regions can be innovative, albeit in different forms. The knowledge base concept has sharpened our view that all industries – not only “high tech” ones – are engaged in innovation processes and it has provided the analytical tools for grasping inter-industrial variations of innovation patterns.

Both the RIS and the knowledge base notions are conceptually well equipped for transcending “one size fits all” formulas in innovation policy. The RIS concept puts due emphasis on the organisational and institutional setting of a region and emphasises that system failures (or deficiencies) should constitute the basis for legitimatising and designing regional innovation policies (Tödtling and Trippl 2005). The differentiated knowledge base approach highlights that industries differ strongly in the underlying knowledge bases (Asheim and Gertler 2005) and, as a consequence, in their policy needs (Martin et al. 2011). The two concepts offer complementary perspectives, which – when combined – provide a valuable framework for the design of fine-tuned regional innovation policies.

The remainder of this paper is structured as follows. Sections 2 and 3 discuss the RIS and knowledge base concepts in more detail, outlining their core arguments and setting out which perspectives they offer for the scope and objectives of fine-tuned regional innovation policies. Section 4 summarises the key insights and advances the idea that fine-tuned regional innovation policies should respond to the innovation challenges and opportunities associated with the institutional structures of a RIS and the specificities of the knowledge bases prevailing in the region.
2 Institutional configurations and failures of regional innovation systems as policy framework

The RIS concept (Cooke 1992, Asheim and Gertler 2005) figures prominently in contemporary discussions about the importance of regions as loci of knowledge creation and innovation processes. Research on RIS has grown enormously since the concept’s first articulation and development in the early 1990s (for an insightful discussion of the theoretical antecedents and origins of the RIS approach, its development over the past two decades and recent advances see Asheim et al. 2011b).

A RIS is commonly understood as a set of several components (or elements) that are embedded in a common region-specific socio-institutional and cultural setting. RIS components include all private and public organisations that are involved in innovation processes, i.e., companies, public research institutes, technology transfer centres, educational and training bodies, workforce mediating organisations and finance providers. Then, regional policy actors are acknowledged to be an important component of RIS as they can play an essential role in shaping and facilitating innovation. This holds particularly true for political-administrative contexts, in which regions possess wide-ranging powers, i.e. sufficient legal competences and financial resources to design and implement their own innovation policies. Institutions – both “hard” ones such as laws and regulations and “soft” ones like norms, conventions and routines – are viewed as highly relevant as they influence the behaviour of innovation-relevant actors and the relations between them. Ideally, there are numerous connections between the elements of a RIS, facilitating a continuous flow of knowledge, human resources and skills at the regional level and giving rise to systemic innovation activities. Finally, it is also emphasised that RIS are not self-sustaining entities but they are usually linked to various national and international actors, organisations and innovation systems.

The general outline of the “architecture” of an ideal-type RIS suggested above does not hide the fact that such systems come in many shapes. Over the past years several typologies have been developed to capture the heterogeneity of regions and the variety of RIS that exist (for an overview see Tödtling and Trippl 2011). The RIS literature has not only shed light on differences between regions in terms of innovation potentials, organisational and institutional settings, network structures and innovation capabilities. One of the main strengths of the RIS concept is its strong policy agenda and capacity to articulate important ingredients and directions of regional innovation policies that are tailor-made to the respective specificities, challenges and needs of various types of regions (Asheim et al. 2013).

Tödtling and Trippl (2005) argue that such differentiated regional innovation policy approach should be built on system failures. They distinguish between three main types of RIS failures (or RIS deficiencies): organisational thinness, lock in, and fragmentation. Organizational thinness refers to situations in which crucial parts of an innovation system are weakly developed or even missing. Low levels of clustering or a weak endowment with key organisations and institutions are typical examples in this regard. Lock-in (or more precisely, negative lock-in) points to innovation problems that are related to an over-embeddedness and over-specialization in mature, declining industries and out-dated technologies. Finally, fragmentation is referred to as lacking interactions and knowledge flows between the organisations in an innovation system, resulting in low levels of systemic innovation activities.
Although regions can feature combinations of these RIS deficiencies, some system failures are more important than others in specific types of regions. Organizational thinness is often the predominant innovation problem in peripheral regions. These areas suffer from low levels of R&D and innovation, brought about by the dominance of SMEs operating in traditional industries, the absence of key assets for the development of new sectors, a low absorption capacity for knowledge from extra-regional sources, and a thin and less specialised structure of support organisations (Doloreux and Dionne 2008, Karlsen et al. 2011). Lock-in is usually a typical characteristic of many old industrial regions. These areas face the problem of an overspecialization in mature industries experiencing decline. Innovation activities in old industrialized areas frequently follow out-dated technological trajectories and the capacity of companies in these regions to engage in more radical innovation activities is rather weak. Functional, cognitive and political lock-ins supress innovation and keep the region in existing development paths (Grabher 1993, Trippl and Otto 2009, Hassink 2010). Finally, fragmentation can frequently be found in metropolitan areas (OECD 2010, Blazek and Zizalova 2010). This particular type of RIS deficiency often results from too much industrial diversity and a lack of related variety (Frenken et al. 2007, Asheim et al. 2011a), leading to low levels of intra-regional knowledge flows and innovation.

The heterogeneity of regions and the variety of RIS failures and deficiencies sketched out above clearly challenge the idea of an “ideal, best practice model” of innovation policy that can be applied in a similar way across all kind of areas. The RIS concept provides a framework for tailor-made policy interventions that address the specific innovation opportunities and problems prevailing in different types of regions. The basic principles and key characteristics of such a differentiated regional innovation policy approach are summarised in Table 1 and have been discussed in detail in previous work (Tödtling and Trippl 2005). In the context of this paper it is thus sufficient to briefly recapitulate the main strategic orientation and key elements of innovation policies for different types of regions.

As shown in Table 1, fine-tuned regional innovation policies for peripheral, old industrial and fragmented metropolitan regions should differ – amongst other aspects - regarding the promotion of intra-regional versus extra-regional networking, the orientation on endogenous versus exogenous firms and knowledge providers, and the strategic orientation on incremental versus radical innovation (see Tödtling and Trippl 2005). Innovation policies for peripheral areas should focus on upgrading the regional economy and promoting technological and organisational processes of “catching up” learning. Accessing extra-regional knowledge is viewed as highly important for this type of region (Rodriguez-Pose and Fitjar 2013). Such a strategy might encompass the attraction of innovative companies and research organisations from outside the region and linking domestic firms to external knowledge providers and innovation systems at higher spatial scales. Policy challenges in old industrial regions differ strongly from those in peripheral areas. Breaking path dependency and facilitating the restructuring of the regional economy are considered as pivotal for these areas. Facilitating industrial and technological diversification processes and fostering renewal and change of existing companies, network structures and institutions are viewed as sound elements in this regard (Trippl and Otto 2009). Fragmented metropolitan regions, in contrast, benefit from policy strategies and actions that aim at stimulating the dynamic development of science-based industries, “knowledge-intensive” services, and radical innovations. Of key importance are policy interventions that enhance interactive learning and knowledge circulation within the RIS to overcome the fragmented state of the system.
Table 1: Regional innovation policies for different types of regions and RIS failures

<table>
<thead>
<tr>
<th>Network initiatives</th>
<th>Peripherial regions – organisational thinness</th>
<th>Old industrial regions – lock in</th>
<th>Metropolitan regions - fragmentation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Promotion of linkages between companies and knowledge providers (within the region and – even more importantly – beyond)</td>
<td>Promotion of networking with respect to new sectors &amp; technologies on regional, national and global scales</td>
<td>Promotion of regional inter-firm networks &amp; university-industry linkages</td>
</tr>
<tr>
<td>Research and Education Infrastructure</td>
<td>Attraction of branches of national research organizations with relevance to regional firms &amp; industries; establishment of technical colleges, engineering &amp; management schools (provision of medium level skills)</td>
<td>Establishment of research organisations and universities in new &amp; related fields; Establishment of technical colleges &amp; universities (provision of new skills)</td>
<td>Establishment of high quality universities and research organisations in relevant fields; Establishment of universities &amp; schools for highly specialised qualifications and skills</td>
</tr>
<tr>
<td>Firms and regional industries</td>
<td>Strengthening of potential clusters in the region; Linking firms to clusters outside the region; Attraction of innovative firms; New firm formation</td>
<td>Support clusters in new/related industries &amp; technologies; Restructuring of old sectors; Diversification; New firm formation; Attraction of cluster related FDI</td>
<td>Support of emerging clusters related to the region’s knowledge base; Develop specialisation advantages to achieve synergies and international visibility; Attract cluster related FDI; Support start-ups and spin-offs in knowledge based sectors</td>
</tr>
<tr>
<td>Overall / main innovation strategy</td>
<td>Strengthening/upgrading of regional economy; Catching up learning (organisation, technology); Improve strategic and innovation capabilities of SMEs</td>
<td>Renewal of regional economy; Innovation in new fields / trajectories; Product &amp; process innovation for new markets</td>
<td>Improve position of regional economy in global knowledge economy; Science based and radical innovation, new ventures; Enhance interaction between industry and knowledge providers</td>
</tr>
</tbody>
</table>

Source: Tödtling and Trippl (2005), own modification

To summarise, the RIS concept provides valuable insights into the sources of regional disparities in innovation, stressing that regions vary strongly with respect to their endowment with innovation-relevant organisations, institutional set-ups and networks. Moreover, the RIS concept offers a useful framework for “diagnosing” specific innovation problems and system failures that tend to prevail in different types of regions. Identification of RIS failures provides a legitimisation of public policy action and a starting point for developing innovation policies that are tailored to the specific organisational and institutional set-up of regions. The RIS approach, however, does not sufficiently take into account that major differences exist between regional industries in terms of innovation patterns and challenges. In the next section, we will demonstrate that the knowledge base concept is a powerful approach for capturing such inter-sectorial variations. The notion of differentiated knowledge bases allows for a fine-grained analysis of the specificities of the industrial and economic structures of a RIS and their particular policy needs.
3 Differentiated knowledge bases as policy framework

Recent work on the geography of innovation stresses the need to draw more attention on industry specific differences that exist within RIS. One way of addressing sectorial variation in RIS is by reference to the knowledge dynamics that underlie innovation activities. The differentiated knowledge base approach argues that industries can be classified based on the type of knowledge that is critical for innovation (Laestadius 1998, Asheim and Gertler 2005). Three types of knowledge base can be distinguished; namely, analytical, synthetic and symbolic, which differ in various respects such as the rationale for knowledge creation, the development and use of new knowledge, the actors involved and the spatial configuration of innovation networks (Asheim et al. 2011a).

An analytical knowledge base is dominant in industries where innovation is primarily driven by scientific progress. Examples mentioned in the literature are biotechnology, life science and information and communication technology (ICT), which are often regarded as “high-tech” industries (Moodysson 2008, Asheim et al. 2011c). In these industries, new products and processes are developed in a relatively systematic manner involving basic and applied research. Firms usually invest heavily in intramural R&D, but rely also on knowledge generated at universities and other research organisations. Linkages between private firms and public research organisations are pivotal and take place more frequently than in other sectors. Since analytical industries deal with knowledge stemming from the academic sphere, they depend to a large extent on codified forms of knowledge contained in scientific publications and patents. These forms of knowledge are relatively easy to transfer and exchange over long distances. Therefore, knowledge sourcing takes place on a wide geographical scale, often within globally configured networks and epistemic communities (Plum and Hassink 2011a, Martin and Moodysson 2011b).

A synthetic knowledge base prevails in industries that innovate through the use and new combination of existing knowledge with the intention of solving concrete practical problems. Examples for synthetic industries are plant engineering, industrial machinery or food processing, sometimes also regarded as “traditional” industries (Trippl 2011a). In these industries, innovation is driven by applied research or incremental product and process development, whereas formal R&D is of minor importance. Linkages between university and industry are relevant, but occur more in applied research and education, and less in basic research. Tacit forms of knowledge are crucial, due to the fact that new knowledge often results from experience gained through learning by doing, using and interacting. Synthetic industries require know-how, craft and practical skills, which are often provided by professional and polytechnics schools or by on-the-job training. In comparison with analytical industries, knowledge networks are less globally configured, and knowledge sourcing takes place within national or regional boundaries, be it through cooperation between firms or mobility of employees. At the same time, many synthetic firms are involved in international user–producer relations, which provide knowledge linkages not to be neglected (Asheim and Coenen 2006, Broekel and Boschma 2011).

The symbolic knowledge base is a third category that receives increasing attention considering the growing importance of cultural production. It is present within a variety of industries such as advertisement, music, fashion, new media and design, sometimes also labelled “the cultural and creative industries” (Grabher 2002, Power and Scott 2004, Scott 2006). These industries have in common that innovation is devoted to the generation of aesthetic value and images and less to physical, tangible goods (Asheim et al. 2007).
Symbolic knowledge can be embedded in material goods such as clothing or furniture, but the impact on consumers and the economic value as such arise from its intangible character and aesthetic quality. Symbolic knowledge is highly context-specific as the interpretation of symbols, images, designs and cultural artefacts is tied to a deep understanding of the norms and conducts of specific social groupings. Therefore, the meaning and the value associated with it can vary considerably from one place to another. This also reflects the spatial dispersion of knowledge networks, which are, due to the context specificity of symbolic knowledge, predominantly locally configured connecting partners that share a similar socio-cultural background (Martin and Moodysson 2011a; Sotarauta et al. 2011).

In correspondence with previous findings on the geography and organisation of innovation outlined above, industries with different knowledge base are argued to differ also with regards to how regional innovation policy should be designed and implemented. Only recently, Martin et al. (2011) have shown that industries with different knowledge base vary strongly in their needs and requirements on innovation policy, while existing policy initiatives, at least in the case of southern Sweden, tend to neglect those differences in favour of rather generic policy measures. It is claimed here that policies should take into account the variety of knowledge bases in a regional innovation system and provide appropriate support that is attuned to the differentiated nature and geography of innovation (Hassink and Plum 2011b). Table 2 provides an overview on key elements of a regional innovation policy approach that is fine-tuned to the needs and characteristics of analytical, synthetic and symbolic industries.

**Table 2: Regional innovation policies for analytical, synthetic and symbolic industries**

<table>
<thead>
<tr>
<th></th>
<th>Analytical</th>
<th>Synthetic</th>
<th>Symbolic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Network initiatives</strong></td>
<td>Promotion of university-industry partnerships</td>
<td>Promotion of inter-firm collaboration and user-producer partnerships</td>
<td>Promotion of project-based collaboration between firms and with public and private customers</td>
</tr>
<tr>
<td></td>
<td>Promotion of international networks</td>
<td>Promotion of national and regional networks</td>
<td>Promotion of regional and local networks</td>
</tr>
<tr>
<td><strong>Research and education Infrastructure</strong></td>
<td>Higher education in fields of natural and formal sciences (e.g. chemistry, physics, mathematics)</td>
<td>Higher education in engineering based fields and applied sciences (e.g. mechanical and electrical engineering)</td>
<td>Higher education in creative and arts based fields (e.g. architecture and design, visual arts, performing arts, humanities)</td>
</tr>
<tr>
<td></td>
<td>Support of top research milieus and global centres of excellence</td>
<td>Support of polytechnic schools and technical colleges with focus on applied science</td>
<td>Support of cultural and creative infrastructure (e.g. theatres, concert halls, exhibitions)</td>
</tr>
<tr>
<td><strong>Innovation support for start-ups and SMEs</strong></td>
<td>Science and technology parks</td>
<td>Innovation awards</td>
<td>Business support and coaching</td>
</tr>
<tr>
<td></td>
<td>Technology brokers and transfer agencies</td>
<td>Innovation vouchers Life-long learning schemes</td>
<td>Provision of meeting places (e.g. conferences, fairs)</td>
</tr>
<tr>
<td></td>
<td>Public-private-partnerships for innovation</td>
<td>Schemes for worker participation in innovation</td>
<td>Public procurement</td>
</tr>
<tr>
<td></td>
<td>Industrial PhDs</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mobility and talent attraction schemes</strong></td>
<td>Attraction of star scientists through promotion of business and people climate</td>
<td>Promotion of business climate (laws, regulations, tax incentives, etc.)</td>
<td>Promotion of people climate (diversity, tolerance, quality of place, etc.)</td>
</tr>
</tbody>
</table>
Access to new knowledge is essential for innovation, irrespective of the knowledge base of an industry, whereas the geographical spread and the actors involved in knowledge networks differ between industries (Martin and Moodysson 2011b). Analytical industries are more prone to university-industry collaboration on a global scale, while inter-firm collaboration on the regional and local scale is more common to synthetic and symbolic industries. Research and education arrangements which are conducive to analytical knowledge bases include university education in natural and formal sciences, as well as research centres of excellence that provide access to global knowledge flows. Higher education for synthetic industries includes engineering training provided by universities and technical colleges with focus on applied science. Symbolic industries can be supported by creative and art-oriented education in combination with a well-developed cultural and creative regional setup. With regard to supporting start-ups and SMEs, typical science, technology and innovation (STI) oriented policy instruments such as science parks and technology transfer agencies are most suitable for analytical industries, while synthetic industries benefit from policy instruments designed to promote doing, using and interacting (DUI) modes of innovation, such as innovation awards and life-long learning schemes. Innovation support for symbolic industries includes the provision of physical and temporary meeting places such as conferences and exhibitions and should be attuned to the project-based organisation of innovation (Grabher 2002).

As regards mobility and talent attraction schemes, talented people with different knowledge base tend to have different locational preferences (Asheim and Hansen 2009). While a diverse and tolerant socio-economic environment, that is, a good “people climate”, is particular important for knowledge workers in symbolic industries, synthetic industries benefit most from a well-developed “business climate”. The attraction and retention of high-profile star-scientists who serve as critical knowledge brokers for analytical industries (Trippl and Maier 2011; Trippl 2011b) can be facilitated by both a good business and people climate (Asheim and Hansen 2009). Furthermore, investment in large anchoring projects attuned to the requirements of different industries may be favourable. Large scale research facilities can strengthen the analytical knowledge base of a region, whereas architectural landmarks and urban development projects can positively affect the symbolic knowledge base of RIS.

The policy approaches outlined above are fine-tuned to the requirements of different knowledge bases and can be applied to foster innovation in analytical, synthetic and symbolic industries. This does, however, not imply that regional innovation policies should solely promote one single knowledge base in order to secure long-term growth (Manniche 2012). Depending on the institutional preconditions of the respective RIS, fine-tuned regional innovation policies can take advantage of cross-fertilizing effects that occur at the intersection of knowledge bases. Grounded on the principles of related variety and differentiated knowledge bases, such “platform polices” should stimulate innovation and knowledge exchange both within and between sectors (Asheim et al. 2011a). In that way, they allow for dynamic combinations and shifts of knowledge bases along the evolution of RIS, and can contribute to breaking negative lock-in in regional development (Martin and Trippl 2013).
4 Conclusions

There is a growing recognition in academic and policy circles of a need for more fine-tuned regional innovation policies. The literature on the geography of innovation offers a rich conceptual basis for developing context-sensitive, tailor-made regional innovation strategies. This article has focused on two concepts, namely the RIS approach, which constitutes an essential theoretical underpinning of contemporary innovation policy strategies (OECD 2011), and the knowledge base approach, which is increasingly acknowledged for extending and further developing the RIS literature in essential ways.

The RIS approach emphasises the importance of a region’s organisational and institutional set-up. According to the RIS theory, regional innovation policies should be designed to address system failures that characterise different institutional settings, such as organisational thinness, lock-in and fragmentation, and consider the specific innovation opportunities and problems prevailing in different types of regions. Policy strategies for peripheral regions, for instance, are recommended to stimulate knowledge upgrading and catching-up learning. Old industrial regions are best addressed by a policy approach that promotes sectoral and technological diversification, whereas metropolitan regions can benefit most from strengthening knowledge intensive industries and the regional STI infrastructure (Tödtling and Trippl 2005).

Adding to this line of argument, the differentiated knowledge base concept highlights the industrial variation that can exist within RIS. It advocates policy approaches that are customised to the nature of knowledge that is critical for innovation in different sectors. The knowledge base concept offers insights into how regional industries differ in their policy needs and demands as a consequence of their distinctive knowledge base characteristics. Besides, it stresses the importance of non-R&D based industries as drivers for regional innovation, which are often overlooked by policy makers (Robertson et al. 2009, Hansen and Winther 2011). Strengthening innovation through STI policy instruments is most conducive to analytical industries, whereas synthetic and in particular symbolic industries require a more “broad based” policy mix including the promotion of DUI and creativity based modes of innovation. A framework for how to design such policy approaches has been provided in this paper.

Depending on the institutional setup and the type of RIS under consideration, policy strategies can either create favourable conditions for one knowledge base, or stimulate cross-fertilisation effects which occur at the intersection of different knowledge bases. Organisationally thin RIS will benefit most from strengthening and expanding the supportive infrastructure attuned to one knowledge base, whereas locked-in regions can take advantage from diversification of knowledge bases, targeting at the renewal of existing regional development paths (Martin and Trippl 2013). Fragmented metropolitan regions typically possess a diversified industrial structure and can benefit from strengthening the connectivity between analytical, synthetic and symbolic activities within the RIS.

To sum up, it is argued in this paper that a nuanced understanding of institutional structures, system failures and industrial knowledge bases is necessary to design policy approaches that can account for the complexity and diversity of regional innovation systems. The notions of RIS and differentiated knowledge bases clearly complement each other. A framework that integrates both perspectives provides valuable implications for the development and implementation of smart, place-based regional innovation policies.
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