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# **Innovation policies for regional structural change: Combining actor-based and system-based strategies**

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## **Abstract**

There seems to be a widespread consensus in academic and policy circles that the promotion of current economic strongholds and specialisations is no longer sufficient in order to ensure the long-term competitiveness of regions. New policy concepts such as smart specialisation emphasize the need to break with past practices and design and implement innovation strategies that boost 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. This new strategic orientation for regional innovation policies has essentially been informed by evolutionary economic geography, which has offered novel insights into how regional economies transform over time and how new growth paths come into being. Applying a regional innovation system (RIS) perspective, recent work has enhanced our understanding of how such processes of regional economic change vary across different types of regions. RIS 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. The policy implications following from these recent findings on the uneven geography of new path development have hardly been thoroughly discussed so far. General claims such as the need to avoid “one size fits all” strategies and develop place-based policies for regional industrial change remain vague and provide little guidance in this regard.

The aim of this paper is to identify opportunities and limitations of regional innovation policies to promote new path development in different types of RIS. We distinguish between (1) organisationally thick and diversified RIS, (2) organisationally thick and specialized RIS and (3) thin RIS. Regarding path development, a distinction is drawn between the extension, modernization, importation, branching and creation of industrial paths, reflecting various degrees of radicalness of change in regional economies. The paper offers a conceptual analysis of conditions and influences that enable and constrain new path development in each RIS type and outlines the contours of policy strategies that are suitable for promoting new path development in those different types of RIS.

Our point of departure is the well-known distinction between system-based and actor-based policy approaches. 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. 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 they are combined, they are well suited to promote new path development. The paper discusses which specific combinations of system-based and actor-based policy strategies matter for different types of RIS.

# 1 Introduction

There is an agreement in the academic and policy literature that the promotion of existing economic strongholds and specialisations does no longer suffice in order to ensure the long-term competitiveness of regions (Asheim et al. 2011, European Commission 2012, Foray 2015). New policy concepts such as smart specialisation 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). 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, Trippel et al. 2015, Isaksen and Trippel 2016a). 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 paper, therefore, is to identify opportunities and limitations of regional innovation policies to nurture new path development in different types of RIS. Regarding changes of industrial paths we distinguish between *path modernisation* (upgrading of existing industries based on new technologies or organisational 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 RIS we draw a distinction between (1) organisationally thick and diversified RIS, (2) organisationally thick and specialized RIS and (3) thin RIS.

The paper 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 the different types of RIS?
- Which conclusions for targeted innovation policies can be derived and which kind of policies might be appropriate in the investigated RIS types?

The paper 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 literature (section 2) and we deal with conditions, and supporting factors to new path development in different types of RIS (section 3). In section 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, Tödting and Tripl 2013, Boschma 2015, Isaksen 2015, Isaksen and Tripl 2016a). We differentiate between five main forms of regional industrial path development (Table 1).

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 modernisation / upgrading	Major change of an industrial path into a new direction based on new technologies or organisational 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 Tödting and Tripl (2013), Isaksen (2015), Isaksen and Tripl (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 of laser technology in the metal industry (Tripl and Tödting 2008) or the forest industry (Foray 2015), the use of new materials in the automotive industry (Tripl and Tödting 2008) or the introduction of project organization in creative industries (Grabher 2001).

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

(Tödttling et al. 2015). 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 (Tripl and Tödttling 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 organisational knowledge. There is a growing recognition that chance, contingent events, serendipity or historical accidents should not be overemphasised 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 Tödttling 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, Frenken and Boschma, 2007). Also existing endogenous firms and universities (Tanner 2014) as well as the inflow of individuals, entrepreneurs and firms from outside (Neffke et al. 2014, Tripl et al. 2015) 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 (Tödttling and Tripl 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. To strengthen a relevant scientific knowledge base, to upgrade the education and training system, and to establish specialized support structures (science parks, academic spin-off centres, incubators, etc.) are key factors in this regard.

## **2.2 Regional innovation systems and policy approaches**

Also 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 conceptualised 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). They are shaped by existing industry structures and technological trajectories, the presence or absence of knowledge- and support organizations, and the prevailing institutions and networks. RIS 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. Changes of industrial paths and the emergence of new paths are context-specific phenomena that vary markedly between types of RIS. In the following we distinguish between (1) organisationally thick and diversified RIS, (2) organisationally thick and specialized RIS and (3) thin RIS (Isaksen and Trippl 2016a).

As regards **policy approaches** we differentiate between actor-based and system-based policy approaches. The former aims to support entrepreneurs and innovation projects by firms and other stakeholders. System-based strategies, in contrast, 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. 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 organisations (like universities and research organizations) or by external actors, such as MNCs, that invest in the region (which may spur path importation). Moreover, actors belonging to the knowledge and support infrastructure who assist firm players in their innovation and diversification efforts need to be taken into account. Thus, actors are crucial for new path development in a region, either as entrepreneurs, firms, local leaders, or as knowledge and support organisations (such as incubators, universities, intermediaries and so on) that facilitate new firm formation and innovation activities.

However, single actors are not able to 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 gain access to production and knowledge networks outside the region (Binz et al. 2015). Firms are functionally related when they use corresponding 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). This demands, however, that a RIS includes related industries and competence, or that regional firms and organisations have the necessary absorptive capacity to harness extra-regional knowledge. RISs first of all support the further development of existing industries, i.e. path extension, amongst others via research activity and education programmes targeting already strong industries in a region.

The regional innovation system and industry structure also 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: 6). ‘The likelihood of starting up a business is intimately related to the conditions of the territory’ (Parrilli et al. 2016: 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. The reason is that ‘entrepreneurship is an inherently local phenomenon. Individuals start companies based on their previous experience and interests’ (Feldman 2007: 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 2015: 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 growth of new regional industrial paths.

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, commercialisation 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 highly qualified 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 RIS, however, vary considerably in their ability to induce and harness endogenous and exogenous forms of path development (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, ‘Jacobian 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 regional innovation systems*** 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 specialised 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 innovation 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 regions and RIS*** 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 (**D**oing, **U**sing, **I**nteracting) 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 RIS 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: 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 RIS**

Innovation-policies should not be applied in a standardised 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 Trippel 2005, Asheim et al. 2011, Isaksen and Trippel 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 types of individual actors (such as firms, SMEs, universities, research organisations, etc), whereas systemic policies aim at improving the performance of the overall RIS. Systemic policies target a better coherence, functioning, and 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 organisationally 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 organisations 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 organisations 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 commercialisation.

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 activity. 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 Trippel 2016). 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 commercialisation.

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 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 (Tripl and Tödting 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 reorganisation 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) 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 ‘smart specialisation strategies’ 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. An example for the role of a technology park in the creation of a new path in a rural region is Hagenberg in Upper Austria (Isaksen and Trippel 2016b).

Whereas firms in core areas have far better access to specialised suppliers, experienced labour and knowledge organisations nearby, and can benefit from local spill-overs, organizationally thin RISs may rely more on policies to mobilise 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 spill-overs 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. New growth paths or major path changes may therefore require providing access to relevant, regional and extra-region input factors for the firms and entrepreneurs pioneering (possible) new growth paths. 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 Trippel 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 Trippel 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 organisations.

**Table 2: Actor- and system-based policy approaches for different types of RIS**

	Actor-based policies	System-based policies
Thick & diversified RIS	Strengthen exploration- and knowledge generation capabilities of universities and research organisations Strengthening exploitation capabilities of firms and non-firm actors	Enhance international attractiveness of RIS Adaptation of RIS
Thick & specialised RIS	Strengthening entrepreneurship and innovation capabilities of firms and non-firm actors in new fields	De-locking & 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	Building up RIS Strengthen external knowledge links

Source: own compilation

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).

## 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 specialisations 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 paper set out to reflect on sound policy approaches for catalysing new path development in three ideal types of regional innovation systems (RISs), namely, organisationally thick and diversified RIS, thick and specialised 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 initiatives 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 initiatives 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.

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