Papers in Innovation Studies

Paper no. 2014/17

Regional industrial path development in different regional innovation systems: A conceptual analysis

Arne Isaksen (arne.isaksen@uia.no)
Department of Working Life and Innovation, University of Agder

Michaela Trippl (michaela.trippl@circle.lu.se)
CIRCLE, Lund University

This is a pre-print version of a paper that has been submitted for publication to an edited book.

This version: September 2014

Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE)
Lund University
P.O. Box 117, Sölvegatan 16, S-221 00 Lund, SWEDEN
http://www.circle.lu.se/publications

WP 2014/17

Regional industrial path development in different regional innovation systems: A conceptual analysis

Arne Isaksen and Michaela Trippl

Abstract

The notion of path dependent regional industrial development has recently received increasing attention in economic geography, innovation studies and related fields. A core idea is that pre-existing industrial and institutional structures constitute the regional environment in which current activities occur and new activities arise. This may lead to a high degree of inertia of industrial structures and reflects the persistence of region-specific institutions, social forms and cultural traditions. The aim of this paper is to take a more nuanced view on regional economic development and to explore conceptually how various types of regions can renew themselves by moving beyond existing paths. Scholarly contributions to regional industrial path development have often emphasised firm-specific routines, norms and tacit knowledge that first of all underpin path extension, i.e., incremental product and process innovations in existing industries and along established technological paths. The paper extends this approach by looking at alternative paths that point to different forms of transformation of regional economies. A distinction between path renewal (branching of existing industries into different but related ones) and path creation (emergence of new industries) is drawn. The paper also extends the mainly micro-level and firm-based views of evolutionary economic geography with an institutional perspective, offered by the regional innovation system (RIS) concept. This enables us to capture the influence of the wider regional environment on the innovation capability of firms. We distinguish between different types of RISs: i) organisationally thick & diversified RISs, ii) organisationally thick & specialised RISs, and iii) organisationally thin RISs. The paper analyses in a conceptual way the relation between these RIS types and forms of regional industrial path development. We demonstrate that various types of regions, with their specific RISs, tend to transform themselves in different ways, i.e., they can be expected to embark on different development paths. We also discuss adequate policy approaches for the various types of regions.

JEL codes: O18, O38, R11

Keywords: Regional industrial path development, regional innovation systems, innovation policy

Regional industrial path development in different regional innovation systems: a conceptual analysis

September 2014

Arne Isaksen[1] and Michaela Trippl[2]

[1] Department of Working Life and Innovation, University of Agder, Norway
[2] CIRCLE, Lund University, Sweden

Abstract
The notion of path dependent regional industrial development has recently received increasing attention in economic geography, innovation studies and related fields. A core idea is that pre-existing industrial and institutional structures constitute the regional environment in which current activities occur and new activities arise. This may lead to a high degree of inertia of industrial structures and reflects the persistence of region-specific institutions, social forms and cultural traditions. The aim of this paper is to take a more nuanced view on regional economic development and to explore conceptually how various types of regions can renew themselves by moving beyond existing paths. Scholarly contributions to regional industrial path development have often emphasised firm-specific routines, norms and tacit knowledge that first of all underpin path extension, i.e., incremental product and process innovations in existing industries and along established technological paths. The paper extends this approach by looking at alternative paths that point to different forms of transformation of regional economies. A distinction between path renewal (branching of existing industries into different but related ones) and path creation (emergence of new industries) is drawn. The paper also extends the mainly micro-level and firm-based views of evolutionary economic geography with an institutional perspective, offered by the regional innovation system (RIS) concept. This enables us to capture the influence of the wider regional environment on the innovation capability of firms. We distinguish between different types of RISs: i) organisationally thick & diversified RISs, ii) organisationally thick & specialised RISs, and iii) organisationally thin RISs. The paper analyses in a conceptual way the relation between these RIS types and forms of regional industrial path development. We demonstrate that various types of regions, with their specific RISs, tend to transform themselves in different ways, i.e., they can be expected to embark on different development paths. We also discuss adequate policy approaches for the various types of regions.

Acknowledgements: The paper is part of a project funded by the Research Council of Norway (Project no. 233737/O50). We are grateful to Mary Genevieve Billington for valuable comments on an earlier version of this paper. The usual disclaimer applies.

1 Introduction

Over the last years, models of path dependent regional industrial development have come to exercise increasing influence over academic work in economic geography, innovation studies and related academic fields (see, for instance, Martin and Sunley 2006; Martin 2010; Boschma and Frenken 2011; Neffke et al. 2011). A key argument advanced in this literature is that pre-existing industrial and institutional structures form the regional environment and context in which current economic and innovation activities take place and new ones emerge. This may result into the long-term persistence of regional industrial structures and institutional set ups.

Conceptual approaches to path dependent regional industrial development have thus far been primarily concerned with explaining the continuation of existing pathways and less so with offering detailed insights into structural change processes (see, Martin 2010, 2012 for a critical appraisal of this literature). Recently, however, a growing body of conceptual and empirical work has enriched our understanding of new path creation and transformation processes in regional economies (Martin and Sunley 2006; Frenken et al. 2007; Boschma and Frenken 2011; Boschma 2014a). This paper aims to contribute to the burgeoning debate on regional industrial renewal and the nature of path development activities across regions. We investigate conceptually to what extent and in what ways different types of regions can reconfigure their economic structures over time and embark on new growth paths.

Academic work on regional industrial path development tends to focus on firm-specific routines, norms and tacit knowledge that are seen as crucially important 'ingredients' to path extension, that is, intra-path changes based on mainly incremental innovations in existing regional industries and along well-established technological trajectories. This paper suggests two major extensions of this framework**. First,** we intend to move beyond the notions of path dependence and path extension as these concepts provide explanations of continuity and stability but do not offer an adequate framework for analysing change. We focus attention on alternative forms of regional industrial path development that relate to various routes of transformation of regional economies and innovation systems. A distinction between two main forms, that is, path renewal and new path creation is drawn. Path renewal is defined here as the diversification of existing industries into new but related ones (Boschma and Frenken 2011) whilst path creation is referred to as the rise of entirely new industries in the region (Martin and Sunley 2006; Asheim et al. 2013).

Second, we go beyond micro-level and firm-based accounts of path development that are prevalent in evolutionary economic geography (see MacKinnon et al. 2009; Pike et al. 2009; Asheim et al. 2013; Hassink et al. 2014 for a critique of micro-level and firm-based approaches). Drawing on insights provided by the regional innovation system (RIS) approach, we highlight that an institutional perspective can essentially enhance our understanding of how regions transform over time. By doing so, we overcome the strong focus on dynamic growth regions, whose experiences often create at least implicitly the basis for current conceptualizations and analyses of path dependent regional industrial development (Dawley 2014, Isaksen 2014). Focusing on two key dimensions of RISs, that is, (i) degree of organisational thickness and (ii) degree of specialization of economic and institutional structures, enables us to categorize different types of regions and to explore for each of them how RIS structures may influence directions and sources of regional change. We distinguish between organisationally thick and diversified RISs (often found in advanced core regions),

organisationally thick and specialised RISs (commonly found in old industrial areas and industrial districts), and organisationally thin RISs (often found in peripheral areas).

Both the influence of policy actions at various spatial scales and the transformative potential of exogenous development impulses have been underplayed in models of path dependent regional industrial development. Only recently, scholarly work has begun to explore the role of exogenous sources of regional growth and change (see, for instance, Boschma and Iammarino 2009; MacKinnon 2012). Apart from a few notable exceptions (Asheim et al. 2011; Simmie 2012; Asheim et al. 2013; Morgan 2013; Boschma 2014b; Dawley 2014) the importance of policy interventions has received little attention so far in conceptual considerations and empirical analyses of regional path development. That which is particularly missing is a systematic account of and more thorough reflections on how policy can promote new path creation and path renewal in a variety of regional settings.

This paper seeks to address some of the research gaps outlined above. We explore how different types of RISs vary in their transformation capacity and we identify major development challenges that can be found in each RIS type. We also intend to contribute to the regional innovation policy debate by discussing adequate policy approaches for different types of regions. More precisely, the paper deals with the following research questions.

- Which forms of regional industrial path development are promoted by different types of RISs and what is the role of intra-regional and extra-regional development impulses in this regard?

- Which development challenges emanate from these regional development patterns and what are sound policy options to promote regional industrial renewal in different types of RISs?

We deal with these questions through a conceptual analysis. The remainder of this paper is organised in three main parts. Section 2 provides definitions and a critical discussion of the key notions and concepts that establish the analytical framework used in this paper. In Section 3 we draw attention on different types of RISs and we explore conceptually which forms of regional industrial path development are likely to take place within each of them. Furthermore, we identify key development and transformation challenges in various types of regions. This creates a basis to elaborate on adequate policy approaches and measures to promote new path development in different RIS types. Finally, Section 4 summarizes the main findings of the paper and draws some lessons.

2 Definition of key concepts: Path development and regional innovation systems

The analytical framework includes two main theoretical constructs, path dependent regional industrial development and regional innovation systems. Understanding of these notions is required before they are combined in analyses of, among other things, the type of path development that tends to be stimulated by specific types of RISs.

Path development

The concept of path dependence is mainly used to explain the economic specialisation of regions that includes lock-in effects that push a technology, an industry, or a regional economy along one path rather than another (Strambach 2010). The approach assumes that the past economic development in a region 'sets the possibilities, while the present controls what possibilities to be explored' (Martin and Sunley 2006, p. 403). The pre-exisiting industrial and institutional structures constitute the regional environment in which current activities occur and new activities arise.

Path dependence means that regional industries may enter into *path extension* through mainly incremental product and process innovations in existing industries and technological paths. In situations of growth this results in continuity or more of the same in a regional economy. In such situations regional industries may, sooner or later, experience stagnation and gradual decline due to lack of renewal (Hassink 2010). Regional industries thus face a risk of *path exhaustion*, which refers to situations wherein the innovation potential of local firms has been severely reduced, or innovations take place only along a restricted technological path. Such situations may reflect high connectivity between regional actors but with few linkages to the outside world. External developments may be overlooked or recognised too late. Firms may become uncompetitive and decline, so the regional industry shrinks; although sometimes path revitalisation is also possible (Martin 2010).

Recent theoretical contributions supplement these notions of path dependent processes that focus on continuity and lock-in with alternative paths that reflect changes that may follow from different forms of reorientation of the regional economy (Garud et al. 2010; Martin 2010, 2012; Neffke et al. 2011; Boschma 2014a). *Path renewal* takes place when some of the existing local firms switch to different, but possibly related, activities and sectors (Boschma and Frenken 2011). The possibilities for path renewal are strengthened when a region's industry structure includes related variety, that is, when the region has a wide range of industries that are technologically related (Frenken et al. 2007). Potentials for inter-industry learning and recombination of knowledge then exist. Regions may develop new growth paths 'as new industries tend to branch out of and recombine resources from existing local industries to which they are technologically related' (Boschma 2014a: 8). This means that both knowledge and other resources that exist in regional firms will shape the type of renewal that occurs (Neffke et al. 2011). Path renewal is then often industry driven as regional industry mutates and widens the industrial structure (Boschma and Frenken 2011), but such processes also make the border between path extension and path renewal fuzzy (Henning et al. 2013).

Path creation denotes the most wide-ranging changes in a regional economy. It includes the establishment of new firms in new sectors for the region, or firms that have different variants of products, employ new techniques or organise differently than what have hitherto dominated in the region (Martin and Sunley 2006). Tödtling and Trippl (2013) distinguish two kinds of new industries in a region; first, the rise of established industries that are new for the region (regional path formation in established industries), and second, rise of totally new industries (path creation in new industries). Path formation may be caused by inward investments and/or sectoral diversification of existing firms. The second case of new path creation is often research driven focusing on commercialisation of research results, and grows up through the establishment of new firms and spin-offs. In this case new sectors may not be 'related to the existing regional industrial base' (Henning et al. 2013: 1353). Research driven, new path

development is not considered in the regional branching and related variety approaches, and the importance of research for the development of new growth paths marks the main difference between path renewal and path creation. Path creation might demand the building of new knowledge organisations and institutional change (Tödling and Trippl 2013). It is thus often policy initiated and demands proactive policy actions (Asheim et al. 2013).

Different paths may be combined in regions, and other paths than the four types mentioned above are possible. Strambach (2010: 407) argues for opening up the path dependency thinking by focusing on path plasticity 'which describes a broad range of possibilities for the creation of innovation within a dominant path of innovation systems'. This leads to the argument that radical innovation activities can occur within existing institutional settings and within a path and do not necessarily lead to breaking out of a path and to the creation of a new path. From the perspective of technological path development in particular Sydow et al. (2012: 158) see path dependence and path creation as only two possible paths, 'others are intentional path defence or extension, unintended path dissolution, or breaking a path without creating a new one. Still, the conceptual discussion in this paper focuses on the three main forms of regional industrial path development, that is, path extension, renewal and creation.

Regional innovation system

The second building block in our conceptual analysis is the regional innovation system (RIS) approach. By using the RIS notion an explicit institutional dimension is introduced to supplement the mainly evolutionary approach of the 'path dependence school'. Theorising of path dependence focuses mainly on micro level and firm-driven processes. We augment this focus with an institutional approach that highlights elements in the wider regional environment that influence the innovation capability of regionally located firms.

A RIS is seen as a specific framework in which close inter-firm interactions, knowledge and policy support infrastructures and socio-cultural and institutional environments serve to stimulate collective learning, continuous innovation and entrepreneurial activity (Asheim and Isaksen 2002, Tödtling and Trippl 2005, Asheim et al. 2013). The RIS approach builds on the acknowledged fact that innovative firms supplement their internal competence with external, specialist competence from a number of different actors (Lundvall 2010). Formal and informal institutions stimulate cooperation among different actors in RISs and reduce uncertainty in innovation processes. Institutions contribute to path dependency as institutions may be slow in adapting to changes in the economic structure (Strambach 2010).

Studies of RISs also rarely deal with the question of how these systems transform over time. RIS studies are mostly snapshots focusing on the characteristics, and strengths and weaknesses, of particular systems, while the historical development of the systems is seldom reflected upon (Doloreux and Parto 2005). Path creation may therefore presume 'the breaking of institutional stability and the creation of new institutions for further innovation' (Strambach 2010: 406). Nevertheless, it may be argued that the RIS approach is better equipped to study change, or path renewal and creation, than the related notion of regional clusters which consist of industries that 'form specialised concentrations in particular locations' (Asheim et al. 2006). RISs may include several clusters, enhancing the potential for cross-sectoral knowledge flows and thus stimulating path renewal. A single cluster, on the other hand, includes few combinatory options at the local scale and therefore 'few potential sources for renewal and diversification' (Boschma 2014a: 7). Furthermore, knowledge organizations play

an independent role in RISs while in clusters these organizations are seen to mainly provide adapted knowledge to the dominating industry in the cluster. Following this reasoning, knowledge organizations as seen in the RIS approach can contribute to path creation.

Regional innovation systems, however, differ in many respects, which also affects the possibilities of RISs to contribute to path renewal and creation. The transformation of individual RISs, the extent and type of changes, and the mechanisms of change, are therefore likely to differ extensively. Important differentiating elements in RISs are the number, size and types of firms and knowledge organisations, and the extent, breadth and reach of knowledge exchange. The type of knowledge exchange depends largely on the type of formal and informal institutions that dominate in a regional industry. 'By lowering uncertainty and information costs, institutions are believed to smooth the process of knowledge and innovation transfer within and across regions' (Rogriguez-Pose 2013: 1038). Among informal institutions, trust and social capital have attracted the greatest attention (op. cit.: 1036), and we focus on social capital in the succeeding conceptual discussion of RISs. Social capital is defined as 'social networks and relations held together by common norms and values (of which trust is one)' (Westlund and Kobayshi 2013: 5). This definition relates to a distinction between two types of social capital; structural social capital as seen in the social networks of actors, and cognitive social capital which refers to shared norms, values, attitudes, beliefs and trust (Malecki 2012: 1026). Another relevant distinction is between bonding and bridging social capital. Bonding refers to the internal network of a group or organization, and the value and norms that keep the members together, while bridging social capital links to actors in other groups and organizations (Westlund and Kobayshi 2013: 5-6).

Social capital is relevant in our context as it differs between regions (Eliasson et al. 2013: 115). 'Social capital is part of a region's 'collective personality'' (Malecki 2012: 1033), of which one outcome is variation among regions 'in the degree to which people – individually and within their organizations – trust and interact with one another (op. cit.: 1023). Variation in social capital 'explains why some regions shoot ahead through innovation while others are left behind in the development race' (Landabaso 2012: 375).

Tödtling and Trippl (2005) characterise some regions, often peripherally located ones, as having *organisationally thin* RISs. These systems have low levels of firm clustering and a weak endowment with organisations of knowledge generation and diffusion. Due to few actors little regional knowledge exchange takes place, and the exchange occurs mainly among local actors as (at least) rural regions usually have developed bonding social capital (Westlund and Kobayashi 2013). Other RISs are *organisationally thick*, but may differ in the configuration of their knowledge networks with regard to the variety of involved actors and their location. Some regions, particularly old industrial areas, have rather specialised and relatively closed, regionally oriented inter-firm and inter-organisational networks (Tödtling and Trippl 2005), that is, they are also dominated by bonding social capital. Other regions, most often larger and more central regions, have diverse and geographically open knowledge networks. Social capital becomes more heterogeneous, i.e., it includes both bonding and bridging networks, in such regions (Malecki 2012). Open knowledge networks coupled with firm and sector heterogeneity are favourable settings for regional industries to branch out into new but related fields, building on existing competences (Boschma and Frenken 2011), which is typical for path renewal. Based on this discussion we distinguish in our subsequent analysis between organizationally thin RISs, organizationally thick and specialised RISs, and organizationally thick and diverse RISs.

3 Types of RISs and regional industrial path development

This section explores the relation between different types of RISs and various forms of regional industrial path development. As noted above, regions vary enormously in their transformation capacity, that is, in their ability to set in motion endogenous processes of path renewal and new path creation. We seek to argue further for this view by investigating conceptually the forms of path development which may be expected to be observed in different types of RIS. We also analyse typical regional development challenges that can be found in each RIS type. This provides the foundation for discussing policy approaches that are adequate for promoting regional transformation in different types of RIS.

3.1 Organizationally thick and diversified regional innovation systems

Typical form of regional industrial path development

Organizationally thick and diversified RISs host a relatively large number of different industries as well as many knowledge and supporting organizations that promote innovation and development in a wide range of economic and technological fields. Such constellations are often found in large, well-performing core regions such as metropolitan areas and advanced technology regions (Tödtling and Trippl 2005). Some smaller 'islands of innovation' that host several distinct clusters of 'high-technology' and knowledge-intensive business service activities (see, for instance, the case of Cambridge (UK), Martin and Sunley 2006) may also fall into this category.

Organizationally thick and diversified areas offer favourable conditions for path renewal and new path creation. Unsurprisingly, current theorizing of regional industrial path development draws at least implicitly on experiences from these areas (Dawley 2014; Isaksen 2014). The strong capacity of these RISs to set in motion endogenous transformation processes is essentially nurtured by the existence of industrial and institutional variety. Industrial diversity and associated 'Jabobsian externalities' are considered as eminently conducive to innovation and new path development activities. The wide range of heterogeneous (but related) industries located in this type of region offer good potential for cross-sector knowledge flows and new re-combinations of knowledge (Boschma 2014a). Moreover, organizationally thick and diversified RIS often exhibit diverse and geographically open knowledge networks. Social capital in these areas is characterized by heterogeneity, that is, it includes both bonding and bridging networks (Malecki 2012). Industrial heterogeneity along with open knowledge networks constitute favourable conditions for path renewal, 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 2014a).

Regional transformation, however, might not only be based on firm-driven, path renewal processes. Organizationally thick and diversified RISs also offer excellent potential for research-driven routes of regional change. These RISs are usually well endowed with strong universities and other research organizations, which can be an important source of regional transformation. They serve as seedbeds of academic spin-offs and promote other forms of commercialization of research results that might lead to the emergence of science-based industries and entirely new regional growth paths.

Both path renewal and new path creation activities are facilitated by a plethora of supporting organizations that are usually present in well-performing core areas. These range from 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 potential for endogenous, self-sustaining regional transformation processes. As Martin and Sunley (2006: 420) put it: 'Diversity of local industries, technologies, and organizations promotes constant innovation and economic reconfiguration, avoiding lock-in to a fixed structure'. Hence, one can expect that path renewal and new path creation constitute the typical development pattern in these regions.

Development challenges and policy approaches

The development challenges of organizationally thick and diversified RISs are twofold. They face the challenge to sustain their strong capacity to set in motion continuous path renewal and new path creation activities. However, this type of RISs may also need to achieve path extension.

Due to their ideal 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 change. New path development activities occur on a more or less regular basis. Continuous change, however, might reflect too much exploration and too little exploitation. This might result in a lack of industrial focus; emerging industries and activities may not achieve a critical mass (Boschma 2014a). Furthermore, the knowledge and supporting infrastructure of the RIS may not succeed in staying abreast of changes, failing to adapt permanently to newly emerging fields and supporting them by adjustments of research and educational programmes and support structures. As Martin (2012, p. 184), with reference to Setterfield (1998, 2009) and Roland (2004), reminds us: '… institutional stability is necessary for economic accumulation, growth and development, but such growth and development may promote change and instability in institutional arrangements. In addition, different institutions and different economic sectors evolve at different rates and with different temporalities'.

The challenges sketched out above imply that organizationally thick and diversified RISs may benefit from policy interventions that promote path extension. Key tasks of policy-makers comprise: the identification of the most promising existing industrial fields that have emerged out of past rounds of regional path renewal and new path creation, and the provision of support to achieve positive lock-in and to facilitate their further growth. Path stabilization and path extension to promote exploitation activities in newly created fields should thus be privileged in policy. 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. Indeed, organizationally thick and diversified RISs may need 'more of the same' instead of permanently exploring new things at the cost of exploitation and commercialization of new knowledge.

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 2014a), investment in new research fields and reconfiguration of the institutional set up to match new industrial requirements.

3.2 Organizationally thick and specialized regional innovation systems

Typical form of regional industrial path development

Organizationally thick and specialized RISs are characterized by the presence of strong clusters in one or a few industries only and by a highly specialized support structure and institutional-set-up that is strongly adapted to the region's narrow industrial base. Such conditions tend to prevail in old industrial areas (Grabher 1993, Hassink 2005, Trippl and Otto 2009) or in Italian industrial districts (see, for instance, Belussi and Sedita 2009).

This RIS type exhibits a rather weak capacity for inducing endogenous processes of regional transformation. Organizationally thick and specialized RISs lack the internal diversity of industries, knowledge bases, supporting organizations and institutional forms that is seen as critically important for developing new regional industrial paths (Boschma and Frenken 2011; Asheim et al. 2011). The degree of intra-regional related variety is low and only few opportunities for combining or recombining diverse knowledge bases at the regional scale exist (Boschma 2014a). These areas are often also rich in bonding social capital, that is, regionally oriented, inward looking networks tend to prevail, closing the region off from extra-regional resources and knowledge and reinforcing existing activities at the cost of industrial change.

Organizationally thick and specialized RISs mainly experience innovation along existing regional industrial development paths. Indeed, these areas can be regarded as 'core centres of continuity'. The strong degree of specialization of industrial and support structures and related Marshallian externalities promote first and foremost continuous incremental innovation activities in existing industries and along prevailing technological pathways. Various forms of positive lock-in effects keep firms in well-established industrial and technological trajectories. Increasing returns and positive externalities reinforce dynamism in existing regional industrial paths (Martin and Sunley 2006), backed by supporting and institutional structures that are well adapted to the prevailing industrial specialization pattern. Boschma (2014a: 7) points to a negative relation between specialization and renewal capacity, arguing that 'once a region specializes in a knowledge base, this offers opportunities to local firms for further improvements, but regions may also become myopic for opportunities that lay beyond their own development paths, and sunk costs may prevent them from switching to new growth tracks' (see also Malmberg and Maskell 1997, Maskell and Malmberg 1999). Path extension is thus the most likely form of regional industrial path development that is promoted by organizationally thick and specialized RISs.

This type of RIS, however, is particularly vulnerable to industrial decline. Firms and the whole RIS may lose their capacity to continuously extend established practices. Positive lock-in can turn into negative lock in, creating a danger of path exhaustion. If changes in the external context conditions require adaptability, novelty and transformation instead of 'more of the same', the lack of potential for endogenous regional industrial renewal that often characterizes organizationally thick and specialized RISs creates major development challenges. The literature on old industrial areas is replete with examples of how negative functional, cognitive and political lock-in result in stagnation, economic downturn and decline of industrial paths (see, for instance, Grabher 1993; Tödtling and Trippl 2004; Hudson 2005; Trippl and Tödtling 2008; Birch et al. 2010; Hassink 2010; Simmie and Martin 2010).

Development challenges and policy approaches

Organizationally thick and specialized RISs face major renewal challenges. Existing development paths can become exhausted if positive lock-in turns into negative lock-in (see above). As a consequence, policy should focus on avoiding path exhaustion by promoting continuous innovation and upgrading in established industries. If negative lock-in has set in, policy should aim at stimulating path revitalization, provided that there are enough knowledge assets left that could be used to regain competitiveness in existing industries. At the same time, however, policy interventions to stimulate the extension, upgrading and revitalization of existing paths are insufficient. Arguably, a key challenge is to move beyond path extension and promote change instead of continuity, that is, to facilitate the development of new industrial paths.

As diversity and related variety are barely present at the regional scale, harnessing exogenous development impulses as a key source for regional transformation should rank high on the policy agenda. Policy options include the promotion of connections to extra-regional knowledge networks to get access to complementary knowledge from abroad and its combination with specialized assets available in the region (Boschma 2014a). Attraction of foreign direct investment may also be a sound policy approach to support path renewal and new path creation processes in organizationally thick and specialized regions (Trippl and Tödtling 2008). The success of a policy strategy that builds on the importation of innovative firms from elsewhere, however, is contingent on 'the absorption capabilities and competences of the existing industrial base …, on the scope for local sourcing of inputs, and the like' (Martin and Sunley 2006: 423).

Policy makers can also play a powerful role in activating endogenous sources of new path development by promoting diversification processes of existing companies into new but related fields 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 elements (Trippl and Tödtling 2008). Investment in new scientific areas, promotion of a reorientation of the support structure and the formation of new networks should thus be key policy priorities.

3.3 Organizationally thin regions

Typical form of regional industrial path development

Regions with organizationally thin RIS have by definition no or few institutions of higher education or R&D-institutes, none or only weakly developed clusters, and consequently little local knowledge exchange. The regions are often dominated by SMEs operating in traditional and resource-based industries, but also larger, externally owned firms (Tödtling and Trippl 2005). Traditional industries and a weak knowledge infrastructure mean that SMEs in thin regions are often characterized by the DUI (Doing, Using, Interacting) mode of innovation (Jensen et al. 2007, Isaksen and Karlsen 2013). This innovation mode is typically based on experience and competences acquired on the job as employees face new problems or new customer demands. OECD (2014: 50) also indirectly points to the importance of the DUI mode in rural areas when insisting that innovation in such areas 'is grounded in actions of individuals looking for ways to solve specific problems'.

The external ownership in some thin RIS may lead to a 'branch plant culture', which means that local actors envisage that new jobs are provided by external investors thus hampering local entrepreneurship and innovativeness (Petrov 2011). A different but not conflicting opinion in the literature is that regions with thin RIS (to the extent that these consist of rural areas) are inward looking and fairly homogenous with regard to knowledge bases and 'world views'. Westlund and Kobayashi (2013) argue that rural areas mostly include bonding social capital which stimulates cooperation and knowledge exchange, in particular, among well-known, local actors who do not challenge the values and norms that hold the networks together. A recurrent argument in the literature is that 'too much bonding social capital becomes negative, creating conformity rather than variety' (Malecki 2012: 1031). Conformity leads to the opposite of knowledge spill-over and interactive learning among actors with a 'related variety' of knowledge and technology, which is seen to stimulate innovation in existing industries and the emergence of new industries in a region (Boschma and Frenken 2011).

The DUI mode of innovation nearly without R&D-activity and a dominance of bonding social capital leads primarily to incremental changes in products and processes within existing industries in organizationally thin RISs. Such regions therefore often experience path extension and risk falling into negative lock-in and path exhaustion.

Development challenges and policy approaches

Regions with organizationally thin RISs will face problems in renewal of existing, and, in particular, in the formation of new regional development paths. Path renewal is, as underlined above, triggered by a diverse industrial structure and the presence of a variety of firms and knowledge bases in a region (Frenken et al. 2007), which are conditions most often not found in thin RISs. Firms in thin RISs can compensate for a scarce and conformal, local knowledge supply base by 1) internalising some of the resources that are available external to firms in organizationally thick and diversified RISs (Isaksen 2014), and by 2) entering into geographic widespread collaboration networks (Herstad and Ebersberger, 2013). The first strategy may not lead to more than path extension if firms build up internal resources 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. This

observation seems to be less relevant for rural areas which are often dominated by bonding social capital. The second strategy then demands to develop new forms of bridging social capital (Westlund and Kobayashi 2013), which is a challenging task as the cognitive part of social capital includes historically developed and regional specific norms and values. 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 people. This would raise the ability of at least some firms (gatekeepers) in a region to identify and acquire external information, interpret and assimilate it, combine it with existing knowledge, share it with other firms and regional actors, and then apply it to commercial ends (Cohen and Levinthal 1990; Giuliani and Bell 2005).

The situation in thin RISs with few technology related firms and industries means that the universal industry-specific 'smart specialisation strategies' are less relevant (Monsson 2014). Rather than focusing on the industry or RIS level, innovation policy in thin RIS should therefore be directed at the firm level. Isaksen and Karlsen (2013) point out that some resourceful firms in thin RISs should 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 follow to place less emphasis on the endogenous development capacities of regions but rather target individual firms that have the ability and willingness to innovate, to support innovation processes in those firms 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 spill-overs. Policy tools that compensate for the lack of organically created externalities, for example technology parks, can be relevant. Firms in core areas have far better access to specialised suppliers, experienced labour, knowledge organisations nearby, and can benefit from local spill-overs, while organizationally thin RISs may need help to create such resources through policy.

Following such reasoning, thin RISs may achieve path renewal first of all by adapting resources that initially derive from outside the region, which requires some local organizations with boundary-spanning functions and that aim contributing to knowledge spill-overs from resourceful and externally linked firms. 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 recommendations for thin RISs (Tödtling and Trippl 2005). Such initiatives may demand national initiatives, which point to the fact that path renewal and creation in organizationally thin RISs are potentially more reliant on policy interventions than is the case in particular in thick and diversified regions (Dawley 2014).

4 Conclusions

This paper has investigated conceptually the relation between RIS structures and types of regional industrial path development. It has also discussed how policy can influence the direction of economic development in different types of regions. We have drawn a basic distinction between thick and diversified RISs, thick and specialised RISs and thin RISs. It has been argued that these RIS types support different forms of regional industrial path

development. Favourable conditions for path renewal and path creation exist in thick and diversified RISs for reasons often highlighted in the literature on related variety, knowledge spill-overs and academic entrepreneurship. The two other types of RIS structures tend to promote in particular path extension.

The main development challenge for thick and specialised RISs and thin RISs is then to avoid becoming trapped into path extension, which can also lead to path exhaustion. To some extent the rather opposite challenge is present in thick and diversified RISs. In these regions a too strong focus on and use of resources for entrepreneurial start-ups and renewal may result in too little knowledge exploitation. Some of the fragmentation of the RIS in various large cities may reflect frequent transformations of the industrial structure, which means that related knowledge bases and knowledge flows between R&D institutions and important firms and regional clusters may not be developed. Even if significant renewal and path creation occur in thick and diversified RISs, path extension may still be a challenge for this type of RIS.

Based on the investigation of how different RIS structures influence the directions of regional change we discussed which policy approach may be recommended in each of the three RIS types. We suggest that regions characterized by organizationally thin RISs should focus on individual firms rather than industries or 'systems' when designing their innovation policy. The policy can, in particular, aim to raise the ability of some firms or organisations to act as 'gatekeepers'. This includes stimulating the absorptive capacity of some firms or organizations so that they are able to bring in knowledge from external sources and to rework and distribute it to other RIS actors.

Regions characterized by thick and specialized RISs ought to increase diversity of knowledge by utilizing extra-regional development impulses. Relevant policies include supporting firms to link to extra-regional knowledge sources, and to attract firms, education or research institutions from outside the region. Policy can also promote diversification processes of existing firms into new but related activities and support new firm formation in entirely new industries.

Thick and diversified RISs will, according to our analysis, benefit from 'path extension policies'. Important then is to stimulate the positive lock-in of regional industries by the use of more or less traditional cluster policy tools such as network building to promote knowledge exchange and development of common input factors for firms within an industry. Policy can also contribute to sustaining the regions' capacity for new path development by removing obstacles that hamper new combinations between industries or knowledge bases and by investing in new research areas.

The conceptual analysis leads to some general lessons. One lesson, which however is old and well known, includes that regions and RISs are different; they exhibit distinctive development potentials and challenges. This calls for a differentiated policy approach. In spite of being an old lesson it may be reminded of as theoretical reflections of path dependence and new path development directly or indirectly build on the situation in dynamic core regions with organisationally thick and diversified RISs. These reflections may overstate the possibilities to achieve path renewal and path creation by means of endogenous resources.

Instead, a second lesson is that path extension prevails for different reasons in most thin, as well as thick and specialised RISs. These RISs have little related variety due to few, or closely related organisations and a predominance of bonding social capital.

A strong path extension may, sooner or later, result in stagnation and job loss due to low adaptability of RISs. A third lesson, however, is that weak path extension may also constrain job growth at the regional level. Positive path extension leads to continual development of competence within specific regional industries and value chains, strengthening of RISs, increased competitiveness, and, in sum, possibilities of job growth. Very dynamic thick and diversified RISs may lose these growth triggers from positive path extension.

A fourth lesson is that endogenously created path renewal and part creation rarely occur outside of thick and diversified RIS. This demands exogenous development impulses, in particular in thin RISs and in thick and specialised, RISs. These types of RISs are thus more than core regions reliant on policy interventions and extra regional investments and knowledge sources.

References

Asheim, B. T. and Isaksen, A. (2002). Regional Innovation Systems: The Integration of Local 'Sticky' and Global 'Ubiquitous' Knowledge. *Journal of Technology Transfer,* 27: 77-86.

Asheim, B. T., Bugge, M., Coenen, L. and Herstad, S. (2013) What does Evolutionary Economic Geography Bring to the Table? Reconceptualising Regional Innovation Systems. CIRCLE Working Paper no. 2013/05, Circle, Lund University.

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

Asheim, B., Cooke, P. and Martin, R. (2006). The rise of the cluser concept in regional analysis and policy. A critical assessment. In B. Asheim, P. Cooke, and R. Martin (eds.), *Clusters and Regional Development. Critical reflections and explorations* (1-29). London/New York: Routledge.

Belussi, F. and Sedita, S. R. (2009). Life Cycle vs. Multiple Path Dependency in Industrial Districts. *European Planning Studies,* 17, 4: 505-528.

Birch, K., MacKinnon, D. and Cumbers, A. (2010). Old industrial regions in Europe: a comparative assessment of economic performance. *Regional Studies,* 44, 1: 35-53.

Boschma, R. (2014a) Towards an evolutionary perspective on regional resilience. *Papers in Evolutionary Economic Geography,* No. 14.09, Utrecht University.

Boschma, R. (2014b) Constructing regional advantage and smart specialization: comparison of two European policy concepts. *Scienze Regionali,* 13, 1: 51-68.

Boschma, R., & Frenken, K. (2011b). Technological relatedness and regional branching. I H. Bathelt, M. P. Feldman, & D. F. Kogler, *Beyond Territory. Dynamic geographies of knowledge creation, diffusion, and innovation* (64-81). London and New York: Routledge.

Boschma, R. and Iammarino, S. (2009) Related variety, trade linkages, and regional growth in Italy. *Economic Geography*, 85(3), 289-311

Cohen, W. M. and Levinthal, D. A. (1990). Absorptive capacity: a new perspctive on learning and innovation. *Administrative Science Quarterly*, 35: 128-153.

Dawley, S. (2014). Creating New Paths? Offshore Wind, Policy Activism, and Peripheral Region Development. *Economic Geography*, 90, 1: 91-112.

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

Eliasson, K., Westlund, H., and Fölster, S. (2013). Does social capital contribute to regional economic growth? Swedish experiences. In H. Westlund and K. Kobayashi (eds.), *Social Capital and Rural Development in the Knowledge Society* (113-126). Cheltenham: Edward Elgar.

Frenken, K., van Oort, F. And Verburg, T. (2007) Related variety, unrelated variety and regional economic growth. Regional Studies 41, 685-697.

Garud, R., Kumaraswamy, A. and Karnøe, P. (2010). Path Dependence or Path Creation? *Journal of Management Studies*, 47, 4: 760-774.

Giuliani, E. and Bell, M. (2005). The micro-determinants of meso-level learning and innovation: evidence from a Chilean wine cluster. *Research Policy*, 34, 1: 47-68.

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

Hassink, R. (2005) How to unlock regional economies from path dependency? From learning region to learning cluster. *European Planning Studies*, 13(4), 520-535

Hassink, R. (2010) Locked in decline? On the role of regional lock-ins in old industrial areas. In Boschma, R. and Martin, R. (Eds.) *Handbook of Evolutionary Economic Geography* (450-468). Edward Elgar, Cheltenham.

Hassink, R., Klaerding, C. and Marques, P. (2014) Advancing evolutionary economic geography by engaged pluralism. Regional Studies (forthcoming) http://dx.doi.org/10.1080/00343404.2014.889815.

Henning, M., Stam, E. and Wenting, R. (2013). Path Dependence Research in Regional Economic Development: Cacophony or Knowledge Accumulation? *Regional Studies*, 47, 8: 1348-1362.

Herstad, S. and Ebersberger, B. (2013). On the Link between Urban Location and the Involvment of Knowledge-Intensive Business Service Firms in Collaboration Networks. *Regional Studies, DOI: 10.1080/00343404.2013.816413*.

Hudson, R. (2005) Rethinking change in old industrial regions: reflecting on the experiences of North East England. *Environment and Planning A*, 37(4), 581-596.

Isaksen, A. (2014). Industrial development in thin regions: Trapped in path extension? *Journal of Economic Geography*. doi:10.1093/jeg/lbu026

Isaksen, A. and Karlsen, J. (2013). Can small regions construct regional advantages? The case of four Norwegian regions. *European Urban and Regional Studies*, 20, 2: 243-257.

Isaksen, A. and Trippl, M. (2014). New path development and combinatorial knowledge bases in the periphery. Paper prepared for the Workshop 'Combinatorial knowledge bases, regional innovation and development dynamics', Circle, Lund University, May 13-14, 2014.

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

Landabaso, M. (2012). What public policies can and cannot do for regional development. In P. Cooke, M. D. Parrilli and J. L. Curbelo (eds.), *Innovation, Global Change and Territorial Resilience* (364-381). Cheltenham: Edward Elgar.

Lundvall, B.-Å. (2010). Scope, Style, and Theme of Research on Knowledge and Learning Societies. *Journal of the Knowledge Economy*, 1, 1: 18-23.

MacKinnon, D, Cumbers, A., Pike, A., Birch, K. and McMaster, R. (2009) Evolution in economic geography: institutions, political economy and adaptation. *Economic Geography* 85, 129-150.

MacKinnon, D. (2012) Beyond strategic coupling: reassessing the firm-region nexus in global production networks. *Journal of Economic Geography* 12, 1. 227-245.

Malecki, E. J. (2012). Regional Social Capital: Why it Matters. *Regional Studies*, 46, 8: 1023-1039.

Malmberg, A. and Maskell, P. (1997) Towards an explanation of regional specialization and industry agglomeration. *European Planning Studies*, 5, 25-41

Maskell, P. and Malmberg, A. (1999) Localised learning and industrial competitiveness. *Cambridge Journal of Economics*, 23(2), 167-186.

Martin, R. (2010). Roepke Lecture in Economic Geography - Rethinking Regional Path Dependence: Beyound Lock-in to Evolution. *Economic Geography*, 86, 1: 1-27.

Martin, R. (2012) (Re)Placing Path Dependence: A Response to the Debate. International *Journal of Urban and Regional Research*, 36, 1: 179-192.

Martin, R. and Sunley, P. (2006). Path dependence and regional economic evolution. *Journal of Economic Geography*, 64, 4: 395-437.

Martin, R. and Sunley, P. (2011). Conceptualizing Cluster Evolution: Beyond the Life Cycle Model? *Regional Studies*, 45, 10: 1299-1318.

Monsson, C. K. (2014). Development without a metropolis: Inspiration for non-metropolitan support practices from Denmark. *Local Economy,OnlineFirst Version; DOI: 10.1177/0269094214532903*.

Morgan, K. (2013). Path dependence and the state. In P. Cooke (ed.), *Re-Framing Regional Development* (pp. 318-340). London and New York: Routledge.

Neffke, F., Henning, M. and Boschma, R. (2011). How Do Regions Diversify over Time? Industry Relatedness and the Development of New growth Paths in Regions. *Economic Geography*, 87, 3: 237-265.

OECD. (2014). Innovation and Modernising the Rural Economy. http://dx.doi.org/10.1787/9789264205390-en. OECD Publishing.

Pike, A., Birch, K., Cumbers, A., MacKinnon, D. and McMasters R. (2009). A geographical political economy of evolution in economic geography. *Economic Geography* 85, 175-182.

Petrov, A. N. (2011). Beyond spillovers. Interrogating innovation and creativity in the peripheries. I H. Bathelt, M. P. Feldman, and D. T. Kogler,(eds), *Beyound Territory. Dynamic Geographies of Knowledge Creation, Diffusion, and Innovation* (168-190). London and New York: Routledge.

Rodriguez-Pose, A. (2013). Do Institutions Matter for Regional Development? *Regional Studies;* 47, 7: 1034-1047.

Roland, G. (2004) Understanding institutional change: fast-moving and slow-moving institutions. *Studies in Comparative Institutional Development* 38, 4: 109–31.

Setterfield, M. (1998) *Rapid growth and relative decline: modelling macroeconomic dynamics with hysteresis*. Macmillan, London.

Setterfield, M. (2009) Path dependency, hysteresis and macrodynamics. In P. Arestis and M. Sawyer (eds.), *Path dependency and macroeconomics*, Palgrave Macmillan, London.

Simmie, J. (2012). Path Dependence and New Technological Path Creation in the Danish Wind Power Industry. *European Planning Studies*, 20, 5: 753-772.

Simmie, J. and Martin, R. (2010) The economic resilience of regions: towards an evolutionary approach. *Cambridge Journal of Regions, Economy and Society*, 3(1), 27-43.

Strambach, S. (2010). Path dependence and path placticity: the co-evolution of institutions and innovation - the German customized business software industry. In R. Boschma and R. Martin (eds.), *The Handbook of Evolutionary Economic Geography* (406-431). Cheltenham: Edward Elgar.

Sydow, J., Windeler, A., Miller-Seitz, G., & Lange, K. (2012). Path Constitution Analysis: A Methodology for Understanding Path Dependence and Path Creation. *Business Research*, 5, 2: 155-176.

Tödtling, F. and Trippl, M. (2004) Like phoenix from the ashes? The renewal of clusters in

old industrial areas. *Urban Studies*, 41(5-6), 1175-1195.

Tödtling, F. and Trippl, M. (2005): One Size Fits All? Towards a Differentiated Regional Innovation Policy Approach. *Research Policy,* 34, 8: 1203–1219.

Tödtling, F., and Trippl, M. (2013). Transformation of regional innovation systems: From old leagacies to new development paths. In P. Cooke (ed.), *Reframing Regional Development* (297-317). London: Routledge.

Trippl, M. and Otto, A. (2009): How to Turn the Fate of Old Industrial Areas: a Comparison of Cluster-based Renewal Processes in Styria and the Saarland. *Environment and Planning A*, 41, 5: 1217–1233.

Trippl, M. and Tödtling, F. (2008) Cluster renewal in old industrial areas. In C. Karlsson (ed.) *Handbook of Research on Cluster Theory* (203-218). Cheltenham: Edward Elgar.

Westlund, H. and Kobayashi, K. (2013). Social capital and sustainable urban-rural relationships in the global knowledge society. In H. Westlund and K. Kobayashi (eds.), *Social Capital and Rural Development in the Knowledge Society* (1-17). Cheltenham: Edward Elgar.