

2018/06

Beyond the 'single path view': Inter-path relationships in regional contexts

Alexandra Frangenheim, Michaela Trippl, Camilla Chlebna

Beyond the ‘single path view’: Inter-path relationships in regional contexts

December 2018

Alexandra Frangenheim, Michaela Tripl and Camilla Chlebna

Alexandra Frangenheim, Department of Geography and Regional Research, University of Vienna (Austria); email: alexandra.frankenheim@univie.ac.at

Michaela Tripl, Department of Geography and Regional Research, University of Vienna, (Austria) and Department of Working Life and Innovation, University of Agder (Norway); email: michaela.tripl@univie.ac.at

Camilla Chlebna, European Societies, Department of Social Sciences, Carl von Ossietzky University (Germany); email: camilla.chlebna@uni-oldenburg.de

Abstract

Recurrent economic and financial crises, globalisation, digitalisation and climate change are posing major challenges for regional economies to constantly renew their industrial structures. Over the past few years much progress has been made in understanding how new path development unfolds in a regional context. However, most conceptualisations and empirical analyses to date have mainly been focused on one new path or path development activities in one nascent industry only. Potential relationships between emerging paths have been neglected and as a consequence little is known about how new paths shape each other’s evolution. This paper develops a framework to analyse the nature of relationships between multiple new regional growth paths. We suggest that paths are either linked or unlinked and we discuss the role of agency in shaping the relationship between linked paths to be either supportive, competitive or neutral towards each other. We conclude by discussing implications for policy and identifying avenues for future research.

Key words: Inter-path relations, regional innovation systems, new path development, agency, innovation policy

JEL codes: O33; R11; R58

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

1 Introduction

Regions across the world are confronted with the constant challenge to renew their industrial structures and to develop new growth paths to compensate for the stagnation and decline of mature industries. Recurrent economic and financial crises, globalisation, digitalisation and climate change are further intensifying this pressure. This has sparked interest into the factors that favour and hinder processes of new regional industrial path development.

Over the past few years much progress has been made in understanding how and where new regional industrial paths emerge and develop over time. A growing body of literature in evolutionary economic geography (EEG), innovation studies and adjacent academic fields has produced new insights into the forms, mechanisms and geographical patterns of regional structural change. EEG frameworks, most notably the development of a ‘path as a process’ model (Martin, 2010) and the literature on related and unrelated diversification (Boschma, 2017) have proven to be powerful approaches for explaining new path development. Recent work has forged a link between EEG and the regional innovation system (RIS) concept to better understand why some types of regions are more likely than others to develop new growth paths (Isaksen and Trippel, 2017; Trippel *et al.*, 2018a). Other scholars have proposed a stronger integration of EEG with the global production network (GPN) approach (MacKinnon, 2012), geographical political economy (GPE) frameworks (Dawley, 2014; Dawley *et al.*, 2015) and the technological innovation system (TIS) concept (Binz *et al.*, 2016) to incorporate a wider set of factors into analyses of new path development (Hassink *et al.*, 2018; MacKinnon *et al.*, 2018).

With some exceptions (Martin and Sunley, 2006, 2010), most conceptualisations and empirical case studies of new path development have been focused on one path or new path development activities in one industrial field only. The ‘single path view’ prevailing in the literature strikes us as a severe limitation. Regions, in particular those with diversified economic and institutional structures and strong innovation capacities (Isaksen and Trippel, 2016; Xiao *et al.*, 2018) may well host a variety of new path development activities in different fields occurring more or less at the same time. EEG studies of industrial diversification aiming at uncovering regularities or patterns of co-occurrence by means of extensive research designs have indeed been concerned with path interdependencies. However, they focus either on existing, full blown paths, exploring to what extent they are related to each other (related versus unrelated variety) or in

which ways emerging paths are related to old ones (related versus unrelated diversification) (Boschma and Frenken, 2011; Boschma, 2017). Less attention has been paid to the relation between simultaneously emerging regional industrial paths and as a consequence little is known about how they shape each other's evolution.

Inspired by systemic perspectives that regional and technological innovation system studies have to offer, this conceptual paper aims to shed light on the meaning and nature of relationships between multiple new regional industrial growth paths. We propose a distinction between unlinked and linked paths and suggest that strategic agency may create supportive, competitive or neutral relationships between linked paths. We also discuss the policy implications and challenges that emanate from this perspective. Understanding inter-path relationships provides a sound basis for a broader, more integrative innovation policy approach and points to the need to proactively build connections and balance competition and cooperation between emerging paths.

The remainder of this paper is organised as follows. The second section provides a short overview of current accounts of new path development and multiple (regional) industrial paths in the extant literature. The third section draws a distinction between unlinked and linked paths. In the fourth section we explore the role of agency in shaping supportive, competitive or neutral relationships between new paths. The concluding section discusses implications for innovation policy and suggests avenues for further research.

2 Current accounts of new regional industrial path development: EEG and TIS perspectives

Arguably the question of which economic activities settle and become industries in which regions and why some regions appear to be better at attracting new industrial growth paths than others is at the core of economic geography (Storper and Walker, 1989; Chapman and Walker, 1991). Since Martin and Sunley's (2006) seminal article on path dependence and regional economic evolution, EEG has made significant progress in explaining processes of regional economic change. This section provides an overview on current debates of new path development and discusses some specificities of emerging paths. We also provide a synthesis of EEG and TIS arguments and findings on the relationship of multiple industrial paths.

2.1 New regional industrial path development

Key contributions to evolutionary economics have been made by theorists of path dependency (David, 1985; Arthur, 1989) who emphasise historical events and attribute change in economies mainly to external shocks. Martin (2010) deviates from these canonical perspectives and suggests viewing path development as an ongoing process where change is understood as inherent. By integrating path dependency in an evolutionary perspective on industrial change (Martin and Sunley, 2006, 2010), current EEG models acknowledge that new paths build on assets inherited from previous ones. The process through which new industrial paths emerge out of technologically or skill related pre-existing paths (termed ‘regional branching’ or ‘related diversification’; Boschma and Frenken, 2011; Neffke *et al.*, 2011) has received enormous attention over the past few years. More recently, scholarly work has also begun to critically revisit the notion of ‘relatedness’ (Steen and Hansen, 2014; Tanner, 2014; Carvalho and Vale, 2018; Hansen *et al.*, 2018) and to explore the role of ‘unrelated diversification’, that is, the development of new industries that are unrelated to the existing regional industrial base (Boschma, 2017).

Most recently a range of studies have argued for a more differentiated perspective of types of new path development (Isaksen *et al.*, 2018b; Grillitsch *et al.*, 2018). In addition to path branching (i.e., the development of a new industry based on existing competencies), current typologies identify other forms of new path development such as path importation (i.e. the establishment of an industry new to the region based on the arrival of foreign companies or inflows of skilled workers), and path creation (i.e. the establishment and development of an entirely new industry based on scientific discoveries, radically new technologies, or as outcome of search for new business models, user-driven or social innovation).

This paper aims to deepen the analysis of new path development by looking at relationships between new industrial growth paths in a regional context. Before doing so, we first need to specify what the key characteristics and challenges of the early development stage of a new path are, what assets are needed and which activities and processes are usually involved. The early path development stage may be seen as unfolding in different stages, each with different conditions, triggers and challenges (Gustafsson *et al.*, 2016). Martin (2010) divides the early path development stage into a ‘path creation phase’ and a subsequent ‘path development phase’. The former is characterised by experimentation and competition among local agents. The latter

is based on local increasing returns and network externalities. He asserts that new path development is about identifying, harnessing and converting historically evolved local conditions to match new market opportunities. Similarly, Boschma (2017) argues that new industrial paths are embedded in region-specific capabilities; they result from activities by entrepreneurs who draw on and combine existing capabilities. Local conditions (Martin, 2010) and territorial capabilities (Boschma, 2017) are broadly defined. These place-based characteristics could involve a variety of local assets, ranging from natural resources to infrastructural factors, technological and other forms of knowledge, skills, capital, innovation capacity, institutional endowment and networks (Maskell and Malmberg, 1999; Dawley, 2014). In EEG frameworks, the early stage of new path development is thus often a matter of the deployment and conversion of existing local assets and capabilities.

Scholarly work has also pointed to the significance of creating new assets locally and the importation and anchoring of non-local industrial and knowledge assets (Tödtling and Tripl, 2013; Dawley, 2014; Dawley *et al.*, 2015; Binz *et al.*, 2016; Neffke *et al.*, 2018; Tripl *et al.*, 2018a). Recent analyses studying the role of resources or assets for new path development elucidate that new paths may be both the outcome of the use of existing assets and the creation of new assets at the actor as well as at the system level (Miörner and Tripl, 2017; Isaksen *et al.*, 2018a; Musiolik *et al.*, 2018).

The TIS approach (Carlsson and Stankiewicz, 1991; Jacobsson and Bergek, 2004; Bergek *et al.*, 2008) addresses the question of the emergence of new technologies or industries from a systemic perspective. It pays particular attention to the formation of innovation systems and on how diverse actors, networks and institutions co-evolve as the technology (and the industry) develops over time by analysing the underlying core processes (Hekkert *et al.*, 2007; Bergek *et al.*, 2008; Hekkert and Negro, 2009). These include the development of formal knowledge, entrepreneurial activities, direction of search, market formation, resource mobilisation, legitimisation and generation of positive externalities.

To summarise, new path development may involve a broad set of activities undertaken by heterogeneous actor groups. Developing new paths is not only about the creation and diffusion of sector-specific knowledge and skills. The literature reviewed above suggests a broader conceptualisation to include a wide range of activities (those aiming at institutional change, the

transformation of network structures, as well as sourcing, mobilising and anchoring of diverse local and non-local assets) that may be essential in nurturing a new growth path.

2.2 Multiple (regional) industrial paths

A number of contributions from the new path development literature in EEG do recognise the possibility or even inevitability of multiple industrial paths developing within a region and most identify this as a promising field of further research (Martin and Sunley, 2006; Simmie *et al.*, 2008; Martin, 2013). Martin (2013) suggests that such multiple paths ought to be seen as interdependent and potentially mutually reinforcing, and co-evolving. Martin and Sunley (2006: 411) define as a key question whether different paths can co-exist within a region and what the nature of ‘interpath coupling’ is. They also question the aggregate effect of the interrelatedness and interdependency between multiple paths for regional path dependency and suggest that ‘path interdependence’ may occur “where the path-dependent trajectories of particular local industries are to some degree mutually reinforcing” (Martin and Sunley 2006: 413). Path interdependencies are also considered in scholarly accounts of related variety and in the literature on regional diversification. By looking at trade data, sector classifications, patent data, labour flows, or co-occurrence (see Content and Frenken, 2016 for a detailed overview on data sources in related variety studies), path interdependencies in the form of related variety between established industrial paths have been described and analysed. Whereas related versus unrelated variety captures the extent of how industries that exist in a certain region are related to each other, related versus unrelated diversification observes in which ways emerging regional paths are related to established ones (Boschma and Frenken, 2011; Boschma, 2017).

Potential relationships between multiple new paths have so far been neglected in the literature on new path development and industrial diversification. Moreover, existing concepts only consider positive relationships between paths whereas negative path interdependencies are left out (Hassink *et al.*, 2018). The literature on TIS and transition studies suggest that in addition to neutral or mutually supportive influence, also competition for scarce assets may occur on a regular basis. These strands of literature offer considerable insights into the interrelationships between different technological innovations, TIS and socio-technical arrangements. In accordance with evolutionary thinking, Hodson *et al.* (2017: 12) explain the variability in the outcome of reconfiguration processes as being constituted by the “relationships between

existing configurations (old) and experimental assemblages (new)”. Acknowledging that socio-technical arrangements are related to each other in an either competing, co-existing, or complementary manner, they consider regional change as an outcome of cumulative processes. Bergek *et al.* (2015) even point to a coevolution of several TISs in the form of competition or complementation. In that sense, the composition and success of possibly related industries in regions decide upon their actual situation at a particular time. Moreover, interrelationships change over time and we agree with Bergek *et al.* (2015) who consider the early phase of a TIS as being particularly predisposed to the influence of other TIS. This can be explained by the fact that emerging paths often have difficulties in terms of their initial performance and cost competitiveness. New paths might also experience barriers resulting from existing paths as well as established production and consumption patterns.

A precondition for interactions between technologies or TIS is that they either fulfil the same function (Sandén and Hillman, 2011), they are vertically related along value chains, or horizontally because they draw on the same inputs in the form of assets or provide similar outputs (Bergek *et al.* 2015; complementary or alternative value chains according to Sandén and Hillman 2011). Sandén and Hillman (2011) point to the important differentiation between non-exclusive goods (e.g. non-patented knowledge) or such goods that are in abundant supply. They further specify that neutral relationships (that is, simple co-existence of paths) may be found, resulting, for instance, from different geographical orientation.

We focus on emerging paths that generally face considerable challenges in their endeavour to overcome their first development phase (Smith and Raven, 2012). Our approach puts emphasis on inter-path relations resulting from the access to markets and the assets available within a RIS. RIS differ in terms of assets, organisational constellations and institutional endowments to actively support new growth paths. They also differ in their capacity to allow the creation of new assets locally as well as the importation and anchoring of non-local assets (Miörner and Trippel, 2018; Trippel *et al.*, 2018b). We argue that agency can play a major role in shaping inter-path collaboration and competition (or its avoidance) for markets and assets in RIS. Before elaborating in more detail on intentions and outcomes of agency in the context of inter-path relationships, we first shed light on the nature of path interactions in regional contexts.

3 Unlinked and linked regional growth paths

We suggest a simple basic distinction between unlinked and linked emerging paths (table 1). Whether new growth paths can be considered as unlinked or linked is determined primarily by the relevant technology and its reliance on markets and on broadly understood assets (see below). Emergent paths which are linked may, by means of agency, be shifted towards supportive, competitive, or neutral relationships (section 4).

Table 1: Unlinked and linked paths

	Market dimension	Asset dimension
Unlinked	Emerging paths produce different outputs and thus target different markets	Emerging paths draw on different scarce assets; or any assets needed by multiple paths are not scarce
Linked	New paths compete for the same market	New paths draw on the same scarce assets

To differentiate between unlinked and linked paths, we determine two key dimensions, the market dimension and the asset dimension. The market dimension is reflected in the question whether or not two or more paths produce goods, services or solutions that target the same market. The asset dimension refers to place-based characteristics as defined by Maskell and Malmberg (1999), that is, natural resources, infrastructural factors, technological and other forms of knowledge, skills, capital, innovation capacity, institutional endowment and networks. Following Sandén and Hillman (2011), we distinguish between scarce and non-scarce (non-exclusive) assets. If scarce assets are accessed by actors in one path they cannot be used in other paths. Examples are skilled labour, private risk capital, estate or properties. Non-scarce assets imply that their use in one path does not restrict their use in other paths (e.g. non-patented knowledge). We argue that the specific characteristics of new paths concerning these two dimensions crucially influence whether they can be considered linked or unlinked.

It follows that emerging paths may either be unlinked, meaning that they rely on neither the same markets nor the same assets or they may be linked, meaning that they rely on the same markets and/or the same assets. Unlinked paths thus refer to the mere co-existence of multiple emerging paths in a region that develop independently of one another. One new industrial path

remains unaffected by the rise and growth of other paths in the region. Emergent paths are unlinked i) when they produce different outputs, i.e. they might be targeting entirely different markets; ii) when new paths draw on different scarce assets; or iii) when an asset that is needed by multiple paths is abundant in supply. Linked paths in a region may affect each other in manifold ways. In a first scenario paths are linked where emerging industries draw on the same scarce assets and provide for the same market. An example may be fuel cell cars and electric cars which both may draw on financial support mechanisms for alternatives to oil based fuel propulsion vehicles and both offer products for the same market (individual transportation). A second scenario may be where paths draw on the same scarce assets, but provide for different markets. An example might be electrical engineers who may work in either the computer chip industry or in the wind energy industry, or either the digital gaming or the new media industry (as shown in a case study by Miörner and Tripl, 2017). In a third scenario, multiple emerging paths draw on different assets but offer products to the same market. Exemplary, the case of the Australian urban water sector can be cited where as a reaction on extreme weather conditions, emerging recycling technologies for waste and storm water provided for the same (water) market as the newly build large-scale seawater desalination plants (Fuenfschilling and Truffer, 2016). Being linked via markets could either mean that different paths are actually competing for the same market or that their outputs could be combined in the same value chain for a solution or product.

While our framework is broad enough to include any form of inter-path relationships, we focus on emerging paths. Inter-path relationship may change over time as the characteristics of the paths themselves change, their markets evolve, or needed assets may be used up or newly added to the innovation system (Sandén and Hillman, 2011; Musiolik *et al.*, 2018).

4 Shaping inter-path relations: the role of agency

In this section we seek to unravel the important role of agency in shaping the relationship between linked paths, leading to a relationship that may either be supportive, competitive or neutral. After discussing scholarly contributions on agency and purposive behaviour which have recently been integrated into EEG and innovation system frameworks (Isaksen and Jakobsen, 2017; Isaksen *et al.*, 2018a; Njøs and Fosse, 2018), we analyse the rationale for and the strategic actions aimed at establishing specific path relationships.

Calls for a stronger emphasis on agency and purposive behaviour in EEG primarily stem from the demand for an “expanded evolutionary-geographical conceptual apparatus” formulated by Martin and Sunley (2015: 715). Boschma et al. (2017) recognise that the role of institutional co-evolution with technological development for regional diversification processes remains under-explored. Therein they especially criticise a weak understanding of agency. Garud and Karnøe (2003) point to ‘mindful agents’ who consciously disconnect themselves from existing practice and introduce novel solutions. In a similar vein, Simmie (2012) suggests focusing on how agents pro-actively seek to escape lock-in situations in order to complement the canonical focus on change through external shocks in path dependency theory. He argues for a consideration of ‘knowledgeable agents’ who seek to introduce and diffuse new technologies. Agency for new path development has therefore been conceptualised as being intentional or purposive (Sotarauta, 2016; Sotarauta and Suvinen, 2018). Garud and Karnøe (2003) moreover suggest a strategy of bricolage in which multiple actors take part in innovative activities, the development of complementary assets and micro-learning processes. The concept of distributed agency has recently been taken up to highlight that besides technological capabilities, other resources or assets need to be accessed and mobilised for new path development (Binz *et al.*, 2016; Carvalho and Vale, 2018) and to further understand the role of agency in path development (Boschma *et al.*, 2017; Isaksen *et al.*, 2018a). Recent scholarly contributions on agency argue to consider not only the past and the present but also ideas and visions of the future (Steen, 2016; Sotarauta and Suvinen, 2018; Grillitsch and Sotarauta, 2018). In other words, actors’ expectations about future development play a role in agentic decision-making processes, which may be of particular importance for setting directions in emergent paths. Furthermore, the strategies of agents to develop specific outcomes at system level are said to be dependent on initial resource constellations (Musiolik *et al.*, 2018) whereas the existence of long-term knowledge links between these actors in the form of networks enables them to join forces (Musiolik *et al.*, 2012).

Agency that nurtures new path development is understood by taking a RIS perspective, which is also crucial when considering inter-path relationships in a regional context due to several reasons. First, we know from the literature that regional restructuring requires not only changes at the firm level but also changes in the organisational and institutional support structures and regional assets (Tödting and Trippel, 2013). Besides firm level agency, system level agency therefore finds increasing consent in the literature on new path development (Isaksen and

Jakobsen, 2017; Isaksen *et al.*, 2018a; Hassink *et al.*, 2018). We argue that not only the existence of several paths in a regional context but also interrelations between these paths have an influence on new path development. In concrete terms, changing assets or organisational or institutional reconfigurations in the RIS can exert influence on more than one path, which is due to the fact that the region's support structures containing research and education programmes, a specific skill base, dominant policy approaches and institutional set ups are used by several paths. Furthermore, the RIS perspective enables the consideration of multiple actors involving firm and non-firm actors such as research and educational institutes, policy actors as well as support organisations for analysing path development activities (Hassink *et al.*, 2018; Tripl *et al.*, 2018a). These actors can either belong to one particular regional industrial path, or – what we want to specifically emphasise – they come from different industrial paths and undertake agency by partially or mutually interacting. Finally, if and how new paths emerge in RIS is said to be dependent on the institutional thickness of the RIS and in particular whether the RIS is to be considered as thick for the industry under consideration (Zukauskaitė *et al.*, 2017). Since RIS are understood as being supportive for existing industries, RIS transformation that enables new path development needs agency (Isaksen and Jakobsen, 2017; Isaksen *et al.*, 2018a). By implication, if agency is undertaken from the side of one or several paths with the aim to thicken the RIS into a certain direction, that is supporting a certain industry, it may have positive or negative effects for one or several other paths existing in the RIS.

Building on the arguments above, our conceptualisation of inter-path relationships takes into account the role of agency in building assets and/or shape markets to the benefit of path development. We understand RIS transformation as a result of asset building and market creation that may on the one hand be implemented by actors from one emergent path, e.g. in the case of the gaming industry in Scania (Mörner and Tripl, 2017). On the other hand, actors from multiple paths may join forces (Musiolik *et al.*, 2018). We specifically focus on agency undertaken by multiple actors who build, access and deploy assets or (re-)orient at markets with the aim to shape inter-path relationships. Since internal and external influences play a role in shaping new path development, i.e. new paths are part of complex multi-scalar processes of industry formation (Markard and Truffer, 2008; Binz and Truffer, 2017), local as well as non-local linkages might be strategically used to shape relationships to other new paths. As a result, the relationship between linked paths becomes either supportive, competitive, or neutral. Potential rationales and strategic options to shape inter-path relationships are discussed below.

Towards supportive relationships

Agency in path development processes is conceptualised as being a reaction to system or transformation barriers or failures (Grillitsch and Tripl, 2018; Isaksen *et al.*, 2018a). Actors belonging to different but linked emerging paths may cooperate to improve the support structure to meet their specific needs. They might create additional assets through e.g. new educational programmes or research activities at universities, work together to initiate institutional co-evolution and change, or join forces to increase demand. A prominent example for collaboration between actors from multiple paths refers to the German feed-in-tariff. Different renewable energy paths – ranging from wind power, solar, biogas, and others – benefitted from the same public financial resources, strategic direction and legitimacy. Evidence suggests that actors belonging to regional emergent paths “worked together to initiate, maintain and strengthen the feed-in tariff” at the national level (Bergek *et al.*, 2015: 56). At the same time, as a result of legitimisation of clean production as an answer to climate change, the market for renewable energies in Germany has been continuously increased. Another example where actors who belong to different paths cooperate to initiate international standardisation was given by Bugge *et al.* (2017). The IT industry and the assisted living path in Norway have been both involved in an international alliance that jointly developed a continua framework to ensure future technological interoperability. At a localised scale, industrial parks or industrial ecosystems follow the idea of supporting path relationships by fostering innovation, improved introduction and access to new technologies, R&D and job creation as well as long-term culture change in networks of organisations. Similarly, the idea of a circular economy supports path relationships along value chains. Cascading, remanufacturing and recycling of products may involve the joint development of various RIS assets as well as the building up of markets.

Towards competitive relationships

Knowledge and support structures of a RIS have at large co-evolved with and is strongly adapted to the regional economic structure. Actors operating in an emergent path may actively seek to build assets for their needs. By ‘manipulating’ the regional support structure through various modes of change (Miörner and Tripl, 2017), the ‘thickness’ of the RIS can be altered to a certain direction favouring specific paths. As a result, competition about assets or markets with other paths may emerge if RIS reconfiguration favours the development of one or several specific paths. Associated activities could include organised lobbying to improve one particular

path's competitive position for assets or markets vis-à-vis other paths. Lobbying activities could be aimed at de-legitimising the rivals for local, regional, and national assets, e.g. funding schemes. Actors that aim to undermine niche development may take advantage of market power by closing off competitors in new business areas (see the case of the platform economy; Frenken *et al.*, 2018) or by means of recruitment and retention strategies targeting skilled workforce. Another example refers to the use of biogas as an input product for renewable energies on the one hand and several bioeconomy paths on the other hand. Whereas biogas for energy as a single main product is strongly supported by policies in Europe, a diversification towards creating multiple products and using them optimally through innovative solutions for the bioeconomy has been so far neglected in the policy arena (Pfau *et al.* 2017). According to Pfau *et al.* (2017), this reflects a misalignment of policy domains resulting in hampering of subsidy schemes, regulations and bureaucracy at the side of the diverse bioeconomy paths. In other words, the creation of renewable energy paths increased the thickness of the RIS to their needs and at the same time impaired the competitive position for assets of other paths. Similar examples can be derived from the competition for land use between food and energy production (Harvey and Pilgrim, 2011).

Towards neutral relationships

In order to escape or to reduce competitive pressure caused by other paths that rely on the same assets and/or markets actors might try to 'unlink' their industrial path from others. One strategy could be to simply 'change geography' in order to escape a competitor for markets, i.e. to supply a different region or target a different market. An example for this is the industrial reorientation from freestanding large scale wind turbines to small scale roof mounted wind turbines, or the specialisation on supplying markets in BRICS countries instead of supplying markets in established economies. Actors may also aim at expanding the asset base by building up additional assets or seeking out different (extra-regional) sources, such as different organisations or forms of funding, e.g. loans versus crowdfunding or a different governance scale, e.g. national support versus European funding.

Arguably, the development of new regional industrial paths can be divided into several sub-processes ranging from the successful development and introduction to the diffusion of new

technologies and business models. Strategies of competition and cooperation between different paths may occur simultaneously and can change over time.

5 Conclusion

Recurrent economic and financial crises, globalisation, digitalisation and climate change intensify the constant challenges for regions to renew their industrial structures and develop new growth paths. We have argued in this paper that it is important in the context of new path development to concentrate not just on the emergence and development of single paths alone but to consider how multiple paths emerge within a region, how they are related and which interactions and interdependencies determine their development. We wish to open the debate and hope to stimulate further research by proposing a basic framework.

EEG studies have been concerned with path interdependencies between existing industries (related versus unrelated variety) as well as with relations between old and new regional industries (related versus unrelated diversification). The interdependence between more or less simultaneously emerging regional industrial paths has however received limited attention in EEG and innovation studies. Emergent paths face considerable challenges when aiming to overcome their first development phase and we know from the literature that regions differ in their capacity to develop new growth paths. We argue that by taking a RIS perspective it becomes obvious that not only the existing industrial base but also early path development activities occurring in other sectors have an influence on an emerging path resulting from the common need for diverse, possibly scarce assets and the potentially limited access to shared markets. Our analysis therefore suggests that multiple regional emerging paths may be linked or unlinked, which is determined by two dimensions, the assets they draw on and the markets that they produce solutions for. Unlinked paths produce different outputs and therefore seek different markets. They also do not compete for the same assets. Linked paths, conversely, produce solutions for the same markets and/or draw on the same scarce assets.

Regional restructuring requires not only changes at the firm level but also changes in the organisational and institutional support structures of the RIS. In this paper, we argue that inter-path relationships play a role in developing assets and markets insofar as agency aiming at changing assets for path development can result from actions taken from diverse actors belonging to different paths. Moreover, agency at the level of the RIS means a ‘manipulation’

of the regional support structure that may result in favouring specific paths over others. In concrete terms, our framework considers that regional actors have to deal with a combination of linked and unlinked new paths. Dependent on their strategic aims, they choose measures, which are directed at one of three types of relationships between paths: First, they may aim to promote cross-path collaboration to foster a supportive relationship in order to develop assets and markets, to exploit synergies or to help legitimate novel solutions. Second, actors may seek to lobby and control assets in order to maintain dominance on a market and improve the competitive position of a specific path. Finally, agents may seek strategies which result in a neutral relationship between paths. Paths can be unlinked by changing geography and seeking assets and markets elsewhere whereby unwanted competition can be circumvented.

Implications for innovation policy

The novel perspective on inter-path relations proposed in this paper may also add to current debates on new policy approaches for innovation and structural change. New path development ranks high on the agenda of regional, national and supranational policy actors (Asheim et al. 2011, European Commission 2012, Foray 2015). Innovation and industrial policies – in particular smart specialisation – aim for the development of new regional specialisations to ensure future growth. How ‘domains’ of competitive advantage, i.e. emerging industrial paths, are selected in smart specialisation, is based on a thorough analysis of the specific regional or national innovation capacity. We contend that regional or national specialisation strategies and broad-based and place-based innovation policies truly benefit from considering inter-path relations instead of applying the predominant single path view due to the possibility of taking into account promising inter-paths relationships during the discovery process. Complementing and reinforcing relationships between two or more paths call for the identification as well as the explicit selection of linked paths. Competition for assets and markets can be made visible to either be used as an enabling factor for path development or to inform policy makers about necessary corrective actions.

Policy should play a strategic and proactive role in i) balancing competition and cooperation between new paths, and ii) facilitating and coordinating inter-path relationships. In terms of policy measures, this implies the development of diversified industrial and institutional infrastructures that are capable to support inter-path cooperation and at the same time to find

the right balance of nurturing and alleviating competition between emerging paths. Different types of regions have different rationales for strategically shaping inter-path relationships. A rationale for encouraging mutually supportive relationships between linked paths may be to further integrate development in diversified regions with several linked paths. Policy instruments for encouraging supportive inter-path relationships would include the facilitation of networking through e.g. innovation platforms as well as targeted support of combined applications. Explicitly bringing together actors involved in different new path development activities and removing barriers that prevent emerging paths to connect are sound policy strategies. Supporting viable paths in diversified regions, where there are a number of different industries which lack any particular industrial focus can be reached by fostering competition by means of competitive funding mechanisms, e.g. competitive tenders. In specialised regions where existing industries are prone to lock-in, bringing new technologies to the market and preparing respective paths for competition is a critical aspect of regional development strategies. Explicitly supporting desirable paths by increasing their competitive position may be achieved through the use of non-neutral support schemes. At certain stages of development, a neutral relationship with other, linked paths may be most beneficial. Broadening the industrial base and enhancing the future diversification potential and resilience, e.g. in highly specialised regions, would support this. In this way, premature displacement of superior technologies or industries could be avoided. Policy instruments to neutralise inter-path relationships could include the provision of additional resources, supporting emerging, linked paths in accessing resources and markets outside the region or demand-side interventions through public procurement or the stimulation of private demand by offering subsidies and tax incentives. Overall, it is clear that there is not one strategic option for the whole region but that a combination of measures must be implemented.

Further research

The aim of this paper has been to broaden the debate beyond single path perspectives. We have done so by contributing a framework which may be the basis for further research. Beside that different types of regions have different rationales for shaping inter-path relationships, it must be recognised that they also have different capacities for strategically linking paths. More in-depth studies of how different RIS types influence the options available for actors to strategically promote inter-path relationships may be a subject of further research. Empirical

research on the emergence of multiple paths within a region, ideally comparing dynamics across different types of regions, would undoubtedly produce important insights to complement, refine and improve the framework.

In our framework how emerging paths relate to local and regional assets and markets determines whether they are linked or unlinked. Yet, we appreciate that such a distinction is often not easily drawn. Moreover, the regional asset base and markets as well as the relations between emerging paths themselves are subject to change over time. It follows that regional path development and strategic choices for path relationships are not only place sensitive but also time sensitive, which would warrant closer examination, especially as part of empirical work.

We have alluded to the opportunity of linked paths that draw on assets from different local and non-local sources but have not in full considered the role of multi-scalar influences on the interactions and interdependencies between multiple emerging paths in regions. Our framework also gives limited consideration to the impact of socio-cultural factors and local and regional institutional arrangements on the scope of strategic action by and on the perceptions of actors. A final aspect could be the question how far our framework for inter-path relationship can be applied to better understand relations between mature paths or between mature and emerging paths.

References

- Arthur, W.B. (1989), “Competing Technologies, Increasing Returns, and Lock-In by Historical Events”, *The Economic Journal*, Vol. 99 No. 394, pp. 116–131.
- Bergek, A., Hekkert, M., Jacobsson, S., Markard, J., Sandén, B. and Truffer, B. (2015), “Technological innovation systems in contexts. Conceptualizing contextual structures and interaction dynamics”, *Environmental Innovation and Societal Transitions*, Vol. 16, pp. 51–64.
- Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S. and Rickne, A. (2008), “Analyzing the functional dynamics of technological innovation systems. A scheme of analysis”, *Research Policy*, Vol. 37 No. 3, pp. 407–429.
- Binz, C. and Truffer, B. (2017), “Global Innovation Systems - A conceptual framework for innovation dynamics in transnational contexts”, *Research Policy*, Vol. 46, pp. 1284–1298.
- Binz, C., Truffer, B. and Coenen, L. (2016), “Path Creation as a Process of Resource Alignment and Anchoring. Industry Formation for On-Site Water Recycling in Beijing”, *Economic Geography*, Vol. 92 No. 2, pp. 172–200.
- Boschma, R. (2017), “Relatedness as driver of regional diversification. A research agenda”, *Regional Studies*, Vol. 51 No. 3, pp. 351–364.
- Boschma, R., Coenen, L., Frenken, K. and Truffer, B. (2017), “Towards a theory of regional diversification. Combining insights from Evolutionary Economic Geography and Transition Studies”, *Regional Studies*, Vol. 51 No. 1, pp. 31–45.
- Boschma, R. and Frenken, K. (2011), “The emerging empirics of evolutionary economic geography”, *Journal of Economic Geography*, Vol. 11 No. 2, pp. 295–307.
- Bugge, M., Coenen, L., Marques, P. and Morgan, K. (2017), “Governing system innovation. Assisted living experiments in the UK and Norway”, *European Planning Studies*, pp. 1–19.
- Carlsson, B. and Stankiewicz, R. (1991), “On the nature, function and composition of technological systems”, *Journal of Evolutionary Economics*, Vol. 1 No. 2, pp. 93–118.
- Carvalho, L. and Vale, M. (2018), “Biotech by bricolage? Agency, institutional relatedness and new path development in peripheral regions”, *Cambridge Journal of Regions, Economy and Society*, Vol. 11 No. 2, pp. 275–295.
- Chapman, K. and Walker, D.F. (1991), *Industrial location: Principles and policies*, Blackwell, Oxford.

- Content, J. and Frenken, K. (2016), “Related variety and economic development: a literature review”, *European Planning Studies*, Vol. 24 No. 12, pp. 2097–2112.
- David, P.A. (1985), “Clio and the Economics of QWERTY”, *The American Economic Review*, Vol. 75 No. 2, pp. 332–337.
- Dawley, S. (2014), “Creating New Paths? Offshore Wind, Policy Activism, and Peripheral Region Development”, *Economic Geography*, Vol. 91 No. 1, pp. 91–112.
- Dawley, S., MacKinnon, D., Cumbers, A. and Pike, A. (2015), “Policy activism and regional path creation: the promotion of offshore wind in North East England and Scotland”, *Cambridge Journal of Regions, Economy and Society*, Vol. 8 No. 2, pp. 257–272.
- Frenken, K., Vaskelainen, T., Fünfschilling, L. and Piscicelli, L. (2018), “An Institutional Logics Perspective on the Gig Economy”, *AocArXiv Papers*, pp. 1–23.
- Fuenfschilling, L. and Truffer, B. (2016), “The interplay of institutions, actors and technologies in socio-technical systems — An analysis of transformations in the Australian urban water sector”, *Technological Forecasting and Social Change*, Vol. 103, pp. 298–312.
- Garud, R. and Karnøe, P. (2003), “Bricolage versus breakthrough. distributed and embedded agency in technology entrepreneurship”, *Research Policy*, No. 32, pp. 277–300.
- Grillitsch, M., Asheim, B. and Trippl, M. (2018), “Unrelated knowledge combinations: the unexplored potential for regional industrial path development”, *Cambridge Journal of Regions, Economy and Society*, Vol. 11 No. 2, pp. 257–274.
- Grillitsch, M. and Sotarauta, M. (2018), “Regional Growth Paths. From Structure to Agency and Back”, *Papers in Innovation Studies*, No. 1, pp. 1–23.
- Grillitsch, M. and Trippl, M. (2018), “Innovation Policies and New Regional Growth Paths”, in Niosi, J. (Ed.), *Innovation Systems, Policy and Management*, Cambridge University Press, pp. 329–358.
- Gustafsson, R., Jääskeläinen, M., Maula, M. and Uotila, J. (2016), “Emergence of Industries. A Review and Future Directions”, *International Journal of Management Reviews*, Vol. 18 No. 1, pp. 28–50.
- Hansen, T., Klitkou, A. and Tanner Nygaard, A. (2018), *Towards a relatedness framework for understanding new industry development in regions*, Cologne, Global Conference on Economic Geography 2018.

- Hassink, R., Isaksen, A. and Trippel, M. (2018), “Towards a comprehensive understanding of new regional industrial path development”, *PEGIS - Papers in Economic Geography and Innovation Studies*, No. 2, pp. 1–19.
- Hekkert, M.P. and Negro, S.O. (2009), “Functions of innovation systems as a framework to understand sustainable technological change: Empirical evidence for earlier claims”, *Technological Forecasting and Social Change*, Vol. 76 No. 4, pp. 584–594.
- Hekkert, M.P., Suurs, R.A.A., Negro, S.O., Kuhlmann, S. and Smits, R.E.H.M. (2007), “Functions of innovation systems: A new approach for analysing technological change”, *Technological Forecasting and Social Change*, Vol. 74 No. 4, pp. 413–432.
- Hodson, M., Geels, F. and McMeekin, A. (2017), “Reconfiguring Urban Sustainability Transitions, Analysing Multiplicity”, *Sustainability*, Vol. 9 No. 2, pp. 1–20.
- Isaksen, A. and Jakobsen, S.-E. (2017), “New path development between innovation systems and individual actors”, *European Planning Studies*, Vol. 25 No. 3, pp. 355–370.
- Isaksen, A., Jakobsen, S.-E., Njøs, R. and Normann, R. (2018a), “Regional industrial restructuring resulting from individual and system agency”, *Innovation: The European Journal of Social Science Research*, Vol. 101 No. 2, pp. 1–18.
- Isaksen, A., Tödting, F. and Trippel, M. (2018b), “Innovation Policies for Regional Structural Change. Combining Actor-Based and System-Based Strategies”, in Isaksen, A., Martin, R. and Trippel, M. (Eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*, Springer International Publishing, Cham, pp. 221–238.
- Isaksen, A. and Trippel, M. (2016), “Path development in different regional innovation systems. A conceptual analysis”, in Rodríguez-Pose, A., Parrilli, M.D. and Dahl-Fitjar, R. (Eds.), *Innovation drivers and regional innovation strategies, RIOT!*, Routledge Taylor & Francis Group, New York, pp. 66–84.
- Isaksen, A. and Trippel, M. (2017), “Innovation in space. The mosaic of regional innovation patterns”, *Oxford Review of Economic Policy*, Vol. 33 No. 1, pp. 122–140.
- Jacobsson, S. and Bergek, A. (2004), “Transforming the energy sector: the evolution of technological systems in renewable energy technology”, *Industrial and Corporate Change*, Vol. 13 No. 5, pp. 815–849.
- MacKinnon, D. (2012), “Beyond strategic coupling. Reassessing the firm-region nexus in global production networks”, *Journal of Economic Geography*, Vol. 12 No. 1, pp. 227–245.

- MacKinnon, D., Dawley, S., Pike, A. and Cumbers, A. (2018), “Rethinking path creation. A geographical political economy approach”, *Papers in Evolutionary Economic Geography*, No. 18.25, pp. 1–49.
- Markard, J. and Truffer, B. (2008), “Technological innovation systems and the multi-level perspective. Towards an integrated framework”, *Research Policy*, Vol. 37 No. 4, pp. 596–615.
- Martin, R. (2010), “Roepke Lecture in Economic Geography - Rethinking Regional Path Dependence. Beyond Lock-in to Evolution”, *Economic Geography*, Vol. 86 No. 1, pp. 1–27.
- Martin, R. (2013), “Regional economies as path-dependent systems. some issues and implications”, in Cooke, P.N. and Asheim, B.T. (Eds.), *Handbook of regional innovation and growth*, Edward Elgar, Cheltenham, pp. 198–210.
- Martin, R. and Sunley, P. (2006), “Path dependence and regional economic evolution”, *Journal of Economic Geography*, Vol. 6 No. 4, pp. 395–437.
- Martin, R. and Sunley, P. (2010), “The place of path dependence in an evolutionary perspective on the economic landscape”, in Boschma, R. and Martin, R. (Eds.), *Handbook of Evolutionary Economic Geography*, Edward Elgar, Cheltenham, pp. 62–92.
- Martin, R. and Sunley, P. (2015), “Towards a Developmental Turn in Evolutionary Economic Geography?”, *Regional Studies*, Vol. 49 No. 5, pp. 712–732.
- Maskell, P. and Malmberg, A. (1999), “The Competitiveness of Firms and Regions”, *European Urban and Regional Studies*, Vol. 6 No. 1, pp. 9–25.
- Miörner, J. and Trippel, M. (2017), “Paving the way for new regional industrial paths. Actors and modes of change in Scania’s games industry”, *European Planning Studies*, Vol. 25 No. 3, pp. 481–497.
- Miörner, J. and Trippel, M. (2018), “Embracing the future: Path transformation and system reconfiguration for self driving cars in West Sweden”, *PEGIS - Papers in Economic Geography and Innovation Studies*, No. 2018/04, pp. 1–22.
- Musiolik, J., Markard, J. and Hekkert, M. (2012), “Networks and network resources in technological innovation systems: Towards a conceptual framework for system building”, *Technological Forecasting and Social Change*, Vol. 79 No. 6, pp. 1032–1048.
- Musiolik, J., Markard, J., Hekkert, M. and Furrer, B. (2018), “Creating innovation systems: How resource constellations affect the strategies of system builders”, *Technological Forecasting and Social Change*, in press.

- Neffke, F., Hartog, M., Boschma, R. and Henning, M. (2018), “Agents of Structural Change: The Role of Firms and Entrepreneurs in Regional Diversification”, *Economic Geography*, Vol. 94 No. 1, pp. 23–48.
- 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*, Vol. 87 No. 3, pp. 237–265.
- Njø, R. and Fosse, J.K. (2018), “Linking the bottom-up and top-down evolution of regional innovation systems to policy: organizations, support structures and learning processes”, *Industry and Innovation*, Vol. 12 No. 3, pp. 1–20.
- Sandén, B.A. and Hillman, K.M. (2011), “A framework for analysis of multi-mode interaction among technologies with examples from the history of alternative transport fuels in Sweden”, *Research Policy*, Vol. 40 No. 3, pp. 403–414.
- Simmie, J. (2012), “Path Dependence and New Technological Path Creation in the Danish Wind Power Industry”, *European Planning Studies*, Vol. 20 No. 5, pp. 753–772.
- Simmie, J., Carpenter, J. and Chadwick, A. Martin, R. (2008), *History Matters: Path dependence and innovation in British city-regions*, Nesta Research report.
- Smith, A. and Raven, R. (2012), “What is protective space? Reconsidering niches in transitions to sustainability”, *Research Policy*, Vol. 41 No. 6, pp. 1025–1036.
- Sotarauta, M. (2016), “An actor-centric bottom-up view of institutions: Combinatorial knowledge dynamics through the eyes of institutional entrepreneurs and institutional navigators”, *Environment and Planning C: Politics and Space*, Vol. 35 No. 4, pp. 584–599.
- Sotarauta, M. and Suvinen, N. (2018), “Institutional Agency and Path Creation”, in Isaksen, A., Martin, R. and Trippel, M. (Eds.), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lessons*, Springer International Publishing, Cham, pp. 85–104.
- Steen, M. (2016), “Reconsidering path creation in economic geography: aspects of agency, temporality and methods”, *European Planning Studies*, Vol. 24 No. 9, pp. 1605–1622.
- Steen, M. and Hansen, G.H. (2014), “Same Sea, Different Ponds. Cross-Sectorial Knowledge Spillovers in the North Sea”, *European Planning Studies*, Vol. 22 No. 10, pp. 2030–2049.
- Storper, M. and Walker, R. (1989), *The capitalist imperative: Territory, technology, and industrial growth*, Blackwell, New York.

- Tanner, A.N. (2014), “Regional Branching Reconsidered. Emergence of the Fuel Cell Industry in European Regions”, *Economic Geography*, Vol. 90 No. 4, pp. 403–427.
- Tödting, F. and Tripl, M. (2013), “Transformation of regional innovation systems. From old legacies to new development paths”, in Cooke, P. (Ed.), *Re-framing regional development: Evolution, innovation and transition, Regions and cities*, 1. publ, Routledge, London u.a., pp. 297–317.
- Tripl, M., Grillitsch, M. and Isaksen, A. (2018a), “Exogenous sources of regional industrial change”, *Progress in Human Geography*, Vol. 42 No. 5, pp. 687–705.
- Tripl, M., Isaksen, A., Baumgartinger-Seiringer, S., Frangenheim, A. and Rypestøl, J.O. (2018b), *Green path development, innovation system reconfiguration and agency, Regional Innovation Policy (RIP) Conference 2018, Bergen, 11-12 Oct 2018*.
- Xiao, J., Boschma, R. and Andersson, M. (2018), “Industrial Diversification in Europe: The Differentiated Role of Relatedness”, *Economic Geography*, Vol. 43 No. 2, pp. 1–36.
- Zukauskaitė, E., Tripl, M. and Plechero, M. (2017), “Institutional Thickness Revisited”, *Economic Geography*, Vol. 5 No. 30, pp. 1–21.

**Department of Geography and Regional Research
University of Vienna**

Contact person: Michaela Trippl
Universitätsstraße 7/5/A0528, 1010 Vienna, Austria
Tel.: +43-1-4277-48720
E-Mail: Michaela.tripppl@univie.ac.at
<https://humangeo.univie.ac.at/>

**Department of Socioeconomics
Vienna University of Economics and Business**

Contact person: Jürgen Essletzbichler
Welthandelsplatz 1, 1020 Vienna, Austria
Tel.: +43-1-31336/4206
E-Mail: juergen.essletzbichler@wu.ac.at
<http://www.wu.ac.at/en/department-socioeconomics>

**Institute for Urban and Regional Research
Austrian Academy of Sciences**

Contact person: Robert Musil
Postgasse 7/4/2, 1010 Vienna, Austria
Tel.: +43-1-51581-3520
E-Mail: robert.musil@oeaw.ac.at
<https://www.oeaw.ac.at/en/isr/home/>

**Department of Working Life and Innovation
University of Agder**

Contact person: Arne Isaksen
Jon Lilletunsvei 3/A161, Grimstad, Norway
Tel.: +47-37-23-33-53
E-Mail: arne.isaksen@uia.no
<https://www.uia.no/en/about-uia/faculties/school-of-business-and-law/department-of-working-life-and-innovation>

**Department of Geography
Kiel University**

Contact person: Robert Hassink
Hermann-Rodewald-Str. 9, 24098 Kiel, Germany
Tel.: +49-431-880-2951
E-Mail: hassink@geographie.uni-kiel.de
<https://www.wigeo.uni-kiel.de/en/>