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External “energy” for regional industrial change: attraction and absorption of non-local knowledge for new path development

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JEL codes: O10, O19, O30, R10

Keywords: New path development, regional industrial change, non-local knowledge, regional innovation systems, degree of organisational thickness, specialisation, diversity

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1 Introduction

Recent scholarly work has enhanced our understanding of how regional economies transform over time, providing new insights into the nature and mechanisms of long-term regional industrial change (see, for instance, Martin and Sunley 2006, Martin 2010, Boschma and Frenken 2011). The interest has been focused on conditions that stimulate the renewal of existing regional industries and the creation of new ones (Feldman 2007, Tödtling and Trippel 2013). Studies are mainly framed in the evolutionary economic geography (EEG) approach, suggesting that future regional development paths are shaped by the past industrial development in the regions (Martin 2010). Consequentially, the EEG approach emphasises the significance of endogenous factors and mechanisms, such as the existing industrial structure and economic actors in a region, knowledge flows in regional innovation systems (RIS), the dominant regional institutions, innovation modes, and type of policy support systems. Such factors partly reflect regions' role in national and global production and innovation systems (Massey 1984), as well as challenges coming from higher geographical levels (MacKinnon 2012). Recent studies have, nevertheless, mainly focused on local conditions and processes, such as related variety and regional branching (Boschma and Frenken 2011) and how they facilitate regional industrial change. Exogenous sources of new path development are underappreciated in this approach (Isaksen and Trippel 2014, Binz et al. 2015, Dawley, et al. 2015). Only a few scholars have sought to shed light on the relation between non-local knowledge and new regional industrial growth paths (Martin and Sunley 2006, Boschma and Iammarino 2009, MacKinnon 2012; Boschma et al. 2015). Little is still known about the ways by which exogenous sources may induce new path development and to what extent and why such processes differ across different types of regions and innovation systems.

The aim of this paper is to contribute to a better understanding of the importance of exogenous sources of new path development. We offer a typology of non-local knowledge sources and we provide a systematic conceptual analysis of the role these sources may play for new growth paths in different types of regional innovation systems (RIS). In the succeeding theoretical discussion we distinguish between three different types of RIS (Isaksen and Trippel 2014), that is, organisationally thick and diversified RIS, organisationally thick and specialised RIS, and organisationally thin RIS. These types can be clearly distinguished from one another and are broad enough to allow coverage of a large variety of areas. We advance the argument that these three RIS types vary markedly in their need for as well as in their capacities to attract and absorb non-local knowledge and to transform it into new development paths. We differentiate between two main types of new regional industrial path development, that is, path renewal and path creation (Isaksen and Trippel 2014). Path renewal denotes the diversification of existing industries into new but related ones, often based on new combinations of existing knowledge in a region. Path creation is referred to as the rise of entirely new industries in a region, which often stems from commercialisation of research results. However, it may also be an outcome of search processes for new business models, user-driven innovation and social innovation.

The remainder of the paper is structured as follows: Section 2 identifies a set of mechanisms by which non-local knowledge can 'enter' the region. In Section 3 we discuss the need for as well as the capacities to attract and absorb knowledge from exogenous sources for new path development in the three types of RIS mentioned above. Finally, Section 4 summarizes our main arguments and concludes.

2 Exogenous sources of new path development: towards a typology

There is a considerable body of work on the globalisation of production and innovation and the nature of non-local knowledge flows. The literature on global value chains (Gereffi et al. 2005, Ponte and Sturgeon 2014) and global production networks (Henderson et al. 2002, Yeung and Coe 2015) has essentially enhanced our understanding of forms and consequences of regions' insertion into globally configured connections and (inter-)dependencies. Upgrading of firms depends on the specific global value chains that firms are part of and their role in these (Humphrey and Schmitz 2004). In some cases lead firms in global value chains assist supplier firms to upgrade products and processes. Similar standpoints are found in the global network approach. Networks affect regions with diverse internal resources differently, depending on regions' role within networks, e.g. whether regions are 'centres of corporate control', have lead firms in global networks or branch plant type of firms (Ó Riain 2011, MacKinnon 2012). However, apart from a few notable exceptions (see in particular MacKinnon 2012) the contribution of these approaches to the understanding of new regional path development remains vague.

Furthermore, there is a vast literature in innovation studies and economic geography that suggests that international knowledge sourcing activities are eminently important for innovation. Bathelt et al. (2004), for example, argue that firms in regional clusters, in order to stay dynamic, need to supplement locally available knowledge with bodies of knowledge residing elsewhere, and for that purpose consciously build pipelines to particular global knowledge sources. Interestingly, this literature has hardly been connected to the work on new regional path development so far. Whilst many studies confirm the positive influence of extra-regional knowledge inputs on innovation, little is said about the impact of these innovations on regional industrial continuity and change. In other words: it remains unclear whether innovations that rest on non-local knowledge sourcing activities promote path-creating, path-renewing or path-extending forms of development.

The literature on regional industrial path development, on the other hand, has failed to fully account for the potential role of exogenous sources of path creation and path renewal. As outlined in the introduction, regional structural change is still mainly conceptualised as an endogenous phenomenon. Martin and Sunley's (2006) seminal article on path dependence and regional economic evolution is one of the few exceptions that acknowledge the possibility of exogenous sources of new path development. They identify 'transplantation from elsewhere' as one of five candidate mechanisms of regional de-locking and new path creation. Transplantation 'refers to the importation and diffusion of new organizational forms, radical new technologies, industries, firms or institutional arrangements, from outside' (Martin and Sunley 2006, p. 422).

There is a need to develop a more differentiated view on and typology of exogenous sources of path development that goes beyond the all-encompassing notions of transplantation and invasion. We argue that there are various mechanisms by which non-local knowledge can enter the region, setting in motion processes of new regional industrial path development. We advocate a distinction between the following main forms of exogenous sources of new growth paths, that is, i) arrival of new actors from outside the region and ii) extra-regional knowledge linkages.

Arrival of new actors from outside the region: New path development can be triggered by the arrival of actors from outside the region. It is useful to distinguish between organisational actors and individual actors in this regard. There are strong reasons to assume that the inflow of new *organisations* can induce or support new growth paths as they bring new knowledge to the region. A powerful mechanism may include the resettlement of firms and other organisations such as R&D institutes. Neffke et al. (2014) have shown that it is relocating firms and not so much regional start-ups and incumbents that introduce most structural change (creation of new industries that require new capabilities instead of existing capabilities) in Swedish regions. New path development may also originate from the relocation of R&D organisations as shown for instance by Isaksen and Trippel (forthcoming) (see also section 3.3). The arrival of FDI can also be an important mechanism for initiating new forms of path development. Martin and Sunley (2006, p. 423) note that ‘new knowledge brought into a region by the inward transplantation of firms from elsewhere (through FDI or takeover or merger) may be critical in initiating a new technological or industrial path locally...’. MacKinnon (2012) argues that the relation between FDI and regional evolution is complex and path dependent in nature and may differ depending on the type of region under consideration. In particular in non-core regions the link between FDI and regional development can be negative, as ‘regions can become ‘locked-in’ to external networks ... controlled by TNCs (transnational corporations, the authors) as is evident from the experiences of branch-plant regions which became over-reliant on relatively low-value production plants, lacking more advanced functions and high-status employment as a result ...’ (MacKinnon 2012, p. 236).

Individual actors are carriers of knowledge, transferring expertise and know-how from one place to another by means of their mobility. Thus, the migration and mobility of highly skilled and resourceful people is a potential source for new path development. Florida’s (2003) work on the creative class, for instance, points into this direction, suggesting that talented people (i.e., members of the creative class such as scientists, poets, artists, designers, architects, and so on) move to places characterized by openness, diversity and tolerance and attract firms which seek “to draw from concentrations of talented people who power innovation and economic growth” (Florida 2003, p. 5). Focusing on internationally mobile star scientists, Trippel (2013) found that these individuals contribute in manifold ways to innovation and regional growth in the places that attract them.

Saxenian’s (2006) work on the “new argonauts” is one of the few studies that have explicitly explored the link between the inflow of new knowledge through mobile individuals and new path development. Saxenian (2006) shows that the rise of ICT industries in various Asian countries has essentially been triggered by returnees, who, after having studied or worked for a certain period of time in the Silicon Valley, moved back to their home countries, transferring by means of their mobility advanced technical knowledge and providing advice to policy actors about the establishment of institutional set-ups that promote venture capital (Saxenian and Sabel 2008). In a similar vein, work by Drori et al. (2009) indicates a positive impact of transnational entrepreneurship on the institutional environments of less-developed regions.

Extra-regional knowledge linkages: New development paths do not necessarily rest on the arrival of organisations or individuals from outside but may also originate through extra-regional knowledge linkages. Such knowledge linkages can come in different forms. Tödttling et al. (2006) categorise the different knowledge sourcing mechanisms depending on the degree of formalisation and interactive learning that takes place. Formal mechanisms have a

contractual basis such as market links or research collaborations between local and non-local firms and organisations. In contrast to research collaborations, market links only warrant limited interactive learning and comprise e.g. buying of patents, acquisition of machinery that embodies new knowledge, or contract research. Boschma and Iammarino (2009) have shown that the importation of related variety through trade linkages has a positive effect on regional growth and development. In addition, more informal mechanisms may play a role. Linkages among actors based on social proximity (Boschma, 2005), e.g. between former colleagues or study friends living and working elsewhere, or knowledge retrieved from ‘open sources’ are good examples in this regard. Furthermore, firms may also get hold of information and knowledge by monitoring non-local competitors, by exchanging knowledge in virtual knowledge communities or by attending conferences and trade fairs (Power and Jansson 2008).

Arguably, exogenous sources of new path development can alone or in combination set in motion new path development. This provokes two key questions:

- When and under what circumstances does the inflow of non-local knowledge induce and support new regional industrial path development?
- How do RIS types (organisationally thick and diversified RIS, organisationally thick and specialised RIS, organisationally thin RIS) differ in their need and capacity to attract and absorb non-local knowledge for new path development?

3 Exogenous sources of new path development in different types of RIS

In this section we explore the nexus between non-local knowledge and regional industrial change. We advance the idea that the opportunities for and challenges of exogenous sources of path development vary markedly between different types of RIS. Our analysis considers three factors or dimensions that are key for sharpening one’s understanding of these differences across regions.

First, RIS vary in their **needs** to harness exogenous sources to set in motion new path development. This is due to differences in the availability of local knowledge and resources. Isaksen and Trippel (2014) have shown, that various RIS types differ strongly in terms of their endowment of local (endogenous) sources of new path development. RIS with a limited availability of local assets may face a higher need for exogenous sources of regional industrial change.

Second, regions are also heterogeneous in the degree of **attractiveness** for non-local knowledge sources. There is indeed evidence that suggests that the capacity to attract innovative organisations and knowledgeable individuals tends to vary strongly across RIS types. Regions with organisationally thick and diversified structures in which highly innovative players are located tend to allure a larger number of leading organisations and talented individuals (Florida 2003, Trippel 2013, Miguelez and Moreno 2015) than other RIS types. Core areas may also be more attractive partners in various forms of non-local knowledge linkages (Maggioni and Uberti 2007).

Third, RIS may differ in their **absorption capacities** of knowledge brought in by various mechanisms. Arguably, the attraction of knowledge from outside is not enough. In order to benefit from it, RIS need to be able to exploit the external knowledge injected by newcomers or through non-local knowledge links, combine it with existing local knowledge and transform it into new development paths. Looking at the inflow of inventors, Crescenzi and Gagliardi (2015, p. 25), for instance, have shown that ‘the attraction of highly skilled knowledgeable individuals can boost local innovation only where this is part of a systemic approach to regional innovation that facilitate the inclusion of these inflows into the network structure of the local economy supporting – where necessary – the correction of myopic knowledge search patterns of local firms’. However, the absorptive capacity of a RIS and its ability to transform knowledge from outside into new path development is not only shaped by firm strategies and the structure of their local networks but also by policy actions, the organisational support structure and the institutional set-up of the region (see, for instance, Tödting and Trippl 2013, Vale and Carvalho 2013, Binz et al. 2015).

Thick and diversified RIS tend to have a stronger absorption capacity than their specialised or thin counterparts, because of a larger and more varied set of firms, industries, knowledge organisations, workers’ skills and so on. However, efforts to create favourable regional environments and to promote localized knowledge links between firm and non-firm actors (Vale and Carvalho 2013) can lead to a strengthening of the absorption capacity for incoming external knowledge in less-favoured types of RIS. Particularly thin RIS may in addition also benefit from the fact that under certain circumstances they can provide more room for experimentation than their thicker counterparts, where existing structures and inertia may suppress the growth of new activities (see, for instance, Simmie 2012). However, more research is needed to understand under which conditions thin structures can facilitate new growth paths and not only constrain them as often argued in the literature.

In a next step we provide a more in-depth analysis of the three dimensions outlined above. We explore conceptually in which ways they differ between organisationally thick and diversified RIS, organisationally thick and specialised RIS and organisationally thin RIS. We also provide a discussion of various illustrative concrete empirical examples of exogenous sources of new path development in each of these RIS types.

3.1 Organisationally thick and diversified RIS

Needs and capacities to attract and absorb non-local knowledge

These RIS are often seen as centres of radical innovation and hot spots of new firm formation (Isaksen and Trippl 2014). The favourable innovation performance relates to a host of economic actors with different knowledge and skills, supporting knowledge exchange and mutual learning. Regions with thick and diversified RIS are usually well endowed with a variety of different (but often related) industries and knowledge bases, a diverse set of strong research organisations and a diversified support infrastructure. The high number of economic actors stimulates flows of knowledge underpinning innovation activities. Several mechanisms underlie localized knowledge circulation, in particular movements of skilled workers between firms and knowledge organisations, and face-to-face contacts between economic agents, which are particularly pertinent when information is rapidly changing and knowledge is tacit (Storper and Venables 2004). Numerous and heterogeneous economic actors and knowledge flows provide ideal conditions for inter-industry crossovers and combinations of knowledge bases (Asheim et al. 2011), which are seen as conducive to related diversification processes

(Boschma 2015) underlying path renewal. In addition, the presence of strong research organisations and a high entrepreneurial climate offer manifold opportunities for the rise of entirely new growth paths (Isaksen and Trippl 2014). Organisationally thick and diversified RIS are thus well endowed with endogenous (local) sources of new path development and may rely less on exogenous ones when compared to other RIS types.

Although organisationally thick and diversified RIS have favourable endogenous conditions for new path development, their economic functions are deeply rooted in external knowledge exchange and long-distance trade (Scott and Storper 2015). Cities, which often have thick and diversified RIS configurations, function ‘as systems of dense local interactions imbricated in complex long-distance movements of people, goods and information’ (Scott and Storper 2015, p. 7). This type of RIS also exhibits a high capacity to attract all types of globally available knowledge. They are the ‘preferred destinations’ of internationally mobile talented individuals, such as creative class members and for research and innovation activities in multinational corporations. More often than not, organisationally thick and diversified RIS are generator regions of lead firms in global production networks (MacKinnon 2012), which make some of them into centres of command and control. They are, indeed, local nodes in global networks (Gertler and Levitte 2005).

The perception of cities (with thick and diversified RIS) as local nodes in global networks sets the scene for analysing the importance of non-local knowledge exchange for path development. The industrial development of this RIS type must be understood in the context of non-local knowledge exchange, or ‘in the context of distanced economic flows and networks’ (Amin and Thrift 2002, p. 53). Leading firms in these regions organise global production and innovation networks, and firms in some sectors depend on ‘project teams scattered around the world, linked up virtually and through placements’ (Amin and Thrift 2002, p. 66). With lead firms in global networks, organisationally thick and diversified RIS have strong capacities to absorb related and unrelated knowledge from non-local sources and to exploit both local and non-local knowledge for path renewal and new path creation. The lead firms can act as technological gatekeepers if they transfer non-local knowledge to other regional actors (Giuliani and Bell 2005). Thus, organisationally thick and diversified RIS have high capacities to transform knowledge into new growth paths. This is also due to a well-developed knowledge and support structure with a high adaption capacity to the needs of new industrial paths.

Arrival of new actors, global knowledge links and new path development

R&D-organisations and firms in thick and diversified RIS are in general on the delivering rather than the receiving end of global knowledge pipelines due to the role of this RIS type as innovation centres. But as said above, the industrial development in thick and diversified RIS can rely on combinations of endogenous and exogenous resources. This is illustrated by the growth of the Norwegian oil and gas industry from the 1960s onwards, which represented a new development path in Norway. The engineering part of the sector grew up and was highly concentrated in the Oslo region until the mid-1990s (Isaksen 2003). The wider oil and gas equipment supplier industry is also concentrated in Norway’s three largest city regions of Stavanger, Bergen and Oslo (Vatne 2008).

The oil and gas industry was transplanted into Norway from outside. Transplantation was required as no knowledge of oil exploration and production existed in Norway when oil

reserves were discovered in the North Sea in the late 1960s (Sæther et al. 2011). While the oil and gas industry in Norway started as path transplantation from outside into the capital region, it continued by path renewal in which existing ship yards and mechanical engineering firms, for example, turned to supplying the oil industry, and it led to path creation when a totally new industry was formed. Inflow of knowledge from foreign sources was instrumental for this achievement.

Absorption capacity was increased through policy intervention. An important instrument in that respect was Goodwill agreements. These included that foreign oil companies got 'goodwill points' by contracting with Norwegian firms and research institutes. The amount of 'goodwill points' was monitored and affected the result when concessions for developing new oilfields were passed to oil companies. Particular important was financial support to research institutes and technology transfer to Norwegian suppliers. The Goodwill agreements contributed to the development of a national innovation system with high research capacity and to the fact that the Norwegian oil and gas supplier industry has become globally competitive in a number of niches (Sæther et al. 2011). This example illustrates the capacity of thick and diversified RIS to build new industrial paths on imported knowledge.

The pharmaceutical and biotech industry in Vienna (Tripl and Tödting 2007) represents another good example. The region has a long tradition in medicine and biomedicine and a strong knowledge exploration capacity in these fields due to an excellent scientific base. Weak incentives and conditions for commercializing research and other missing ingredients such as a culture of high-risk taking, however, severely undermined the capacity of regional actors to exploit these knowledge assets. The emergence of a new growth path around pharmaceutical (and later biotech) activities was essentially triggered by the arrival of international companies with capabilities to transform the strong local research and skill base into new regional industrial path development. External energy targeted at knowledge exploitation has thus fuelled the creation of a new path. Similar findings have been documented for the rise and early development of Vienna's biotech sector. Importation of managerial expertise through international recruitments of highly skilled people and various types of global knowledge linkages (R&D partnerships, buying of patents and licenses) for exchanging specialized scientific expertise have significantly contributed to the emergence of this sector. Furthermore, regional and national policy interventions have played a major role in enhancing the absorption capacity. A variety of public programs and actions have strengthened the organizational support structures in order to better exploit the inflow of external knowledge.

While exogenous sources potentially contribute in many ways to new industrial path development in thick and diversified RIS, it can be expected that high complementarities exist in particular if "external energy" is targeted at knowledge exploitation. Thick and diversified RIS have high capacities in knowledge exploration, and are globally embedded centers for research excellence. A question in such regions is then how to make this knowledge economically viable, which can be done through "endogenous" entrepreneurial experimentation. However, capacities for knowledge exploitation can also be brought in by external actors, who have the necessary absorption capacity, access to global markets and financial resources, either internally or through their network embeddedness. In this case, external energy would lead to the creation of new regional industrial paths by exploiting (but also adding to) the strong regional knowledge infrastructure. Given the complementarity between knowledge exploration and exploitation, such a process would also be conducive in terms of transforming incoming knowledge into new path development.

3.2 Organisationally thick and specialised RIS

Needs and capacities to attract and absorb non-local knowledge

Organisationally thick and specialized RIS exhibit a strong economic specialization pattern in only one or a few sectors as well as organizational and institutional support structures that are well adapted to the needs of the dominating industries. Such RIS configurations are often found in old industrial regions (Hassink 2005, Trippl and Otto 2009) or in Italian industrial districts (Becattini et al. 2009). Isaksen and Trippl (2014) argue that the strong specialisation of industrial and support structures and the Marshallian externalities resulting from such conditions mainly promote incremental innovation and keep this RIS type in well-established industrial and technological trajectories. Path extension is thus the dominant form of regional industrial path development in this RIS type. These regions tend to be ‘myopic’ for opportunities that lay beyond existing growth paths and face serious challenges to switch to new ones (Boschma 2015).

Organisationally thick and specialised RIS lack the internal diversity of industries, knowledge bases and supporting organisations that are considered as critically important for new path development (Asheim et al. 2011, Boschma and Frenken 2011). Due to the dominance of a few industries, 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 (Isaksen and Trippl 2014, Boschma 2015). In other words: The availability of local assets is lower when compared to organisationally thick and diversified regions and as a consequence the need for exogenous sources of path development is more pronounced.

However, organisationally thick and specialised RIS seem to exhibit a lower capacity to attract knowledge for new path development from outside the region. This holds in particular true for internationally mobile talent and highly skilled people such as entrepreneurs, scientists, and other members of the creative class (and to some extent also for firms and other organisations). These actors are usually lured to places characterised by diversity, openness and excellence in emerging fields. Organisationally thick and specialised RIS hardly offer such assets and as a consequence their capacity to attract these exogenous sources of new path development is limited. The capacity to absorb knowledge that has been explored elsewhere is also lower in this RIS type. This is due to the strong specialisation of firms in a narrow knowledge base and the lack of organisational support structures that are required to fully exploit the related and unrelated knowledge for new path development.

Arrival of new actors, global knowledge links and new path development

The arguments raised above, however, do not imply that this RIS type is cut off from any inflow from people, organisations and knowledge from outside the region. Empirical studies show that “external energy” in thick and specialised RIS can support path extension but also new path development. Some contributions suggest that the arrival of new actors from elsewhere can lead to *path extension*. Research on the evolution of Italian industrial districts, for instance, provides some support for this view. The cases of some textile, clothing and leather districts in the Third Italy point to a growing employment of unskilled immigrants to cut labour costs. It remains to be seen if this will drive the specialization of the manufacturing industry towards low-skilled sectors or if it will help to avoid the leakage of key competences

to new emerging countries. The emergence/arrival of new ethnic firms from China, which build their competitive advantage on high flexibility and low costs, has allowed districts like Prato and Capri to sustain their international competitiveness in existing paths (Rabellotti et al. 2009).

However, there is also evidence that the arrival of new actors and organisations can set in motion new path development. Studies of Italian industrial districts have revealed some relevant findings in this regard. Belussi and Asheim (2003) have shown that by attracting FDI Montebelluna has become an international innovation centre for the winter sports industry. Whilst labor intensive and unskilled phases have been outsourced to regions in Asia and Eastern Europe, Montebelluna succeeded in keeping key competencies and a substantial manufacturing base within the local industrial district system. Another good example for the role of FDI in new path development is Mirandola, where the entry of US, German and Swedish MNCs has led to the rise of an internationally competitive biomedical industry (Biggiero 2002).

Studies of old industrial regions also demonstrate that under certain circumstances the entry of people and organisations can induce regional industrial change. Scholarly work on the role of FDI in old industrial regions has shown that the arrival of foreign companies can open up new development paths, if these firms feature high value-added functions and embed themselves in the local economy by forming long-term linkages to regional suppliers and partners. This has been observed in Styria (Austria) and Wales (UK), where the arrival of MNCs has fuelled the creation of new paths in the automotive industry (Trippel and Tödtling 2008). The rise of the software industry in Ireland has been spurred on essentially by the attraction of foreign companies (O'Malley and O'Gorman 2001) and return flows of highly skilled workers (Kapur and McHale 2005). Similar processes have been observed in Blekinge, an old industrial region in the South East of Sweden, where the relocation of big Swedish IT companies from Stockholm to Karlskrona, the region's capital city, has set in motion the development of one of Sweden's largest ICT clusters in the 1990s (Fredin et al. 2015). The cases of Wales and Blekinge, however, also demonstrate that new path development based on FDI can be vulnerable, if the big players decide to leave the region (MacKinnon 2012). Finally, recent evidence on new path creation processes in the offshore wind industry in UK regions also suggest that 'transplantation' of new knowledge from outside the region has played a major role (Dawley et al. 2015). This holds in particular true for Scotland, where 'transplantation is a key mechanism of path creation in the ... wind sector, providing some parallels with the development of other recent growth sectors such as electronics and oil and gas, although ... transplantation extends to research and development in offshore renewables, in contrast to the branch plant nature of electronics in particular' (Dawley et al. 2015, p. 11).

Organisationally thick and specialised RIS may also benefit from being connected to distant knowledge sources through various types of linkages. It has often been argued that this RIS type is characterised by inward looking networks that close the region off from extra-regional knowledge and reinforce path extension at the cost of new path development (Isaksen and Trippel 2014). Indeed, as claimed by Trippel and Tödtling (2008) and Trippel and Otto (2009) new path development in these regions requires the establishment of new networks and socio-cultural shifts. Work on path renewal processes in the Styrian metal industry (diversification from mass products towards manufacturing of high value and high quality forgings for the aviation and space industry, ultra-long weld-free rails), for instance, clearly show that these branching processes were facilitated by a reconfiguration of local networks *and* new connections to actors outside the region (Trippel and Otto 2009).

The illustrative empirical examples presented above suggest that new path development in thick and specialised RIS often requires “external energy” in the form of new actors or non-local knowledge linkages. In contrast to thick and diversified RIS, there is little potential to combine different types of local knowledge and resources outside the existing specialisations. Hence, accessing such knowledge externally will be crucial for new industrial path development. New industrial path development will typically realise in the form of path renewal through branching processes. Such processes imply that new non-local knowledge relates to and complements existing industrial specialisations of thick and specialised RIS.

3.3 Organisationally thin RIS

Needs and capacities to attract and absorb non-local knowledge

Organisationally thin RIS exhibit a lack of organisations with the required knowledge bases and resources to engage in localized learning processes (Isaksen and Trippel, forthcoming). Such regions may in principle have one or few strong organizations but these organizations lack local collaboration partners to exchange knowledge with. In contrast to organisationally thick regions, organisational thin RIS do not have a critical mass in any specific industry, let alone opportunities to benefit from variety in the regional industrial structure or from combining different knowledge bases. Often such regions are dominated by SMEs active in traditional and resource-based industries. Innovation activities tend to be low and typically of an incremental type improving existing processes and products. Furthermore, organisational thin RIS have per definition deficits as regards knowledge and support infrastructure such as universities, R&D institutes, or technologic transfer centres. In other words, the endogenous potential for new path development is low in organisational thin RIS and therefore the need for exogenous sources is particularly high.

While the need is high, the capacity to attract external knowledge is rather low in such regions. Typical investments in organisational thin regions relate to natural resources, or cheap labour and land. Another rationale for investment in the periphery is market access to for instance highly populated developing countries, which also lack organisations with the required capabilities to create new development paths. However, resource or market seeking investments do not require embedding in the local milieu and exchanging knowledge with other local entities (Dunning and Lundan 2008). Moreover, MacKinnon (2012) argues that path dependencies in global production networks may generate lock-ins in peripheral regions. Typically, the relationships are highly asymmetrical where regions offer rather ubiquitous resources such as low-skilled labour and consequently have limited bargaining power vis-à-vis the multinational enterprise investing in the region. On the other hand, the exploitation of global knowledge linkages tends to be hampered in organisationally thin RIS due to the strength of bonding social capital and the relative homogenous knowledge bases and world views (Westlund and Kobayashi 2013). Too much bonding social capital and region-mindedness lower the likelihood for actors to search for complementary knowledge globally (Fitjar & Rodríguez-Pose 2011, Malecki 2011). Hence, the stylized fact that organisationally thin RIS have little to contribute in a learning economy suggests that they are also badly equipped to attract exogenous knowledge.

Organisationally thin RIS exhibit low levels of knowledge in general. Even if there are a few strong organisations that may attract exogenous knowledge, this would imply that local

spillovers to other organisations in such regions are low because of the general low absorption capacity.

Adding the three dimensions together, organisationally thin RIS are characterised by a high need for exogenous sources but low capacities to attract and absorb knowledge generated elsewhere. This mix explains the difficulties for new path development in the periphery. However, this does not necessarily imply that new path development is impossible in organisationally thin RIS. It has been argued that such RIS may offer room for experimentation due to the lack of pre-existing structures and inertia in the incumbent system that may hold down new growth paths (Simmie 2012). Empirical studies provide evidence for path creation in peripheral areas and underline the importance of exogenous stimuli. This seems very plausible because of the limited endogenous potential in such regions. The key questions are then why exogenous knowledge could be attracted to organisationally thin RIS and why such RIS could simultaneously build up the regional knowledge bases and absorption capacity that would allow for the emergence of a new path.

Arrival of new actors, global knowledge links and new path development

Mudambi and Santangelo (2015) study the arrival of MNEs in peripheral regions and highlight the importance of a dynamic perspective, which also involves building up of local knowledge bases over time. Their starting point is that even in the periphery some untapped knowledge resources may exist, typically bundled within a strong organisation. The first MNE to move to a specific periphery typically acquires a strong local firm and thereby gains control over the most attractive local resources. The first mover provides legitimacy to the location. However, as the resource pool is shallow and the most attractive resources bound by the first mover, the location's knowledge pool becomes less attractive for second movers. Second movers may still consider it valuable to enter the peripheral region, e.g. in order not to miss out on opportunities to supply to the first mover. The investments of the first and second movers, spillovers between them and potentially few local firms, combined with supportive public investments may increase the attractiveness of the location over time and thereby lead to the emergence of a new growth path in the periphery.

Isaksen and Trippel (forthcoming) also show that the arrival of new actors can be essential for new path creation in peripheral regions. In Mühlviertel, one of the least developed regions in Upper Austria, the settlement of several research institutes has over time led to spin-offs, the attraction of other research centres and firms, as well as the establishment of publically funded support infrastructure. In Arendal-Grimstad, located in the Southern part of Norway, two pioneering firms in the electronics sector were established in the early 1960s. Starting with simple contract production, these firms transformed and upgraded over time to automated production lines and advanced software production. The key firms went through merger and acquisition processes, as well as downscaling of foreign owned subsidiaries. Against the backdrop of these dynamics, supporting infrastructure such as new study programmes, a technology park and incubator was established, which created a favourable environment for spin-offs. The two cases show that the arrival of external actors combined with policy support can initiate new growth paths.

As regards the arrival of individual actors, research largely ignores organisational thin RIS. According to Florida (2003), highly qualified individuals tend to cluster in metropolitan areas. However, creative class does not only exist in thick and diversified RIS (Petrov 2007). Furthermore, Williams et al. (2004) find that international labour mobility differs by

profession. While indeed top management professionals and star scientists migrate mainly to world cities and islands of innovation, other professions such as engineers and technicians are spread more evenly because production sites are more dispersed. Moreover, literature on transnational diaspora entrepreneurs illustrates that mobility of individuals can lead to new industrial path development in emerging markets (Saxenian and Sabel 2008, Riddle et al. 2010). Such entrepreneurs bring not only knowledge to the region but are also embedded in global networks that facilitate for instance access to venture capital or access to global markets.

Furthermore, much of the established literature on global knowledge linkages emphasises the complementary effect of localized learning in knowledge rich environments, this is to say organisationally thick regions, and global knowledge linkages (see, for instance, Camagni 1995, Bathelt et al. 2004, Wolfe and Gertler 2004). This line of reasoning implies that organisations in the periphery would face a double disadvantage: on the one hand they lack opportunities for localized learning and on the other hand they will find it more difficult to establish global knowledge linkages. Investigating this dilemma, Grillitsch and Nilsson (2015) find that innovative firms in the periphery tend to collaborate more than comparable firms in the centres, thus compensating for a lack of local knowledge spillovers. However, to move a step further, that is, from strong but possibly isolated firms to new growth paths, additional issues need to be resolved such as the lack of capable regional partner organisations or the lack of qualified labour, that is, the lack of absorption capacity at the regional level. Policy can play an important role in this respect as shown already above (Mudambi and Santangelo 2015, Isaksen and Trippel forthcoming).

As regards informal networks, Saxenian and Sabel (2008) highlight the importance of social ties to emigrants. While traditionally often regretted as wasteful “braindrain”, the authors attribute the development of Taiwan into a global leader in technological entrepreneurship focussed on semi-conductor and computer-related firms largely to the sourcing of knowledge from emigrants, in particular the Taiwanese diaspora in the US. Accordingly, knowledge exchange through these informal linkages was instrumental for informing the responsible government officials about the venture capital industry and supporting the establishment of such an industry. This created a favourable environment for technological entrepreneurship also attracting finance, foreign direct investments and return migration of qualified individuals.

In summary, organisationally thin RIS in general are characterised by the highest need and the lowest attractiveness and absorptive capacity of all three RIS types. However, the stylized facts and general arguments ignore the heterogeneity of regions, strategies and motivations as well as a dynamic perspective that may lead to an upgrading of the knowledge bases in peripheral regions. The seed for the creation of new industrial paths in thin RIS is often found within one or few strong, rather isolated and self-sufficient organisations with global knowledge linkages. As shown empirically, strong and innovative firms can exist even in organisational thin RIS. Furthermore, the arrival of external actors, organisations or individuals, can be the nucleus for a new path development. However, new path development also requires building regional absorption capacity over time. This typically encompasses upgrading the local knowledge and support infrastructure with strong policy support.

4 Summary and Conclusions

Recent scholarly work has essentially increased our understanding of forms, mechanisms and determinants of new path development across regions. Regional industrial change, however, has thus far largely been conceptualised as an endogenous phenomenon, underplaying the transformative capacity of exogenously generated knowledge transferred to regions through various channels. As a consequence, the nexus between the inflow of non-local knowledge and new path development is still poorly understood. This paper sought to contribute to the current debate on regional industrial path development by exploring conceptually and illustrating with empirical examples from the literature the role that exogenous sources can play in path renewal and new path creation.

We identified various forms of exogenous sources of regional industrial change, thus offering a nuanced view by which non-local knowledge can enter regions and trigger or support new path development. A distinction between the *arrival of new organisational and individual actors* (such as firms and research organisations, entrepreneurs, highly skilled researchers and other members of the creative class) and non-local *knowledge linkages* (such as global R&D partnerships, buying of knowledge from non-local sources, participation in trade fairs, and so on) has been drawn.

We advanced the argument that patterns of exogenously led path development vary markedly between RIS types. RIS differ not only in their need for non-local knowledge but also in their capacities to attract, absorb and transform it into new path development. Our conceptual analysis has shown that organisationally thick and diversified RIS are well endowed with endogenous sources of path development and have thus a lower need for relying on exogenous sources. At the same time their capacity to attract and anchor non-local knowledge is rather high. In organisationally thick and specialised and especially in organisationally thin RIS the situation is reverse. In these RIS types the local availability of knowledge is lower, resulting in a higher need for exogenous sources of path development. Their capacities to attract and anchor inflowing knowledge tend to be lower when compared to organisationally thick and diversified RIS. However, we have also shown that these RIS types can enhance their attractiveness for exogenous sources of new path development and they can benefit from the inflow of non-local knowledge if they strengthen their capacity to absorb and transform it into path renewal and new path creation. We have also discussed some illustrative empirical examples to support our claims.

The discussion has also shown that there is a large heterogeneity of regions within each RIS type that is not well covered by stylized facts and general arguments on the role of exogenous sources of path development in various types of regions. A key challenge for future research is to conduct more theoretically informed and empirically grounded research to capture the heterogeneity of regions, provide an in-depth discussion of the ways by which regions can attract and absorb non-local knowledge, identify the important underlying mechanisms through which external energy promotes new path development, and to build deeper analyses of strategies and motivations of stakeholders involved in harnessing exogenous sources of path renewal and new path creation.

The findings of this paper have important policy implications. A first and general conclusion is that policies for new path development should not rely on the activation of endogenous sources and dynamics only but should also focus on attracting exogenous sources. Since the ways by which non-local knowledge supports new path development seems to depend on

regional characteristics, a differentiated policy approach is required. Second, and more specifically, the attraction of exogenous sources is not enough. The absorption capacity needs to be strengthened, too. More often than not this requires a major reconfiguration of the organisational support structures of RIS.

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