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Distance, Proximity and Types of Cross-Border Innovation Systems: A Conceptual Analysis

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Abstract

Due to a lack of both theoretical and systematic empirical work, innovation-driven integration processes in cross-border areas are still poorly understood. Departing from the regional innovation system (RIS) approach, recent work on different forms of proximity, and the literature on cross-border areas, this paper seeks to identify in a conceptual way different stages in the development of cross-border innovation systems and to highlight the main characteristics and barriers characterizing each phase. The conceptual model proposed in this paper can serve as useful framework, guiding more systematic and comparative empirical work on cross-border innovation systems in different regional and national contexts.

JEL codes: O30, R10

Key words: innovation-driven integration, cross-border areas, regional innovation systems
1. Introduction

Due to regionalization processes in many parts of the world, the political and economic transformation in Central and Eastern Europe and the continuing enlargement of the European Union cross-border regions have grown considerably in number and importance in the last years (see, for instance, BLATTER, 2004; NIEBUHR, 2008). There is a widespread agreement in the academic literature that in the emerging globalized knowledge economy the long term competitive strength of these areas will rest on their capacity to create an integrated innovation system. This view is often shared by local and European policy makers and other stakeholders promoting cross-border integration and it goes hand in hand with the intention of the Lisbon strategy to transform Europe into the most dynamic and competitive knowledge-based economy in the world.

However, there are also some reasons to doubt whether the vast majority of cross-border areas will have the capacity to build a common innovation system. Many of them might not be characterized by collective learning systems or by socio-cultural and institutional proximity assumed to be important prerequisites for systemic innovation activities (see, for instance, GERTLER, 2003; COOKE et al., 2004). This is related to the embeddedness of cross-border areas in different national and regional innovations systems (NIS and RIS) and their position and roles in national, regional and urban systems.

The different parts of cross-border regions often show very dissimilar economic histories, technological trajectories, institutional set-ups as well as different social dynamics, political visions, governance structures, modes of regulation and cultural identities (ANDERSON and O’DOWD, 1999; HOSPERS, 2006; LÖFGREN, 2008; JOHNSON, 2009). Such differences can be both a key source of innovation and major barriers for interaction and knowledge
exchange (see also LUNDVALL, 2010). Simultaneously as these differences create the foundation for cross-border growth by offering potentials for new combinations and unexploited synergies, they also form barriers obstructing successful integration, especially when it comes to generate, transmit and share innovation-relevant knowledge (KOSCHATZKY, 2000; HOECKMAN et al., 2009).

From this point of view there are probably ‘easier’ ways to go than following an innovation-oriented growth path. At least in the short run and as a first step of cross-border integration other pathways might be more reasonable. These could include an integration and enlargement of local consumer and factor markets, increase of labor mobility, extended division of labor and specialization. Meanwhile, these more ‘traditional’ integration processes are well understood. Little is still known, however, about the nature of innovation-driven development processes in cross-border areas. Only a few scholars have so far explicitly used the RIS approach for empirically analyzing (COENEN et al., 2004; MOODYSSON and JONSSON, 2007) or conceptualizing (TRIPPL, 2010) integration processes in trans-frontier regions. Undoubtedly, their work has provided interesting insights into innovation activities taking place at the cross-border level. Recent conceptual work done by TRIPPL (2010) is particularly relevant for our article. Looking at five core dimensions of innovation systems, she elaborated on some key determinants of innovation-driven integration processes in cross-border areas. This analysis has to be acknowledged for shedding light on a set of factors that might favor or inhibit the development of a cross-border RIS and for suggesting some first ideas about the relevance of different types of distance in this regard. Although her conceptual framework constitutes an important starting point for our analysis, we go beyond this work in several crucial respects. First, TRIPPL’s (2010) analysis is restricted to identifying hindering and favoring factors for the emergence of cross-border RIS. Our analysis is clearly different in
nature and provides a dynamic perspective on the issue under consideration as our focus is on developing a typology of cross-border RIS that draws a clear distinction between different stages of innovation-driven integration processes. Second, our paper advances the existing body of work by discussing in a far more systematic way and in more detail the role of different kinds of distance and proximity in cross-border regions. Most importantly, we conceptualize various types of proximity and distance as both opportunities for and barriers to cross-border innovation activities. Third, the conceptual model suggested in this paper takes explicit account of the importance of innovation linkages to other spatial scales (including regional, national and international ones).

In this paper it will be argued that cross-border RIS should be seen as the most advanced form of transnational integration, resting upon the success of previous incremental and less innovation-oriented modes of development. The key aim of this article is to develop a conceptual model that draws a clear distinction between these different types of integration. More specifically, by bringing together three strands of literature – the RIS approach, recent insights provided by the ‘proximity school’ and work done on cross-border regionalization – the paper will deal with the following research questions:

- Which stages of cross-border RIS development can be identified in a conceptual way?
- What is the role of physical, cognitive, functional and institutional distance in shaping the opportunities and barriers for cross-border innovation activities and which kinds of proximity and distance are likely to prevail in each stage?

Departing from the RIS approach (see, for instance, AUTIO, 1998; COOKE et al., 2004; ASHEIM and GERTLER, 2005) and its application to cross-border contexts (TRIPPL, 2010)
we will suggest a conceptual framework that allows for identifying different types or stages of trans-frontier innovation systems. Focusing on different concepts of proximity (BOSCHMA, 2005; TORRE, 2008) we will elaborate on a characterization of each stage of cross-border RIS development. Drawing on the literature on cross-border areas, particularly on findings concerning barriers and driving forces connected to different integration processes, will further inform this discussion. This literature is also useful, as it provides some empirical evidence that underlines and supports our conceptual arguments.

The remainder of this paper is organized as follows. Section 2 provides a short literature review on cross-border areas and recapitulates recent insights provided by the ‘proximity school’. Section 3 analyzes in a conceptual way different phases of innovation-driven integration in cross-border areas. Finally, in Section 4, the key arguments are summarized and some conclusions are drawn.

2. Cross-border areas and proximities

2.1. Basic features of heterogeneity

As a starting point for the conceptual discussion we will initially apply a very broad and simple definition of a cross-border region as an area consisting of adjacent territories belonging to different nation states. This broad definition covers all types of cross-border settings regardless of differences in terms of size, geographic conditions, history, culture and socio-economic conditions. The heterogeneity between different cross-border areas is, however, considerable. On the one extreme they can be very extensive in terms of space and population stretching over several nations and including a larger number of regions located in densely populated economic core areas. A prime example for such a setting is the Centrope region with a total population of more than six million inhabitants, consisting of the two
capital cities of Vienna and Bratislava and adjacent regions in Austria, Hungary, Slovakia and
the Czech Republic. On the other hand this definition also covers cross-border areas including
only two neighboring regions with a small population distributed on a large area in the
geographic as well as the economic periphery far away from core national and international
markets. One example for such a cross-border region is the area around the twin cities of
Haparanda and Torneå located along the northern part of the Swedish and Finish border.
Between these two extreme cases there is wide range of cross-border regions showing a
considerable variation in basic geographical preconditions in terms of scale, size and location,
engendering primary restriction of what kind of integration is likely to occur and what types
of benefits might be related to different integration processes.

Furthermore, the magnitude and character of internal heterogeneity in cross-border areas will
have a strong impact on the possibilities for and constraints to the emergence of an integrated
socio-economic system. Many cross-border regions tend to show very dissimilar economic
histories, technological trajectories and innovation capacities, institutional set-ups and
positions in the regional system of their respective nations, as well as different social
dynamics, political visions, governance structures, modes of regulation and cultural identities
(ANDERSON and O’DOWD, 1999; TRIPPL, 2010). To a certain extent these differences
create the foundation for cross-border growth. They might give rise to complementarities and
synergies which could be capitalized on through interaction. Potential benefits might be
related to an integration and enlargement of local consumer, labor and factor markets,
enhanced competition, extended division of labor and increased specialization. Such
processes could lead to shared growth effects and new opportunities for upgrading the
competitive edge of the economy on both sides of the border. Simultaneously as some of
these differences create the main driving forces for cross-border growth, they could also form
barriers hindering successful integration. Thus, in addition to the political-administrative
borders also economic, cultural and social borders tend to further divide these areas
(ANDERSON and O’DOWD, 1999; SMALLBONE et al., 2007; LÖFGREN, 2008).

2.2. The complexity of integration processes in cross-border regions

Cross-border regionalization is a multi-faceted and complex phenomenon. It takes shape
along nation state boundaries and requires contacts and partnership between public as well as
private actors across borders. The process takes place in what could be labeled as a ‘grey
zone’ between civil and public law in combination with the emergence of informal and formal
networks between a wide spectrum of actors, ranging from the single citizen and firm to
universities, industrial organizations, trade unions, political parties and cultural organizations
(JÖNSSON et al., 2000). The overall concern of the importance of increased cross-border
integration and the different ways to achieve it can be assumed to vary among the actors,
reflecting conflicting goals and asymmetry in power relations (JOHNSON, 2009).

Furthermore, all these stakeholders are more or less strongly embedded in or have relations to
other spatial scales, from the local community to the global level. This historically rooted
embeddedness shapes routines that will govern the actors’ decisions in general, for instance a
firm’s decision about what to produce, when and how, investment decisions and search
behavior for networking partners (NELSON and WINTER, 1982; NELSON, 1995; 2008). In
many respects these routines will also frame the actors’ potential ‘cross-border behavior’.

Furthermore, as noted above, the driving forces for cross-border integration processes, i.e., the
differences in economic structure, innovation capabilities and cost structures giving rise to
new complementarities and synergies, could also constitute major barriers to interaction
between the different parts of a cross-border region. Consequently, to consider and analyze
this tension and interplay between differences working as driving forces on the one hand and as barriers on the other, is essential for enhancing our knowledge about cross-border integration processes. A crucial point of departure for understanding cross-border integration in general and the formation of cross-border innovation systems in particular is to uncover the role of different types of proximity and distance and to explore how they have an influence on what kinds of linkages are likely to be established.

2.3. Distance and proximity

Recent research findings generated by the ‘proximity school’ (BOSCHMA, 2005; TORRE, 2008) provide a useful foundation for conceptualizing and categorizing different types of differences between the constituent parts of a cross-border area and to discuss their impact on potentials for and crucial impediments to cross-border knowledge interactions. Following the literature, three main categories of proximity, i.e. physical, functional and relational proximity, could be identified as central for this understanding (TORRE and GILLY, 2000; MOODYSSON and JONSSON, 2007; TORRE, 2008). Physical proximity is closely related to the geographical dimension of agglomeration economies, transaction and transportation cost. When it comes to the exchange of knowledge (especially tacit one) which depends on face-to-face contacts the accessibility dimension could be assumed to be very important. As underlined in the literature it has less to do with pure distance measured in kilometers between different actors, but with the efforts it takes for them to interact in terms of time and costs. This could depend on several factors, for instance, the quality of the transport infrastructure and political-administrative set ups that facilitate or hinder mobility of goods and people. The construction of the fixed link between Sweden and Denmark is one example where investments in infrastructure have had a strong impact on reducing the physical distance between different parts of the cross-border area of the Oresund. In the case of
Centrope, the fall of the iron curtain, followed by the EU-membership of the former Eastern countries and finally the Schengen Treaty have gradually decreased the physical distance between different parts of this area triggering the same kind of hope as in the Oresund region: new possibilities for the creation of a powerful international competitive cross-border region. Functional distance (MAGGIONI and UBERTI 2007) refers to differences between regions in innovation performance. MAGGIONI and UBERTI (2007) showed that knowledge does not flow easily between areas, if they differ strongly in their innovation capacity. Consequently, a strong asymmetry in performance and capability (i.e., too much functional distance) will limit the opportunities for mutual advantages of integration. Finally, the notion of relational proximity could be used as an umbrella term for a number of non-tangible dimensions discussed in the literature, for instance cognitive, organizational, social, institutional, cultural and technological proximity (see, e.g., TORRE and GILLY, 2000; BOSCHMA, 2005; MOODYSSON and JONSSON, 2007). Relational proximity is associated with the structures, relations and processes that originate, for instance, from the social dynamics, governance structures, regulation and cultural identities that together comprise the embeddedness of social action (GRANOVETTER, 1985). In a growing body of literature (GERTLER, 2003; BOSCHMA, 2005; STERNBERG, 2007) on relational proximity the discussion is centered around the importance of shared norms, institutions and regulation, mutual understanding, trust and codes of conduct and shared organizational and technological cultures for collaboration and knowledge exchange. A certain degree of relational proximity between key actors is a necessary condition for a fruitful knowledge exchange and collaboration in a cross-border area. In the conceptual model discussed in section 3, special attention will be given to the importance of the cognitive and institutional dimension of relational proximity. The cognitive dimension (NOOTEBOOM, 2000; NOOTEBOOM et al., 2007) is about the fine balance between being so close in terms of knowledge bases and technical know-how that the
partners are able to cooperate efficiently, but far away enough to learn something new through cross-fertilization and the exploitation of new complementarities. Good levels of ‘related variety’ (FRENKEN et al., 2007) defined in this sense can be regarded as key drivers of economic growth and innovation in cross-border regions. The institutional dimension of relational proximity reflects the significance of differences in both formal and informal institutions, laws, regulations and also differences in culture and language (BOSCHMA, 2005).

The relation between the three main types of proximity is complex (for a further discussion see e.g., COENEN et al., 2004; BOSCHMA, 2005; MOODYSSON and JONSSON, 2007). Physical proximity, for example, could in some cases be an important facilitator of relational proximity; in other cases relational proximity can emerge totally detached from physical proximity. The latter case is in line with GRANOVETTER’s (1985) geographically unbounded view of the concept, where embeddedness can emerge regardless of physical proximity (MOODYSSON, 2008). This aspect is important to remember in the discussion of cross-border areas. Being geographically close does not automatically mean that relational proximity abounds. More fruitful alternative relations might be found elsewhere. However, cross-border areas where physical, functional and relational proximity coincide might become major places of new knowledge generation and dynamic learning. It is this interplay between certain degrees of physical proximity and appropriate levels of functional and relational proximity that under certain circumstances shape a unique competitive advantage of cross-border regions compared to other spatial units. Furthermore, it is vital to understand cross-border regions in terms of their relations to and dependence on other spatial scales rather than concentrating only on their internal conditions. The embeddedness of actors and organizations in existing and historically evolved RISs and NISs as well as the importance of international
linkages must be taken into consideration. These already established linkages on both sides of
the border have been created under similar constraints of physical, functional and relational
proximity and will influence the character of new potential cross-border linkages. From this
point of view it is important to take into consideration to what extent the exploitation of
potential cross-border linkages will be affected by the quality and strength of existing
linkages embedded in other geographical scales. It is still unclear in what ways cross-border
integration reinforces, complements, changes, challenges or even substitutes existing relations
and linkages.

3. Stages of cross-border RIS development
This section departs from the RIS concept (AUTIO, 1998; COOKE et al., 2004; ASHEIM and
GERTLER, 2005) and identifies in a conceptual way different stages in the development of
cross-border innovation systems. TRIPPL (2010) who applied the RIS approach to cross-
border settings, suggested to analyze five different RIS elements and dimensions to
disentangle those factors that influence a cross-border region’s potential for joint innovation
activities. RISs are considered to be made up of a subsystem of knowledge generation &
diffusion including R&D organizations, educational bodies and technology transfer agencies
(RIS dimension ‘science base/knowledge infrastructure’), and a subsystem of knowledge
application & exploitation comprising the companies and clusters located in the region (RIS
dimension ‘economic structure/specialization pattern’). Intensive flows of knowledge,
resources and human capital within and between these subsystems (RIS dimension ‘nature of
linkages’) are regarded to be pivotal, constituting the foundations for systemic innovation.
The regional policy subsystem (RIS dimension ‘policy structures’) is often acknowledged to
be another important RIS element. Finally, the specific institutional and socio-cultural setting
prevailing in the region (RIS dimension ‘institutional set-up’) is ascribed to play a significant
role. It covers both formal institutions such as laws and regulations and informal institutions like routines, conventions and habits which have an impact on the behavior of and relations between actors and organizations.

Focusing on these different RIS dimensions and on the role of various types of proximity, in the following we will discuss a conceptual framework that draws a distinction between different stages of cross-border RIS evolution.

[Figure 1 about here]

To guide the discussion, three ideal types of cross-border settings are identified (see Figure 1) which represent different degrees of integration: weakly integrated systems (stage I), semi-integrated systems (stage II) and strongly integrated systems (stage III). In the following we will pinpoint basic conditions characterizing each stage regarding the main RIS dimensions identified above, i.e., economic structure, science and knowledge bases, nature of linkages, institutional set-ups, and policy structures. Furthermore, we add the dimension ‘accessibility’ to take into account the degree of physical proximity.

As shown in Figure 1, the linkages to other geographical scales as well as the effects of different barriers are crucial for understanding the character and magnitude of cross-border integration in each stage. Furthermore, two points should be underlined. Firstly, the three stages represent ideal types. In the real world the distinction between the three stages might not be as clear-cut as in our conceptual model. Cross-border areas which, for instance, display
semi-integration in one dimension, can be more or less strongly integrated in other
dimensions. Secondly, although we will discuss conditions for further development this does
not imply that cross-border areas move necessarily or automatically from one stage to the next
one. Table 1 summarizes the main features of the three ideal types of cross-border innovation
systems.

[Table 1 about here]

3.1. Stage I: Weakly integrated systems

Weakly integrated systems are characterized by low levels of cross-border economic relations
in general and a lack of knowledge interactions and innovation linkages in particular. Various
‘Euroregions’ seem to represent a case in point in this respect (HASSINK et al., 1995; VAN
GEENHUIZEN et al., 1996). Integration processes – if any exist or develop at all – show a
dominance of asymmetric cost-driven linkages, mainly exploiting internal price and cost
differences. Such an asymmetric pattern of integration has been reported in several analyses
of cross-border regions (see, for instance, the work by KRÄTKE (1999) and KRÄTKE and
BORST (2007) on the German-Polish border area or the study done by TRIPPL (2008) on the
Centrope region). There are two main reasons for such a situation, i.e. lack of synergies and
under-exploitation of synergies.

Lack of synergies: Non-integration can be the outcome of missing synergies for cross-border
linkages. On the one hand, too strong differences in the scientific specialization, knowledge
bases, and economic structures (i.e. cognitive distance) make interaction useless, because
none of the involved regions can draw benefits from integration. On the other hand, if the regions are too similar in terms of their knowledge bases (reflecting too much cognitive proximity) also little can be learnt from interaction. Consequently, the potential benefits that result from establishing relations and investing in new cross-border linkages can be assumed to be rather low compared to those which are likely to result from further developing and capitalizing on already existing links with actors at other spatial scales. If sub-optimal levels of cognitive distance are the main reason for missing linkages, at least in the medium term, the prospects for the development of more advanced and interactive knowledge interactions are poor, regardless if it is possible to the remove other types of barriers. Absence of synergies might also be the consequence of too high levels of functional distance. Although there might be some similarities in the scientific or economic specialization pattern there is no interaction because the regions differ too strongly in their respective innovation capabilities, performances and receiver competences. For the strong region little can be learnt from the weak region, whilst the weak regions might potentially learn a lot but might miss the absorption capacity. Such a constellation has been observed for example in the US-Mexican border region (SCOTT, 1999) and in the Centrope area (TRIPPL, 2008). Consequently, functional distance results in an unequal distribution of benefits from interaction and is closely related to the problem of absorptive capacity. Barriers related to functional distance can take decades to erode if ever. One key point in this respect is whether or not the form of asymmetric cost-driven integration can also generate a certain amount of learning for and knowledge spillovers to the weak side of the border. FDI activities, mobility of managers and key labor in general might be important mechanisms in this regard.

Under-exploitation of synergies: Some cross-border areas exhibit potentials for synergies in innovation, but several kinds of distance create borders and prohibit actors to establish
contacts and capitalize on the learning potential. Physical distance might have such effects. If
the accessibility is restricted (resulting in high time costs to cross the border), the possibilities
for exploiting potential synergies connected to enlarged and enhanced agglomeration
advantages may be jeopardized. This type of distance could be one of many reasons for a low
level of linkages and flows in general. Furthermore, a high degree of physical distance has a
negative influence on knowledge linkages and learning processes which often contain a large
proportion of tacit knowledge and therefore require frequent face-to-face contacts. The
importance of physical proximity has been highlighted in many cross-border studies,
especially in relation to debates about the benefits or drawbacks of new infrastructure
investments in cross-border regions (see, for example, the case of the Oresund region
documented in MATTHIESSEN, 2004). Arguably, barriers resulting from physical distance
can be easier dealt with than those resulting from cognitive and functional distance. New
investment in infrastructure or minimizing the cost to use it for crossing the border will for
instance have a positive impact on accessibility.

Furthermore, various manifestations of institutional distance can lead to an under-exploitation
of synergies. This could include differences in both hard institutions such as laws and
regulations and soft institutions such as the lack of a common culture and language (VAN
HOUTUM, 1998; KLATT and BRÖCKER, 2006). Weakly integrated systems are often
categorized by institutional thinness depending on very few cross-border institutions and the
absence of trustful cross-border ‘leadership’, reflecting a lack of legitimacy (HALL, 2008)
and conflicting goals between different actors. One important aspect of this is, for instance, a
low or asymmetric support and interest from the involved nation states (see JOHNSON’s
(2009) insightful study on cross-border co-operation between Eastern Germany, Western
Poland and the Northern Czech Republic). Strong forms of embeddedness of actors in their
RIS and NIS or in other contexts and relations might also be a powerful impediment. Such well-established, long lasting and trust-based linkages have many advantages for actors and organizations, including lower search costs and a reduction of uncertainty due to strong social proximity. Consequently, actors who are inserted in such well-established links might be less prone to create new ones at the cross-border level.

The combination of institutional thinness and strong forms of embeddedness on the one hand and a very low social acceptance of building a cross-border region among firms and citizens on the other hand will not only be a barrier to many forms of integration. It will also shape a very weak cross-border identity, and it has an influence on the positioning of the cross-border region in the global arena (HOSPERS, 2006). This means that it is more or less impossible to ‘brand’ the cross-border area as an attractive location for foreign direct investment.

3.2. Stage II: Semi-integrated systems

In semi-integrated settings we might observe what can be referred to as an emerging knowledge-driven system. Such systems feature decreasing levels of asymmetry and provide opportunities for new and more mutual beneficial linkages on both sides of the border. In addition to links drawing on pure internal price-cost differences resulting in increased economies of scales and the opening up of new markets, there are also windows of opportunities leading to economies of scope and increased cross-border learning processes in a few selective parts of the economy. These more interactive linkages can be observed in narrow segments of the science base and economic structure where good levels of cognitive and functional proximity prevail. Consequently, in semi-integrated systems we might find a few networked cross-border clusters exhibiting such sound degrees of cognitive and functional proximity (see, for instance, the case of the Canada-US cross-border region of
Cascadia (Pacific North West) as described by BRUNET-JAILLY (2008). Innovation networking, however, is not a system-wide or region-wide phenomenon yet, but occurs in these few clusters only. In this stage of development, thus, one might identify innovative cross-border clusters but not a coherent trans-frontier innovation system. Apart from networking in a few clusters, cross-border knowledge links are still of subordinate importance when compared to linkages to other contexts.

The emerging knowledge-driven form of integration could also be partial in the sense that it only includes single steps in an innovation process as indicated by MOODYSSON and JONSSON (2007) in their empirical analysis of the biotechnology sector in the Oresund area. Furthermore in semi-integrated systems the linkages are also likely to be geographically concentrated to selective parts of the cross-border area and leaving out others, as indicated by an analysis of the internal heterogeneity of the Oresund region where only the core parts on both side of the border seem to have some degree of appropriate functional and cognitive proximity (LUNDQUIST and WINTHER, 2006).

These innovation activities of the cross-border area could be described as rather isolated ‘islands of innovation’ in an otherwise fragmented cross-border innovation system. However, these small segments of the economy could be important role models and drivers of change. Actors who are involved in such processes might turn into what LÖFGREN (2008) has called ‘regionauts’. Through their daily experience in working in a cross-border area they are able to identify the barriers in terms of accessibility, institutions, laws, regulation and also trustfully suggest how these could be transformed or removed in order to facilitate further cross-border integration.
Compared to stage I, physical accessibility is no longer a major obstacle for interaction. We might observe an increase of exchange of students, researchers, highly qualified people, scientific collaborations, university-industry partnerships, and enhanced institutional networking. Interaction at the cross-border level becomes essentially promoted by the emergence of bridging-organizations (often related to areas where good levels of functional and cognitive proximity exist), an increasing societal acceptance of cross-border projects and a growing consensus among different actors about potential benefits of increased integration.

3.3. Stage III: Strongly integrated systems

This stage of cross-border RIS development represents the most advanced form of innovation-driven integration. We look at an ideal type of integration, where the distinct RIS in the constituent regions of the cross-border area become more and more melted into a single one. Strongly integrated trans-frontier RIS are characterized by a considerable flow of knowledge, expertise and skills across the border, brought about by a high intensity of mobility of students and labor, innovation related networking among firms, academic collaborations, university-industry partnerships, etc. These knowledge interactions have reached a level at which they form a central underpinning of the innovation performance of the cross-border region. This does not mean that innovation linkages at other spatial scales have lost in significance. The argument is that cross-border innovation linkages have grown in strategic importance and are no longer subordinate when compared to other innovation linkages. These linkages reflect the existence of substantial synergies for cross-border interaction and learning. Such synergies result from the co-existence of high levels of functional proximity (i.e. similar high levels of innovation abilities and knowledge generating capacities) and optimal levels of cognitive distance (related variety) in both the business systems and the knowledge bases. In contrast to stage II such synergies could not only be found in a few
fields, but in many economic and scientific sectors. Consequently, we might observe a
dynamic evolution of several fully developed and highly innovative cross-border clusters with
strong collective learning mechanisms.

Strongly integrated cross-border RIS do not only provide good synergy potentials as they
have been described above, but they offer also favorable conditions which enable and support
actors to make effectively use of them. They exhibit an excellent transportation and
communication infrastructure, thus, allowing for easy accessibility and interaction (physical
proximity). Furthermore, other kinds of borders and barriers have been dismantled rather
successfully, allowing for the establishment of cross-border interactions. Arguably, most
critical and difficult to reach in this context is a good level of institutional proximity in the
cross-border area. We might observe a high societal acceptance of building a strongly
integrated cross-border RIS, probably even a gradual emergence of a common culture and
identity and a high density of bridging institutions which help to deal with socio-institutional
and cultural barriers (like differences in language) which might never vanish. A key feature of
stage III is, indeed, that solving common problems at the cross-border level is becoming part
of normal life, seeking and mobilizing knowledge that is available at the other side of the
border are turning into routine activities and cross-border RIS development is widely accepted
in business, academic and other societal spheres. Such processes are tightly connected to
advanced forms of cross-border political governance (PERKMANN, 1999, 2003, 2007;
GUALINI, 2003). In strongly integrated RIS we might find fully working cross-border
governance structures and high levels of institutional thickness. There are not only many
organizations and policy actions geared towards innovation-driven integration, but they form
a coherent whole and reflect a successful implementation of institutionalized and stable
mechanisms for long-term policy coordination. Specialized organizations responsible for
steering cross-border issues and a common innovation strategy and policy might be essential elements in this regard. In the best case we find transparent and democratic structures which allow for inclusive forms of governance and civic participation (see also the respective claims made by HALL, 2008) and which are vital for the emergence of societal acceptance and a common identity at the cross-border level. From a conceptual point of view, this final stage could be referred to as the ‘utopia’ of cross-border region building. Whilst some areas might succeed in reaching stage III in a few dimensions, in the real world it is probably very hard for most cross-border regions to meet the final stage in all dimensions outlined above. However, the utopian world of stage III might play a powerful role in the development of visions, animating and guiding actors in search for enhancing innovation-driven integration processes.

4. Conclusions

Cross-border regionalization is a multi-faceted and complex phenomenon. Firstly, there is a wide range of cross-border regions showing a considerable variation in basic geographical preconditions in terms of scale, size and location causing primary restriction of what kind of integration is likely to occur and what types of benefits can result from different integration processes. Secondly, cross-border regionalization is a process taking place in a ‘grey zone’ between civil and public law in combination with the emergence of informal and formal interaction among diverse organizations and actors. The overall interest in increased cross-border integration and the ability to engage in such processes can be assumed to vary among the actors reflecting conflicting goals and asymmetry in power relations. Thirdly, these stakeholders are more or less strongly embedded in or have relations to other spatial scales, from the local community to the global level. This historically rooted embeddedness has an influence on the actors’ decisions in general and on their ‘cross-border behavior’. Fourthly,
the driving forces for cross-border integration processes, e.g. the differences in economic structure, innovation capabilities and cost structure give rise to new complementarities and synergies, but often also generate the barriers that exist between the different parts of a cross-border region. Consequently, this tension and interplay between differences working as driving force on the one hand and as barriers on the other hand is crucial for understanding cross-border integration processes. As argued in this article, an essential point of departure to enhance our knowledge about cross-border integration in general and cross-border RIS development in particular is to uncover the role of different types of proximity and distance, and to explore how they influence driving forces and barriers and determine what linkages are likely to be established.

There is a consensus in both academic and policy circles that in the globalizing knowledge economy the long term competitive advantage of cross-border areas will be based on their capacity to create a common innovation system. As a general statement this is a rather undisputed one. However, a crucial question raised in this paper is how achievable this is for most cross-border settings as many of them are not characterized by the collective learning systems or the socio-cultural proximity that are assumed to be important prerequisites for successful innovation systems. In order to unleash this paradox, we suggested a conceptual model that distinguishes between three ideal stages of cross-border integration: weakly integrated systems (stage I), semi-integrated systems (stage II) and strongly integrated systems (stage III). To summarize, the three types are characterized by very different levels of physical, functional, cognitive and institutional proximity which in turn lead to very different possibilities for cross-border knowledge interactions to emerge. Cross-border RIS constitute the most advanced form of cross-border region building and will often be based on the success of previous incremental and less advanced modes of integration.
The conceptual model suggested in this article could constitute a useful theoretical background, guiding systematic and comparative empirical work on the development of cross-border innovation systems in different national and regional contexts. So far, empirical studies have only looked at single dimensions of cross-border RIS development and neglected others. Our model could serve as a conceptual framework for empirical work that takes into account several dimensions and their interplay. Such empirical studies might also lead to conceptual adjustments.

Finally, the conceptual analysis provided in this paper might also have far-reaching policy implications. There are at least two broad and general conclusions for policy which can be drawn immediately. First, the opportunities and prospects for successful policy interventions in cross-border RIS formation are subject to the types of barriers and sub-optimal levels of proximities prevailing in a specific cross-border setting. Whilst physical distance and some manifestations of institutional distance (particularly laws and regulations) can be dismantled rather easily, cognitive distance and differences in culture or language will probably never vanish or could be reduced only in the long term, requiring enormous efforts on the part of policy actors and other stakeholders. Second, our work on different stages of cross-border RIS development challenges any uniform policy models for promoting innovation-driven integration in cross-border regions and provides essential foundations for more tailor-made policy approaches. Arguably, the role of policy can be expected to differ strongly, depending on the respective phase of cross-border RIS evolution. In weakly integrated systems (stage I) which suffer from massive differences (particularly in terms of functional and cognitive distance) between adjacent regions, it might be more efficient for policy actors to address other issues than promoting cross-border innovation-driven integration. The lack of synergies
calls for a ‘hands off’ policy approach. The situation is clearly different, if poor integration results from unexploited synergies. Weakly integrated systems (stage I) of this type require a very proactive policy approach oriented on removing various forms of impediments in different RIS dimensions. Promoting a socio-cultural shift towards a stronger acceptance of cross-border integration processes, establishing cross-border governance structures, improving transport infrastructure and thus accessibility might be key policy tasks. Furthermore, fostering knowledge interaction in a few fields which could serve as role models for other sectors should be on the policy agenda. To be sure, to support a transition of a weakly integrated system towards a more innovation-driven one is outstandingly challenging, calling for comprehensive measures and – given the long time span which such a transformation requires – a ‘patient’ policy system. In later phases of cross-border RIS evolution, there is a need for adjusting the innovation policy portfolio. A further strengthening of ongoing integration efforts in the economic, scientific, institutional and socio-cultural spheres, and broadening and deepening cross-border learning processes will become key policy tasks. Elaborating more on specific and adequate policy approaches required for different stages of cross-border RIS development and dealing explicitly with the question how crucial policy making is for the transition from one stage to the next one are worthy subjects for further research.

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Table 1: Characteristics of different stages of cross-border RIS integration

<table>
<thead>
<tr>
<th>RIS dimensions</th>
<th>Stage I</th>
<th>Stage II</th>
<th>Stage III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymmetric cost-driven system</td>
<td>Emerging</td>
<td>Symmetric</td>
<td></td>
</tr>
<tr>
<td>(Weakly integrated)</td>
<td>knowledge-driven system</td>
<td>(Semi-integrated)</td>
<td>(Strongly integrated)</td>
</tr>
<tr>
<td>Economic structure / specialization pattern</td>
<td>Strong differences in specialization</td>
<td>Emerging synergies and complementarities</td>
<td>Related variety,</td>
</tr>
<tr>
<td></td>
<td>(lack of synergies)</td>
<td>(cognitive proximity) and functional proximity in a few business areas</td>
<td></td>
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<tr>
<td></td>
<td>Functional distance</td>
<td>Functional distance</td>
<td>Functional distance</td>
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<tr>
<td></td>
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<tr>
<td>Science base / knowledge infrastructure</td>
<td>Strong differences in specialization</td>
<td>Fruitful synergies and complementarities</td>
<td>Related variety,</td>
</tr>
<tr>
<td></td>
<td>(lack of synergies)</td>
<td>(cognitive proximity) and functional proximity in a few scientific fields</td>
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<td></td>
<td>Functional distance</td>
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</table>
Nature of linkages

- Cost-driven asymmetrical linkages
- Lack of knowledge flows
- Strong embeddedness in established RIS / NIS / international linkages

Institutional set up

- High degree of (hard & soft) institutional distance
- Institutional thinness at the cross-border level
- Low acceptance of cross-border integration processes

- Decreasing asymmetry → interactive links in selected fields
- Links to existing RIS / NIS / global level more important

- Decreasing levels of (hard & soft) institutional distance
- Rise of institutional set-up at the cross-border level
- Increasing acceptance of

- Intensive cross-border knowledge exchange
- Reshaping the importance of established links
- Low levels of (hard & soft) institutional distance / remaining distances mediated by specialized bridging organizations
- Institutional thickness at the
<table>
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<tr>
<th></th>
<th>Building a common cross-border region</th>
<th>High acceptance of creating a common innovation system</th>
</tr>
</thead>
</table>

**Policy structures**
- Absence of policy ‘leadership’ with vision & lack of legitimacy
- Low or asymmetric support from nation states
- Emergence of mechanisms for coordination of innovation policies
- Transparent & democratic governance structures
- Inclusive forms of governance & civic participation

**Accessibility**
- Low / medium degree of physical proximity
- Medium / high degree of physical proximity
- High degree of physical proximity

Source: Own compilation
Figure

Figure 1: Ideal types of different levels of cross-border integration

Source: Own compilation