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Policy options for constructing cross-border innovation systems

Draft version
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Abstract

This paper deals with policy options for constructing cross-border innovation systems. Trans-frontier cooperation and policies to stimulate increased interaction between neighbouring regions that belong to different nation states are not new phenomena. There is a large body of work on the governance structures of such areas and the array of public policies geared towards promoting increased economic integration. Little has been said so far, however, about the nature of policies that could stimulate the innovation dynamics of cross-border regions. This issue is critically important, because in the contemporary era of the globalizing knowledge economy the competitiveness of these regions will – at least in the long run – depend on their capacity to develop a common innovation system. Arguably, cross-border regions differ markedly in their preconditions and abilities to create such systems. Recent research has enhanced our understanding of different types (or stages) of cross-border RIS and the role played by suboptimal levels of distance – including physical, cognitive, functional and institutional ones – as barriers to the flow of knowledge across borders. What remain less understood are the policy implications that result from these insights. The paper intends to shed some light on the role of policy in constructing a cross-border RIS by addressing the following research questions. Do suboptimal levels of distance constitute rationales for innovation policy and demand specific policy actions? What are adequate policy strategies for different stages of cross-border RIS development?

Key words: cross-border regions, distance, innovation policy

1 Introduction

This paper is concerned with policy options for constructing cross-border innovation systems. Trans-frontier cooperation and policies to stimulate increased interaction between neighboring regions that belong to different nation states are not a new phenomenon. In Europe, since the 1990s the INTERREG program and other policy actions have essentially stimulated the formation of cross-border areas in the Western part of the continent. More recently, the fall of the iron curtain has led to the emergence of a new generation of cross-border regions located at the intersection of old and new member states of the European Union. In the meantime there is a considerable body of work dealing with the governance structures of such areas and the array of public policies geared towards promoting increased economic integration (see, for instance, Perkmann 1999, 2007). Little has been said so far, however, about the nature of policy approaches that could stimulate the innovation dynamics of cross-border regions and contribute to the formation of a common innovation space. This issue is of critical importance, because in the contemporary era of increased global competition and the emergence of the knowledge economy the competitiveness of these regions will – at least in the long run – depend on their innovation capacity and their ability to continuously upgrade the economy. A unique option in this respect for these regions may be to establish and strengthen a common innovation system.

Arguably, there are strong reasons to assume that cross-border regions differ markedly in their preconditions and abilities to create a common innovation system (Trippel 2010; Lundquist and Trippel 2011). Recent research has suggested that three main types (or stages) of cross-border RIS can be distinguished in a conceptual way (Lundquist and Trippel 2011). Furthermore, it was argued that suboptimal levels of distance – including physical, cognitive, functional and institutional ones – can form severe barriers for the flow of talent, knowledge and expertise across borders (Trippel 2010, Lundquist and Trippel 2011). What remain less understood are the policy implications that result from these insights. The paper intends to shed some light on the role of policy in constructing a cross-border RIS by addressing the following research questions:

- Do suboptimal levels of proximity or distance constitute rationales for innovation policy and which tasks for policy can be derived from manifestations of distance that prove to be hostile to cross-border innovation?
- What are adequate policy strategies and actions for different stages of cross-border RIS development?

The remainder of this paper is organized as follows. Section 2 provides a short summary of the recent discussion about various types of cross-border RIS and the role of different kinds of proximity in the development of such systems. In section 3 we identify policy options and strategies for cross-border RIS. Finally, in Section 4, we summarize the most important arguments and draw some conclusions.

2 Distances, proximities and types of cross-border RIS

2.1 Distance and proximity: opportunities or barriers for cross-border innovation?

Cross-border regions – i.e. areas that consist of adjacent territories which belong to different nation states – vary considerably in terms of size, location, history, culture and socio-economic conditions. These conditions have a strong influence on the nature of cross-border relations in a cross-border area. Research on cross-border regions has shown that many of these areas are characterized by internal heterogeneity, that is, differences between its constituent parts in terms of economic histories, technological trajectories and innovation capacities, institutional set-ups, governance structures, modes of regulation, cultural identities and positions in the regional system of their respective nations (Anderson and O'Dowd, 1999; Tripl, 2010).

This heterogeneity can have both positive and negative effects on collective learning and innovation outcomes (Lundvall 2010; Lundquist and Tripl 2011). Differences and diversity in various dimensions between agents and regions can be a key source of cross-border innovation, pointing to complementarities and synergies. 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. But at the same time, differences constitute what has been termed 'economic, cultural and social borders' (Anderson and O'Dowd, 1999; Löfgren, 2008), i.e. they are essential impediments to interactive learning and cross-border integration processes.

The 'proximity school' (Boschma, 2005; Torre, 2008) provides a useful perspective to categorize different kinds of differences between adjacent regions and to grasp their potentially ambiguous role as both driving forces and crucial barriers of cross-border innovation processes. Drawing on this work, Lundquist and Tripl (2011) distinguish between three main types of distance:

- **Physical distance:** This type of distance is related to the geographical dimension of agglomeration economies, accessibility, and transaction and transportation cost. Physical proximity plays an important role when it comes to the transfer of tacit knowledge which is best transmitted through face-to-face interaction. It is not only a matter of pure distance measured in kilometers between different actors. The efforts it takes for them to interact in terms of time and costs are critical here. Therefore, much depends on the quality of the transport infrastructure and political-administrative set ups that facilitate or hinder flows of goods and people.
- **Functional distance:** This type of distance refers to differences between regions in innovation performance (Maggioni and Uberti 2007). It has been shown 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.
- **Relational proximity:** The notion of relational proximity covers a set of non-tangible dimensions such as cognitive, organizational, social, institutional and cultural

proximity (Moodysson and Jonsson 2007). It points to the structures, relations and processes that originate from the social dynamics, governance structures, regulation and cultural identities that together comprise the embeddedness of social action (Granovetter, 1985). In the conceptual model discussed below, 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’ defined in this sense are regarded as key drivers of economic growth and innovation (Frenken et al., 2007). The institutional dimension of relational proximity reflects the significance of differences in both formal and informal institutions, i.e. laws, regulations, culture, language, codes of conduct, etc. (Gertler 2003; Boschma 2005; Sternberg 2007).

The relation between the three main types of proximity is complex (Boschma, 2005). Physical proximity, for instance, can facilitate the emergence of relational proximity; in other cases relational proximity can emerge independently from geographically proximity. This aspect is highly relevant for discussing the potentials of cross-border areas. Geographic proximity in such areas does not automatically mean that relational or functional proximities abound. However, cross-border areas where physical, functional and relational proximity coincide might become major places of innovation. It is this interplay between physical proximity and appropriate levels of relational and functional proximity that – under certain circumstances – can shape a unique competitive advantage of cross-border regions compared to other spatial units. This unique competitive advantage is not necessary only a result of a successful merger of the internal resources of two separate RIS. In addition, especially in the long run, the emergence of cross-border RIS have the potential to gradually decrease distances between the different national innovation systems of the cross-border area. As a second round effect of successful integration processes this might lead to short cuts and pipelines to additional resources and unexpected synergies reinforcing the dynamics of the internal processes taking place in the cross-border area. This “bridging” function to other spaces might be as important as synergies and complementarities gained from endogenous processes in the cross-border region and will probably also form an important factor in avoiding future lock-in. From this point of view, 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 in existing and historically evolved RISs and NISs as well as the importance of international linkages must be taken into consideration. It is little understood, however, to what extent new cross-border links reinforce, complement, or even substitute existing relations at other spatial scales.

2.2 Stages of cross-border RIS development

In this section we apply the RIS approach to cross-border areas and we identify essential preconditions, driving forces and barriers for the development of innovation systems in these geographical settings. According to the protagonists of the RIS concept (Cooke al., 2004; Asheim and Gertler, 2005) the innovation capacity of regions depends on the interplay of different RIS elements and dimensions. RISs are made up of a subsystem of knowledge generation & diffusion (science base/knowledge infrastructure dimension) including R&D organizations, educational bodies and technology transfer agencies, and a subsystem of knowledge application & exploitation (economic structure/business dimension) comprising

the companies located in the region. There is an agreement in the literature that intensive flows of knowledge, resources and human capital within and between these subsystems (relational dimension) are of crucial significance, giving rise to systemic innovation activities. The regional policy subsystem (governance dimension) promoting innovation, networks and cluster building constitutes another important RIS element (Tödtling and Trippel 2005). Finally, the institutional and socio-cultural set-up of a region (socio-institutional dimension) plays 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 the RIS actors and organizations.

The insights into the basic structuring of a RIS just outlined above and the academic discussion about the influence of various kinds of distances on innovation (see Section 2) provide essential foundations for conceptualizing the development of cross-border innovation spaces. In the remainder of this section, we briefly recapitulate a conceptual model (see Lundquist and Trippel, 2011) that draws a distinction between three ideal types of stages of cross-border RIS evolution: (1) asymmetric cost-driven systems (stage I); (2) emerging knowledge-driven systems (stage II); and, (3) symmetric innovation-driven systems (stage III). Table 1 identifies for each of these stages the key characteristics of the main RIS dimensions, highlighting particularly the extent of cognitive, functional and institutional distance. Furthermore, the model also includes the dimension ‘accessibility’ to acknowledge the role played by physical distance.

Table 1: Stages of cross-border RIS integration: key features

RIS dimensions	STAGE I Asymmetric cost-driven system (Weakly integrated)	STAGE II Emerging knowledge-driven system (Semi-integrated)	STAGE III Symmetric innovation-driven system (Strongly integrated)
Economic structure / specialization pattern	<ul style="list-style-type: none"> Strong differences in specialization → cognitive distance (lack of synergies) Functional distance 	<ul style="list-style-type: none"> Emerging synergies and complementarities (cognitive proximity) and functional proximity in a few business areas 	<ul style="list-style-type: none"> Related variety, complementarities (cognitive proximity) and functional proximity in a wide range of business areas
Science base / knowledge infrastructure	<ul style="list-style-type: none"> Strong differences in specialization → cognitive distance (lack of synergies) Functional distance 	<ul style="list-style-type: none"> Fruitful synergies (cognitive proximity) and functional proximity in a few scientific fields 	<ul style="list-style-type: none"> Related variety, complementarities (cognitive proximity) and functional proximity in a wide range of scientific fields
Nature of linkages	<ul style="list-style-type: none"> Cost-driven asymmetrical linkages Lack of knowledge flows Strong embeddedness in established RIS / NIS / international linkages 	<ul style="list-style-type: none"> Decreasing asymmetry → interactive links in selected fields Links to existing RIS / NIS / global level more important 	<ul style="list-style-type: none"> Intensive cross-border knowledge exchange Reshaping the importance of established links
Institutional set up	<ul style="list-style-type: none"> High degree of (hard & soft) institutional distance Institutional thinness at the cross-border level 	<ul style="list-style-type: none"> Decreasing levels of (hard & soft) institutional distance Rise of institutional set-up 	<ul style="list-style-type: none"> Low levels of (hard & soft) institutional distance / remaining distances mediated by specialized

	<ul style="list-style-type: none"> ▪ Low acceptance of cross-border integration processes 	<ul style="list-style-type: none"> ▪ at the cross-border level ▪ Increasing acceptance of building a common cross-border region 	<ul style="list-style-type: none"> ▪ bridging organizations ▪ Institutional thickness at the cross-border level ▪ High acceptance of creating a common innovation system
Policy structures	<ul style="list-style-type: none"> ▪ Absence of policy 'leadership' with vision & lack of legitimacy ▪ Low or asymmetric support from nation states 	<ul style="list-style-type: none"> ▪ Emergence of mechanisms for coordination of innovation policies 	<ul style="list-style-type: none"> ▪ Transparent & democratic governance structures ▪ Inclusive forms of governance & civic participation
Accessibility	<ul style="list-style-type: none"> ▪ Low / medium degree of physical proximity 	<ul style="list-style-type: none"> ▪ Medium / high degree of physical proximity 	<ul style="list-style-type: none"> ▪ High degree of physical proximity

Source: Lundquist and Trippel (2011)

2.2.1 Asymmetric cost-driven systems

Asymmetric cost-driven systems are characterized by low levels of cross-border innovation relations (Hassink and Dankbaar, 1995; Van Geenhuizen et al., 1995). Integration processes are based on the exploitation of price and cost differences and correspondingly asymmetric linkages tend to prevail (see, for instance, the case of the German-Polish border region reported by Krätke, 1999 and Krätke and Borst, 2007). There are two main reasons for such a constellation, i.e. (1) lack of synergies, and (2) under-exploitation of synergies. *Lack of synergies*: Missing synergies are often the outcome of suboptimal levels of cognitive distance, i.e. they result from either too strong differences or too strong similarities in the scientific specialization, knowledge bases, and economic structures. Such situations point to a lack of opportunities for interaction, because little can be learnt from each other. The potential benefits from investing in new cross-border linkages are rather low compared with those which result from further developing existing links at other spatial scales. Absence of synergies might also be the consequence of too high levels of functional distance. This type of distance points to an unequal distribution of the potential advantages from interaction and the problem of absorptive capacity. 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 capacity to absorb and make use of the knowledge (see, for example, Scott's (1999) study about the US-Mexican border region).

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 capitalize on the learning potential. Physical distance might have such effects. If the accessibility is restricted (resulting in high costs to cross the border), the possibilities for benefiting from enlarged agglomeration advantages at the cross-border level may be jeopardized. High levels of physical distance will also undermine the establishment of innovation links which require frequent face-to-face contacts (often containing a large proportion of tacit knowledge). Furthermore, various manifestations of institutional distance – such as differences between regions in hard institutions (laws, regulations) and soft institutions (lack of a common culture and language) – can lead to an under-exploitation of synergies (Van Houtum 1998; Koschatzky 2000; Klatt and Bröcker 2006). Weakly integrated systems are often characterized by institutional thinness, the absence of trustful cross-border 'leadership'

reflecting a lack of legitimacy (Hall 2008), low or asymmetric support from the involved nation states (Johnson 2009), strong path dependence (e.g. strong forms of embeddedness of actors in their RIS, NIS or in other contexts and relations) and a low social acceptance of building a cross-border region. A set of fully working bridging institutions and trustful cross-border leadership and governance mechanisms constitute missing ingredients.

2.2.2 Emerging knowledge-driven systems

Emerging knowledge-driven systems feature decreasing levels of asymmetry and provide opportunities for cross-border innovation and knowledge exchange in a few parts of the economy. Interactive linkages are not a system-wide or region-wide phenomenon yet. They may be restricted to a few segments of the science base and economic structure where good levels of cognitive and functional proximity prevail. Consequently, semi-integrated systems might host 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 (Brunet-Jailly 2008)). Interaction, however, still takes place between distinct RIS embedded in their respective NIS. Compared to well-established relations to other spatial contexts the newly emerging cross-border knowledge links are still of subordinate importance for the overall innovative performance on both sides of the border. This form of innovation-driven integration could also be partial in the sense that it only includes single steps in the innovation process or is spatially concentrated in selective parts of the cross-border region (see the case of the Oresund region as described by Lundquist and Winther 2006). However, although restricted in number and importance, these ‘islands of innovative cross-border interaction’ could become important role models for other fields where joint learning potentials still constitute a missed opportunity. Compared to stage I, accessibility (i.e. physical distance) is no longer a core barrier to interaction and innovation-driven integration. In this stage of cross-border RIS development trans-border flows of talent and knowledge via movements of qualified people, scientific collaborations, university-industry partnerships are increasing. Moreover, institutional networking and bridging institutions (often related to areas characterized by good levels of functional and cognitive proximity) might be observed. The rise in importance of interaction at the cross-border level is also often underpinned by a growing societal acceptance for building a cross-border region and an emerging consensus among different actors about potential benefits of increased integration.

2.2.3 Symmetric innovation-driven systems

Symmetric innovation-driven systems represent the most advanced form cross-border RIS development and integration. Distinct RIS in the constituent regions of the cross-border area become more and more melted into a single one. Such systems exhibit a densely knit web of cross-border knowledge links brought about by the mobility of students and skilled labor, innovation networking among firms, academic collaborations, university-industry partnerships, etc. Importantly, such trans-frontier knowledge links are no longer subordinate to links at other spatial scales but they essentially underpin the innovation capacity of the cross-border region. They reflect substantial opportunities for cross-border innovation originating from high levels of functional proximity and optimal levels of cognitive distance (related variety) in the business systems and the science bases. Symmetric innovation-driven systems do not only provide potentials for cross-border learning processes but also offer favorable conditions which enable actors to make effectively use of them. They exhibit advanced infrastructural ties allowing for easy accessibility (physical proximity). Moreover,

good levels of institutional proximity are present, forming an essential backbone of cross-border knowledge flows. This points to processes of new institutional path creation involving new attitudes and routines: solving common problems at the cross-border level is becoming part of normal life, knowledge sharing activities are turning into routine activities and cross-border RIS development is widely accepted in business, academic and other societal spheres. Institutional path creation is tightly connected to advanced forms of cross-border political governance (Perkmann 1999, 2007; Gualini 2003). Symmetric innovation-driven systems exhibit advanced forms of cross-border governance, a thick web of bridging institutions, and stable mechanisms for long-term policy coordination. In the ideal case, democratic platforms are established, which allow for inclusive forms of governance and which are vital for the emergence a common identity at the cross-border level. Arguably, symmetric innovation-driven systems might be referred to as the ‘utopia’ of cross-border region building. In the real world, the majority of cross-border regions will hardly meet this stage in all dimensions discussed above.

It is important to note that the three stages of cross-border RIS development discussed above represent ideal types. In the real world the distinction between the three stages might not be as clear-cut as the conceptual model suggests. Cross-border areas which, for instance, display semi-integration in one dimension, can be more or less strongly integrated in other dimensions.

3 Policy options for cross-border RIS

In this section we discuss the policy implications that result from the conceptual work on cross-border RIS development outlined above. Our aims are twofold. In a first step we advance the argument that suboptimal levels of distance and proximity constitute essential rationales for innovation policies and demand specific policy measures and actions. This is followed by an attempt to identify adequate policy strategies for different stages of cross-border RIS evolution.

3.1 Suboptimal levels of proximity and distance as rationales for policy actions

The discussion in the previous section made clear that various kinds of proximities and distances can constitute substantial opportunities *and* significant barriers for cross-border learning processes. Suboptimal levels of proximity in different dimensions point to missed opportunities and ‘system failures’ which undermine the emergence and development of cross-border innovation spaces. They thus form a main rationale and target for policy actions.

To set a first framework for policy interventions, we classify distances along two dimensions. The first dimension is related to the financial efforts which are required for abolishing distances. Some distances can only be reduced at very high costs while others put comparatively less strain on public budgets. The second dimension concerns the temporal aspect of removing distances and barriers. Distances vary considerably in their propensity to change over time. Some types of distances can be dismantled rather quickly whilst others take many years to erode if ever.

Table 2: Typology of distances

		Propensity of change over time	
		High	Low
Costs	High	Physical distance	Cognitive distance Functional distance
	Low	Hard institutional distance	Social distance Soft institutional distance (culture, language, identity)

Barriers related with physical distance can be reduced rather quickly but their removal requires huge investments. Policy actions oriented towards reducing physical distance comprise the establishment or further improvement of the transport and communication infrastructure between the constituent parts of a cross-border region.

Barriers resulting from hard institutional distance can also be dismantled in the short term. In contrast to physical distance, they can be removed at relatively low costs. Differences between regions in hard institutions point to the task of policy-makers to repeal or adapt laws and regulations that hamper an easy flow of knowledge and talented people across borders.

Barriers which originate from soft institutional distance (such as culture, identity, or language) also require little investment in terms of financial resources. It is unlikely, however, that policy interventions into the socio-institutional and cultural fabric of a cross-border region – such as the promotion of social networks, innovation partnerships, cultural events, etc. – will have immediate effects. It can take many years or even decades before various manifestations of cultural and soft institutional distance will change. A patient policy system is thus needed.

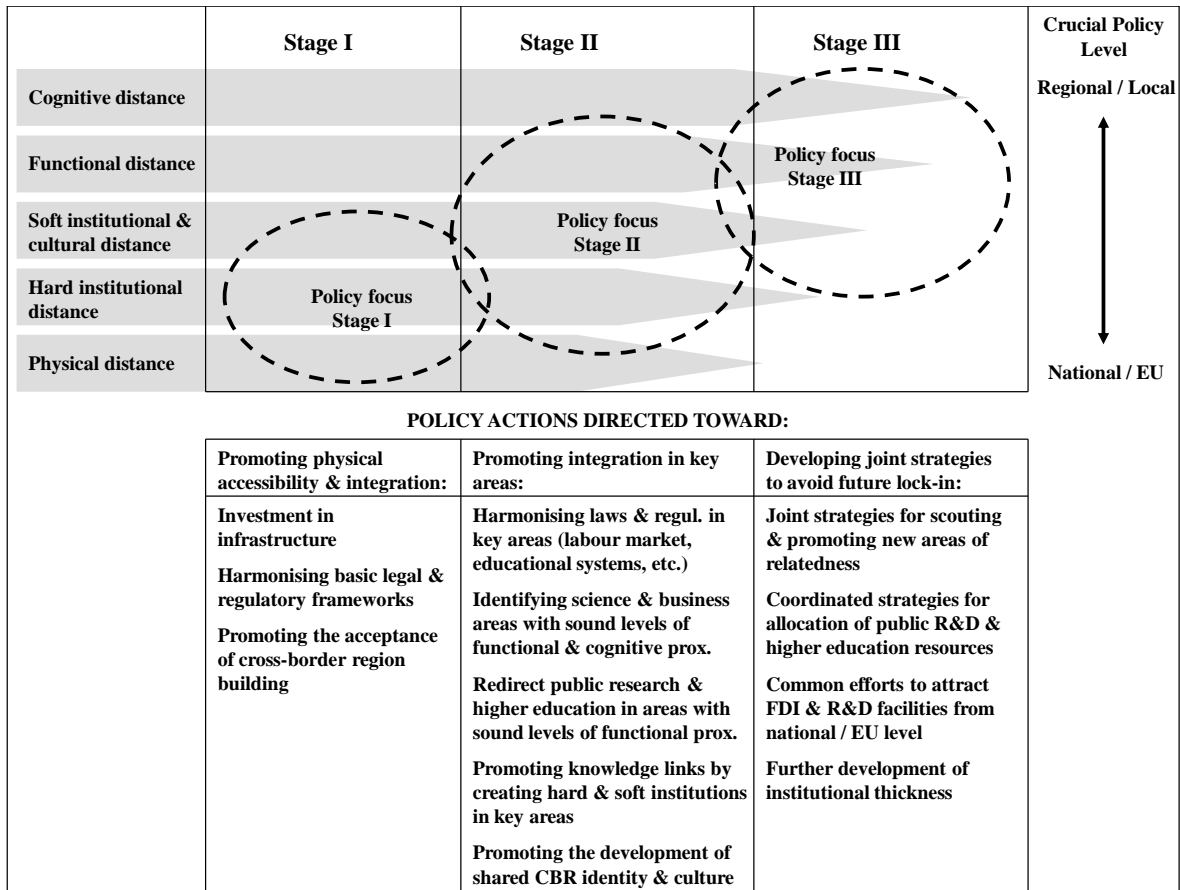
Finally, there are barriers which can only be removed in the long run and at rather high costs. These kinds of obstacles are typically related with cognitive and functional distance. Differences between regions in innovation capacity and specialization patterns require enormous investments in R&D, the learning capabilities and absorptive capacity of firms and regions. In some cases a major reconstruction of the whole cross-border RIS might be necessary. In those cases, however, where cognitive distance between adjacent regions is too strong resulting in a lack of synergies (see section 2.2.1), a ‘hands-off’ policy approach might be more reasonable.

Before we turn to discuss different policy strategies it is important to underline that there is a sliding scale and overlap between the different categories of distances and barriers regarding their propensity to change over time and to what costs. Furthermore, various forms of barriers could be expected to be related to each other in a complex way reminding of the relations between different types of proximity discussed in section 2.1. The erosion of one barrier will probably have an induced effect on other barriers and their propensity to change. For instance increased accessibility facilitating face to face contacts, knowledge flows and mobility in general will most probably also have an impact on the possibilities to reduce cultural, social and cognitive distances. From this point of view the removing of barriers should be seen as a dynamic process where the removal of one barrier will change the preconditions for eroding other barriers. The specific outcome of such a dynamic process is hard to predict and can probably result in both unexpected positive and negative effects for the possibilities to decrease other types of distances in the cross-border area.

3.2 Policy strategies and measures for different types of cross-border RIS

In this section we will discuss policy strategies and options that support the construction of cross-border innovation systems. The key argument suggested in this paper is that adequate innovation policy approaches differ strongly in dependence of the respective type of cross-border RIS. Figure 1 provides an overview on critical policy issues for different levels of cross-border innovation-driven integration processes.

Figure 1: Policy issues for different stages of cross-border RIS development



3.2.1 The role of policy in stage I

As noted in section 2.2.1, asymmetric cost-driven systems can be characterized by two general conditions, namely lack of synergies and under-exploitation of synergies. This basic distinction has far reaching consequences for policy. If the lack of synergies is the prevailing feature of a system, a hands-off policy approach might be a sound strategy. This holds particularly true for those cases where missing synergies reflect too high levels of cognitive distance. Under-exploitation of synergies, in contrast, creates multiple opportunities and potentials for policy actions.

What are key policy issues for cross-border regions suffering from a poor use of synergies? Promoting physical accessibility and integration in general should constitute the key elements of an adequate policy strategy for asymmetric cost-driven systems (stage I). An essential task of policy actors is to reduce the physical distance that often prevails in this stage of cross-

border RIS development by establishing or improving the transport and communication infrastructure. Another crucial issue for policy concerns the harmonization of basic legal and regulatory frameworks to alleviate ‘hard institutional distance’ between agents situated in different national contexts. By employing these actions, policy agents create basic preconditions for economic relations and flows of people and knowledge. In stage I, cross-border RIS policy actions and more general policy measures to promote integration between adjacent areas, thus, seem to go hand in hand.

While infrastructure investments and legal changes are the core policy tasks for the first stage of cross-border RIS development, a set of interventions in other fields also appear to be required. Policy actors face the challenge to develop and implement instruments that contribute to minimizing functional distance in the long run. To upgrade the innovation and absorption capacities of the weak parts of the cross-border RIS, policy-makers should promote the transfer of technology and knowledge (via FDI, labor mobility, co-operations, etc.), invest in R&D and strengthen the learning capabilities of firms and regions. Furthermore, in stage I of cross-border RIS development there is often a need for policy actions geared towards the gradual reduction of too high levels of ‘soft’ institutional distance. To enhance peoples’ knowledge about the specific competencies, culture, business practices, etc. existing in regions at the other side of the border and to promote the societal acceptance of the formation of a cross-border area (by, e.g., organizing cultural events and involving stakeholders and opinion leaders in developing joint visions) might be essential steps in this regard. Setting up specialized organizations that help to bridge ‘institutionally distant’ actors in the cross-border region by offering information and brokering services might also be a key issue for cross-border innovation policy.

Finally, advance in cross-border RIS development is associated with overcoming ‘institutional thinness’ and establishing governance structures that facilitate the exchange of ideas among innovation policy actors and other stakeholders in the involved regions and allow for casual co-operation for specific purposes.

3.2.2 The role of policy in stage II

In stage II of cross-border RIS development the role and key tasks of policy change considerably. Although reduction of ‘hard institutional distance’ remains an important task (brought about by the need to harmonize laws and regulations in areas such as the labour market or the education systems), facilitating innovation-driven integration in a few key fields that show high potentials for cross-border learning processes becomes the core policy strategy in this phase of cross-border RIS development. To put it differently: The main focus of policy should be on identifying and promoting those business areas and scientific fields where sound levels of cognitive and functional proximities exist. Policy measures for these fields may include specific trans-border research funding programs, joint degrees in tertiary education institutions, and the promotion of knowledge links enabling an exchange of ideas, knowledge and expertise across borders.

If innovation-driven integration is fuelled and succeeded in a few fields, they might act as ‘role models’. Communication and demonstration of the functioning and effects of these ‘success stories’ is a crucial policy task. Such actions might have an animating effect to agents and organizations in other business areas or scientific fields. Moreover, interventions into the socio-institutional and cultural fabric seem to be required. Promoting the gradual development of a shared identity and cultural interfaces at the cross-border level might be key

issues in this context. Finally, creating more stable arrangements for cross-border governance structures appear to be an important condition for the further development of the trans-frontier RIS.

3.2.3 The role of policy in stage III

The primary goal of policy in the third stage of cross-border RIS development should be to sustain the high level of innovation-driven integration and to develop joint strategies to avoid future lock-in. A constant search for and promotion of new areas of relatedness both in the scientific and industrial spheres and the facilitation of new combinations of talent, competences and knowledge at the cross-border level are at the core of such a strategy. To put it differently: the focus of policy should be on laying the grounds for new economic activities to occur by fostering diversity and related variety and consequently sound levels of cognitive proximity. Support for (Jacobian) clusters and the co-evolution of industries that share a common knowledge base or technological platform (Cooke 2008) might be essential steps in this regard.

Moreover, policy should focus on a further strengthening of the science base and other knowledge infrastructure elements. A coordinated investment in public R&D organizations and educational bodies and a common strategy to attract R&D facilities from national and EU levels appear to be critical to in this context. In addition, joint science parks, academic spin-off centers, and technology transfer agencies operating at the cross-border level are high in demand in this stage of innovation-driven integration. Other key policy actions comprise the fostering of joint training schemes and joint degrees in tertiary education institutions.

Designing and implementing a joint innovation strategy and policy for the whole cross-border RIS might be essential for further boosting the dynamics of symmetric innovation-driven systems. Arguably, this requires high levels of cooperation among policy actors which might be best achieved by establishing fully working and stable institutional arrangements for cross-border governance.

To summarize, each type of cross-border RIS development requires a specific kind of policy support. More precisely, a tailor-made ‘policy mix’, i.e. a combination of various instruments and measures that complement each other is called for. As a consequence, the role of policy varies considerably, depending on the specific stage of cross-border innovation-driven integration. In any case, it is not individual innovation policy instruments by which the evolution of such systems can be supported but rather a combination of various instruments into policy mixes. Constructing cross-border RIS thus goes beyond classic innovation policy measures. Infrastructure investment, labor market policies, etc. are necessary complements of (narrowly defined) cross-border innovation policies. Consequently, there is a requirement for policy actions at multiple fronts. Policy actors face the challenge to perform many roles including those of a funder, investor, regulator and facilitator. As argued above, some roles are more important in the early stage of cross-border RIS development whilst others tend to increase in significance in later phases.

The policy actions and measures suggested above point to the relevance of a multi-level governance system, i.e. to a need of cooperation and coordination between regional, national and European policy-makers. There are strong reasons to assume that the importance of these different policy levels vary, depending on the specific stage of cross-border innovation-driven integration. In stage I, policy-makers at higher spatial scales may play a dominating role.

Reducing physical and ‘hard’ institutional distance by improving infrastructural ties, opening of political administrative borders, harmonizing laws, etc. and diminishing functional distance by specific funding actions (e.g., in the context of cohesion funds) are largely the responsibility of national and European policy actors. In later stages one can expect that the regional policy level gains in importance. Policy measures to enhance social proximity among actors and promote cross-border knowledge linkages and ‘interventions’ into the socio-cultural fabric are probably best performed at this level.

4 Summary and Conclusions

This paper intended to shed some light on the potential nature, directions and scope of policies for developing cross-border innovation systems. While there is a well-established and growing literature on the governance structures of cross-border regions and the wide variety of public policies aiming at the promotion of economic integration in general, little is still known about the nature of policies that could enhance the innovation capacity of such areas. This issue is fundamentally important, because in the contemporary era of the globalizing knowledge economy the competitive advantage and prosperity of these regions will – at least in the longer run – be related to their capacity to create a common innovation system.

Recent research has suggested that cross-border regions differ strongly in their preconditions and capabilities to promote innovation-driven forms of innovation (Trippel 2010). In this paper, we have drawn on a conceptual model developed elsewhere (see Lundquist and Trippel 2011) that highlights such divergent capacities of regions by distinguishing between three ideal types or stages of cross-border RIS development: (1) asymmetric cost-driven systems, (2) emerging knowledge-driven systems, and (3) symmetric innovation driven systems. It was shown that these three types of cross-border RIS have distinctive features in terms of key RIS dimensions (economic structure, science base, nature of linkages, institutional set up, accessibility) and are shaped by specific forms and combinations of distance (including cognitive, functional, institutional and geographic types of distance).

Relying on and departing from these insights, enabled us to elaborate on the potential nature and scope of cross-border innovation policies. In a first step we have argued that suboptimal levels of distance and proximity are crucial barriers to cross-border knowledge flows, and, thus, constitute essential rationales and targets for policy actions. We have also demonstrated that distances differ markedly regarding (1) their propensity to change over time and (2) the financial efforts which are required for their elimination. Barriers which originate from hard institutional distance can be removed rather quickly at relatively low costs. Barriers resulting from physical distance can also be dismantled in the short term, but their removal requires huge public investment. Barriers related with soft institutional distance can be dismantled without substantial financial investment, but it often takes many years before they change or erode. Finally, barriers which reflect suboptimal levels of functional and cognitive distance can only be removed in the long run at very high costs. Consequently, different types of distance imply very different challenges for policy agents in terms of time horizons and burden on public budgets.

In a second step we have identified and discussed policy strategies and options for constructing cross-border innovation systems. The key idea advanced in this paper was that sound policy approaches differ strongly in dependence of the respective type or stage of cross-border RIS development. For asymmetric cost-driven systems (stage 1) suffering from a lack of synergies caused by too high levels of cognitive distance, a hands-off policy approach appears to be a suitable strategy. Asymmetric cost-driven systems (stage 1) characterized by an under-exploitation of synergies might benefit most from policy actions that promote physical accessibility and integration in general. In stage 2 (emerging knowledge-driven systems) the key aims of policy will change, focusing more on the provision of support for the use of synergies in areas with good levels of cognitive and functional proximity. Finally, in stage III (symmetric knowledge-driven systems) a major task of policy is to sustain high levels of cross-border innovation processes and to develop strategies to avoid future lock-in. To summarize, public policy can potentially play an important role in transforming cross-

border areas into supportive ecosystems for knowledge creation and innovation, provided that they are fine-tuned to the specific characteristics of three stages of cross-border RIS development. Furthermore, we have shown that there is no single policy instrument but rather a mix of very different measures that matters. Arguably, the 'cross-border policy mix' differs strongly in dependence of the respective stage of development.

The arguments proposed in this paper were mainly conceptual in nature. There is a need for empirical research to verify, falsify or refine our assumptions about different stages of cross-border RIS development and the policy implications resulting from the conceptual ideas presented above. Furthermore, there is a set of critical issues that deserve due attention in future research. Key questions in this context might include: How do cross-border RIS policies differ from 'conventional' RIS policies and what are the relations between them? What is the role of regional policy compared to those performed at higher spatial scales, i.e., at the national and European level? What is the relation between bottom-up and top-down strategies in the policy mix and how does it change over time? What are the implications and effects of conflicting goals and asymmetry in power between different policy levels and actors? In what ways do the integration processes and the policy tools differ between regions belonging to nations with strong regional political autonomy in contrast to those belonging to countries with centralized political structures? Can we expect a strong commitment from central governments in cases where successful cross-border innovation integration is not beneficial for other parts of the involved nations? Finally, in what way can external or internal "shocks", for instances structural, economic and political crises, open windows of opportunity for new and stronger policy actions which are more difficult to perform in stable periods of development?

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