
Multi-level governance in regional innovation systems

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The paper deals with the regionalisation of technology and innovation policies in a multi-level governance context. It is argued that a number of problems are associated with this regionalisation. Multi-actor policy arenas and multi-level governance structures turn political action into a complex bargaining process between several levels and actor groups. The paper sketches recent theoretical and political developments regarding multi-actor and multi-level governance of innovation at the regional level. Based on the evidence from a German regional innovation system, it aims to analyse whether innovation policy is an appropriate policy for the devolution to regional governments.

Este artículo trata sobre la regionalización de las políticas de tecnología e innovación en el contexto de gobernanza multinivel. Dicha regionalización entraña una serie de problemas. Los ámbitos de políticas con múltiples actores y estructuras de gobernanza multinivel convierten la acción política en un proceso complejo de negociaciones entre los distintos niveles y grupos de actores. El artículo describe los recientes desarrollos teóricos y políticos relativos a la gobernanza de la innovación multinivel y con múltiples actores en la escala regional. Basándose en el caso de un sistema regional de innovación alemán, evalúa si la política de innovación resulta adecuada para ser transferida a los gobiernos regionales.

Artikulu honek teknologiako eta berrikuntzako politiken eskualdekatzeaz dihardu, maila anitzeko gobernamendu deituaren testuinguruan. Eskualdekatze horrek arazo batzuk dakartza. Maila anitzeko gobernamenduko askotariko eragileak eta egiturak dituzten politiken eremuak direla eta, ekintza politikoa maila eta eragile-talde guztien arteko negoziazio-prozesu konplexua bihurtu da. Artikulu honek berrikuntzaren maila anitzeko gobernamenduari buruzko garapen teoriko eta praktikoko berrienak azaltzen ditu, eskualde mailan askotariko eragileak baititu. Alemaniako berrikuntzako eskualde-sistema baten kasuan oinarrituta, balioesten du ea berrikuntzako politika egokia den eskualde mailako gobernuetara aldatua izateko.

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Keywords: Regional governance, Multi-level Governance, Innovation System, Innovation policy, Germany, Bremen

JEL classifications: H70, O38, R58

1. INTRODUCTION

The increasing regionalism in technology and innovation policy demands a better knowledge about the strengths and weaknesses of regional approaches in the promotion of scientific and technological developments and about necessary framework conditions for the effective and efficient execution of policy decisions at the regional level (Nauwelaers and Wintjes, 2003). Major problems concern possible conflicts of interest between national and regional development objectives and between growth and efficiency-oriented technology and innovation policies and balance-oriented regional policies, or the effectiveness of measures implemented in regions by regional governments, serving not only regional but national growth objectives as well.

Since the degree of regional autonomy and the understanding of what a spatial entity might be worth for a certain degree of

self-governance vary between the different countries (Giodarno and Roller, 2003), no single good practice of regional governance of technology and innovation policies exists (Tödtling and Tripl, 2005). Nevertheless, it seems more and more necessary to look at governance practices in those countries where the sub-national, i.e. regional level, plays a role in policy-making, in order to learn more about framework conditions, the interaction between the different hierarchical policy levels (multi-level governance), and policy implementation and execution (cf. Sanz-Menéndez and Cruz-Castro, 2005, for Spain). If regional technology and innovation policy are to be effective at the regional level, then it is not only necessary to make a clear distinction between the different objectives of these policies, but also to allocate competences to regional governments in terms of budgets and strategic intelligence in policy-making (Kuhlmann, 2002), in order to achieve the intended objectives of the devolution process (Cooke, 2002a, pp. 55-56).

Based on the assumption that evidence from the German experiences on federalism could contribute to a better understanding of the mechanisms underlying the regional governance of innovation, the objective of this paper is twofold. Firstly, it sketches recent theoretical and political developments regarding multi-actor and multi-level governance in regional innovation systems. Against this theoretical background, it aims secondly to describe and analyse the specific economic, political and scientific conditions and the kind of innovation policy which is pursued in Germany. Taking the empirical evidence from Bremen as a case study of a small German *Land*, conclusions for regional innovation policy in a multi-level context will be drawn.

2. THEORETICAL FRAMEWORK

2.1. Regional systems of innovation

Systems of innovation are defined by "...all important economic, social, political, organizational, institutional, and other factors that influence the development, diffusion, and use of innovation" (Edquist, 2005, p. 182). The first approach towards the understanding of nations as national systems of innovation was made by Freeman (1987, 1988) who analysed technology policy and economic performance in Japan and raised the question whether Japan is a new system of innovation. In the following years, Lundvall (1992) made important contributions to the theoretical advancement of the concept while Nelson (1993) enriched it with case studies examples. The major focus lay on the institutional set up defined by national boundaries and the factors influencing innovative activity at the national scale. At

the same time, Cooke (1992) developed the concept of regional systems of innovation. Regional systems are not national systems writ small, but respond to different rationales, institutional and governance settings which can be found at the sub-national territorial level. It is a distinct element of the concept that a region does not offer all factors and institutions necessary for innovation, but that it is a part of a superior, i.e. national system, and has to cooperate with other regional or national systems in order to merge all necessary resources at the specific territory (Cooke et al., 2004, Asheim and Gertler, 2005).

National and regional innovation systems are easily to define, i.e. generally by national or regional geographical boundaries, or by the degree of stickiness and the kind of the regional knowledge base and its relation to proximity (Asheim and Gertler, 2005, p. 310). In the context of regional governance this aspect is related to the question about the level of "region" that defines the territorial responsibility of 'regional' policy makers. Commonly, regions are defined in a way of an administrative, functional or homogenous spatial entity (Schätzl, 2001, p. 99), or as authentic community of interest (Ohmae, 1995). In European regional policy, regions are defined either by the NUTS-1 or the NUTS-2 classification of the European "Nomenclature des unités territoriales statistiques". These are administrative units, reflecting for example the "régions" in France (NUTS-2) or the federal states (NUTS-1) in Germany. Even within the same classification, regions are not at all identical functional or political-administrative spatial units, but vary in size, economic strengths, institutional settings and governance abilities. This relates to the second aspect of regional definitions: the possibilities for

innovation governance and the level of political hierarchy. The scope of political autonomy is influenced by the degree of political devolution and the national regime, be it centralistic or federal. Although in recent years more and more countries increased the regional autonomy in research and innovation policy (see for instance Rolfo and Calabrese, 2006 for Italy), political powers, budgetary responsibilities, experiences and responsibilities still vary to a great extent.

2.2. Governance

The theoretical discussion about the shaping of regional innovation systems is closely connected to the term “governance” (Cooke, 2002a; Cooke et al. 2004). The fact that governance has been promoted to an “in” expression (Frey, 2003, pp. 451) depends closely on the situation where the state, on the one hand, is increasingly withdrawing from its prior broad involvement (e.g. by privatising state firms) and building up a new self-conception oriented towards the core functions of the state (Fürst, 2003). On the other hand, within the framework of European integration, some original tasks of the nation states were delegated to the European Commission, so that a new supra-national state actor has stepped onto the political stage, whose political actions must be coordinated with the policies of the nation states (Schmitt-Eigner, 2005).

The term “governance” originates not only in economic theorising, e.g. in the new institutional economics, but also the political sciences. From an economic perspective, governance is defined as the existence of rules and the way they are enforced in economic transactions. Starting point of

the new institutional economics, which was firmly established in the scientific debate by Oliver Williamson’s contribution about “Markets and Hierarchies” in the year 1975, is the assumption that bounded rationality and behavioural uncertainty are the most significant barriers and limitations for human decision-making behaviour. “Bounded rationality” and “genuine uncertainty” prevent the perfect coordination of complete contracts to reduce uncertainty (Williamson 1985, p. 46). Uncertainty arises among others through opportunistic behaviour (“moral hazard”) by the actors, i.e. by pursuit of self-interests seeking with guile or through artificially caused information asymmetries (ibid, pp. 47-48). Depending on the expected opportunistic behaviour, different protective arrangements are required, e.g. contracts or laws and rights emerging therefrom (e.g. property rights), which must be protected (North, 1990, pp. 3-4). The state is interpreted thereby as a powerful organisation which sets up rules and standards, as well as institutions, and is not dependent on consensus in this endeavour.

From a political science viewpoint, governance refers to the analysis of the balance of power in relationships and thus to collective action in different fields of activity (Fürst, 2001, p. 371). According to a definition of governance given by the Commission on Global Governance (1995, p. 4), it “...is the sum of the many ways individuals and institutions, public and private, manage their common affairs. It is a continuing process through which conflicting or diverse interests may be accommodated and cooperative action may be taken. It includes formal institutions and regimes empowered to enforce compliance, as well as informal arrangements that people and

institutions either have agreed to or perceive to be in their interest.” Mayntz (1993, p. 11) defines governance as the social coordination of collective action by systems of norms and order. Collective action thus plays an important role in governance.

2.3. Multi-level regional governance

Regional governance is aimed at complex and intermediary regulatory structures in regions (Benz and Fürst, 2003, p. 12) and can be understood as complementary to state, private sector or communal regulation (Fürst, 2004). It starts with the typical structural characteristics of the regions, consisting of market, hierarchy and associations and in particular the interdependency of these structures (Fürst, 2001, p. 374). Resulting from the regional contexts of these structural characteristics, specific regional governing styles emerge, so that regional governance “... (is) not a standardisable form of self-government, but each region... (develops) its own idiosyncratic form” (ibid, p. 375). Thus the political regulatory competences of the regions are unequal and due to the connection to the inherent regional structures, also path-dependent. Accordingly, different regions distinguish themselves by region-specific governance structures, which grew out of the respective economic, political and social environment and in the course of the individual history. Wiehler and Stumm (1995, pp. 244-245) differentiate the following governance types in Europe:

- regions with wide-ranging powers (e.g. German Länder),
- regions with advanced powers (e.g. Spanish autonomous communities),

- regions with limited powers (e.g. Dutch provinces) and
- regions without power (e.g. Portuguese planning regions).

From the regional perspective, the heuristic model of the regional innovation system (Iammarino, 2005) provides a suitable basis to analyse the contextual structures of regional governance. In this model, the governance approach has also been transposed to the regional dimension (cf. Braczyk and Heidenreich, 1998; Cooke et al., 2000). If political actions can steer regional development processes, which is mainly the case in public regional innovation systems (Cooke, 2001), then “multi-level governance relationships” play a special role. This governance system creates the preconditions for regional openness, the docking into supra-regional, national and supra-national policy levels and the integration of regional innovation systems in globally operating technological and enterprise systems (cf. Cooke, 2002b, pp. 136-137).

In a democratic system, policy-making does not take place in the form of top-down decision-making, but is a result of networking and bargaining between different societal actors, interest coalitions and systems, i.e. in “multi-actor innovation policy arenas” (Kuhlmann, 2001, p. 961). Usually, there is no dominant player, but the policy arena is composed by a variety of political, corporate, social and scientific bodies. Since the beginning of the 1990s, regional governments have become an additional and important actor in this policy arena. According to Cooke (2003, p. 414), this move towards regional innovation “... brought a stronger emphasis from the sub-national, mainly regional level of intervention

as animator of a public-private process of interactive and mainly incremental learning-based innovation". In regions, not only multi-actor arenas exist, but they are also object of multi-level governance structures. Due to the complexity of intervening factors at the regional level (besides the upper hierarchical policy levels, corporate and technology regimes for instance play an important role), "...necessary adaptation and integration processes of the innovation systems can obviously not be carried out completely and exclusively by the original innovation actors in industry and science on their own...(but)...state-based mediating and regulatory capacities of political systems will remain indispensable" (Kuhlmann 2001, p. 966).

In this context, those regions are privileged which are object of national and European policy support – in the framework of the general policy that aims at concentrating on excellence within the European Research Area (European Commission, 2001) and quite less at regional equality (Héraud, 2003). On the other hand, for many regions the fight for public funds becomes harder: strongly relying on knowledge resources for economic and social development, they enter a new form of global competition with similar regions. In this respect, the formulation and implementation of new policy concepts and the use of strategic intelligence is necessary for creating a supportive environment which attracts innovative companies - and human capital for research and development as well (Fürst, 2001).

Depending on the economic situation of a region and its degree of exploitation of the regional innovation potential, either more catalytic (i.e. support of network

formation) or more interventionalist (i.e. direct intervention and governance) policy approaches are appropriate (Enright, 2003). In a catalytic approach, the role of a (regional) government should be confined to the setting of a favourable legal and institutional environment, and should stimulate but not govern processes. According to Charles *et al.* (2004, p. 13) three key roles are attributed to regional governments:

- setting regional priorities for research on the basis of small units of excellence not necessarily recognised at the national scale;
- negotiating with central actors to shape central policies for the benefits of their regions;
- building linkages from all elements of the regional science system into innovation, commercialisation and technology transfer.

2.4. Regional Policies

Regarding the different policies which are relevant for governance in innovation systems, it is necessary to make a clear distinction between technology and innovation policy. The terms "innovation and technological policy" are often synonymously used, although important differences exist. Technology policy is understood as the "... policy concentrated on scientific-technical areas" (Meyer-Krahmer, 1997, p. 1). Its main objective is the promotion of application-oriented research and development as well as the use of R&D results in the form of new technology in industry. It is thus the application arm of science policy, aiming at bringing scientific ideas to technological solutions. Innovation policy represents the

intersection of science and technology policy (Meyer-Krahmer, 1989, p. 1). With regard to a broad definition of innovation, innovation policy aims at the support of science and the economy from the first generation of an idea up to its introduction onto the market. In this way, scientific, technological, economic, organisational and social aspects of the socio-economic change are raised for discussion. From a regional viewpoint, innovation policy can be regarded as an end-of-pipe activity, channelling the pre-stage science and technology policy measures to market-ready solutions by a variety of often low-budget information, transfer, networking or marketing activities. Since innovation does not only comprise technological aspects, but social and organisational inventions as well, regional governments have much more opportunities to create favourable conditions for innovative activities in this broad understanding than to establish new technological paradigms or scientific breakthroughs.

Only recently, innovation policy became an explicit issue at the regional level. This is the case in countries in which regions have a certain political autonomy, e.g. in the German *Länder*, and in countries with pronounced devolution processes like the UK or even France as well (Charles and Benneworth, 2001). It should not be forgotten that innovation policy, as innovation itself, is an activity which is characterised by a high degree of uncertainty (Freeman and Soete, 1997). Contrary to the focus on infrastructure development of classical regional policy, it is by far more difficult to attain intended results in the promotion of an innovation friendly environment or by providing incentives for network formation. Results are not clearly

visible within a short-term perspective and cannot be presented to the public like the inauguration of a building or a road. Due to different approaches and the non-linearity of policy input and the intended output, a high degree of experimentalism in policy making is needed.

In many strategies pursued by regional technology and innovation policy, a conflict about targets becomes evident. This is especially true for technology policy with its generally superior objectives. It is sometimes also true for innovation policy. If the view is predominantly directed towards the conflict between spatial balance and overall economic efficiency of a regionally-oriented innovation and technology policy, it has to be questioned whether a preference is to be given to the development of specialised regions (e.g. competence centres, clusters), with the consequence of a possible increase in regional disparities, or to a broad regional, innovation-based development in a multiplicity of regions (Koschatzky, 2005a). Competition in this respect can lead to benefits like strengthened technology and increasing absorptive capacity of regions for new technologies, but also to drawbacks in a way that "...even in a time of growing innovation and knowledge networks, peripheral locations are likely to become even more peripheral" (Malecki, 2004, p. 1113). Usually, the decision is not "either - or", but multi-dimensional with respect to the specific potentials and functions of regions (Tödtling and Trippel, 2005). Nevertheless, a tendency towards policy convergence, i.e. the growing cross-national similarity of policies, can be observed (Holzinger and Knill, 2005), which raises the question of appropriateness of similar innovation policy measures implemented separately and uncoordinated in different regions.

2.5. Conclusions and research issue

The above remarks have shown that a number of problems are associated with regional governance in innovation systems, which turn political action into a complex bargaining process between several levels and actor groups. On the one hand, the number of policy levels has increased in the European Union. The EU Commission is involved not only in classical regional policy, but in pursuit of the European Research Area and in order to reach the Lisbon and Barcelona objectives (3 % objective) is intensifying also its technology and innovation policy aimed at regions (European Commission, 2001, 2005). On the other hand, political decentralisation tendencies in some European countries lead to the strengthening of the regional policy level so that regional governments became an important actor in the political system (Lyll and Tait, 2004).

By means of various promotional measures, e.g. networking, by privatisation and public-private partnerships, the number of regional stakeholders has grown who articulate their interest in the public governance of regional development processes. Furthermore, it can be observed that the spectrum of policy measures targeting the regional level has also increased. The conflicting targets between growth and balance orientation, the question of who is responsible for policy implementation (national or regional government) and whether regionally focused measures produce the same efficiency, effectiveness and additionality as programmes which are not regionally oriented per se, make it clear that the input of coordination and governance has considerably increased.

To illustrate the complexity and necessary pre-conditions for regional governance of innovation in a country with a long record in the devolution of political powers, Bremen as the smallest federal state (*Land*) in Germany serves as a case study for the specific institutional system in Germany, but for smaller regions in Europe possessing a similar status of legal and financial autonomy as well. Bremen is characterised by a strong regional government, possesses financial resources which allow the formulation and implementation of own innovation policies and is characterised by a strong science base. These are major and important elements which constitute a regional innovation system. Nevertheless, the Bremen economy shows several weaknesses and is strongly influenced by national and even European priority settings. It is this area of conflict which makes regional innovation policy a difficult task. Even if it is not possible within the limits of this paper to clearly answer the question of the effectiveness of regional technology and innovation policy, its major objective is to derive conclusions from the presented case study about the necessary framework conditions for regional governance of innovation and to shed some light on the question whether regional innovation policy is a practicable approach for political action at the regional level.

3. MULTI-LEVEL GOVERNANCE OF INNOVATION IN GERMANY

3.1. Policy levels and division of tasks in a federal system

The division of competences between the national government and the federal states is fixed in the German constitution and

aims to prevent a renewed concentration of power. Consequently, each federal state has its own school and higher education laws, as well as ministries for cultural affairs or science. A crucial element of the science policy of the Länder is the financing and organisation of higher education. In this field, the federal states have paramount decision-making powers and can set different scientific-technological agendas in university research. In 2005, around 59 % of the total German public expenditures for science of € 32.15 billion are borne by the Länder and communes, 35 % by the federal government and 5.5 % by scientific non-profit organisations (BMBF, 2008). In 2005, funding of the universities and the university hospitals amounted to 87 % of the total science expenditures of the federal states. The federal government allocated only 19 % of its science expenditure to higher education, and 81 % to non-university science and research (BMBF, 2008). In order to enable all federal states to adequately perform those tasks, fiscal equalisation payments are made between states to re-distribute financial means from the financially strong to the financially weak; either directly or via the federal level (Döring, 2005).

With regard to education, science and research policy an important coordination body is the standing conference of the ministers of education and cultural affairs (KMK). The KMK seeks to ensure agreement or comparability of certificates and examinations; secure quality standards for schools, vocational training, and universities; promote cooperation between education and scientific organisations. Even though it plays a significant guiding role, this coordinating body can only formulate recommendations or work towards binding

agreements between states. It has no legislative power itself.

In technology and innovation policy, in contrast, the essential impulses are set at the level of federal government. Above all, the ministries of education and research (BMBF) and of economics and technology (BMW) play an important role. Their budgets for institutional promotion and promotional programmes are much higher than those of the single federal states. With the sum of € 6.47 billion (2005), the BMBF is responsible for about 58 % of the federal government funds spent on science, research and development followed by the ministry for economics and technology 19.4 % (€ 2.15 billion) and the ministry of defence 11.1 % (€ 1.24 billion). In general, however, the individual states have a right to participate in all budget decisions, including those in STI policy through their representation at federal level ("Bundesrat"). Additionally, there are several committees, e.g. the committee for research and technology, in which the federal government and the states inform each other about planned activities.

Regarding science and innovation policy and regional development, there are two important interfaces between the federal and the Länder governments. The first one is the "joint task university building". Since 1970, the extension and new building of universities including the university hospitals are regarded as an area in which the federal government needs to support the federal states in fulfilling their tasks, which is regarded to be of significance for and improve the quality of living of the population as a whole. From 1970 until 2004 a total of about € 56.2 billion was invested, of which one half was contributed by the federal government and the other by the federal states. The second interface is

the joint task “improvement of the regional economic structure”, in the financing of which federal government and the states participate to 50 % each.

Admittedly, the implementation of the promotional measures is the responsibility of the states, but the necessary framework plan has to be drafted in agreement of the federal and the states’ governments. Moreover, as an element of regional budgets, all funds for the joint task have to be approved by the federal and Länder parliaments at an annual basis. One focus lays in the area of regional structural policy, but in the past years the significance of research, development, technology transfer and innovation has increased (Koschätzky, 2002).

In recent years, an attempt was made attempt to reform the federal system including the promotion of scientific research to reduce the complex distribution of responsibilities between the various political levels in Germany (Gönner, 2004). Due to the complex German governance structure, however, quick results cannot be expected (for spatial aspects of the German federalism cf. Fürst and Kilper, 2005).

3.2. Autonomy and science policy governance competencies in Bremen

Bremen is a federal state with all the autonomy this status offers. It is an old trading city, in which overseas trade has contributed to wealth and growth for many centuries. In 2006, Bremen had 663,723 inhabitants, a share of 0.8 % of the total German population, which in an urban area of 357.1 km² leads to a high population density of 1,859 inhabitants

per km². Although Bremen has the highest unemployment rate of all federal states in western Germany (11.9% in 2007), its GDP per capita of € 37,121 is 73% above EU-27 average, while GDP growth in the years 1995 to 2005 is relatively low with only 1.8 % annually (European Commission, 2004, p. 188). The budgetary situation is characterised by financial compensation payments from other federal states which made Bremen a net receiver of public funds for many years (Pohl and Sünner, 2001).

The regional government called “Senat” is an elected government with own legislative and budgetary competencies. Due to the fact that Bremen enjoys a relatively high degree of autonomy the regional government is responsible for research and education at the university and possesses science policy competences. The local administration of education and science as well as the local administration of economic affairs and ports are the major actors in R&D and innovation policy and have the possibility to arrange own support programmes (Free Hanseatic City of Bremen, 2004). Regarding coordination activities with upper or other policy levels, Bremen is no exception from the German rule. The state is member of the standing conference of the ministers of education and cultural affairs, and also of several federal government and Länder committees. Between Bremen and the surrounding Lower Saxony, coordination exists in the field of concerted spatial planning. Recent joint activities deal with a better marketing of the technology potentials of northern Germany’s coastal states.

Parts of Bremen benefited from objective 2 funding from the structural funds of the European Union 2000-2006. The volume of the funding under objective 2 was € 226

million, of which 50 % are ERDF funding (Bornemann et al., 2003). ERDF funds and the parts of the joint task 'improvement of the regional economic structure' which are funded by the Commission have to be jointly negotiated between Bremen, the federal government and the European Commission. As with all European policies, measures financed by structural funding had to follow the EU guidelines in that they had to be SME- and technology-oriented and aim at strengthening innovation potentials. In the funding period from 2007 to 2013 Community support for Bremen is allocated under the "Regional Competitiveness and Employment" objective. Total Community assistance through the ERDF amounts to EUR 142 million (0.54% of the total EU structural funds allocated to Germany). For the first time, the financing of the Bremen ERDF Programme 2007-2013 includes private-sector money. In total, including the national co-financing, almost € 322 million is available for the implementation of the programme. Additionally, € 89 million will be allocated from the European Social Funds supporting projects with an overall volume of € 179 million (European Commission, 2007).

The government of Bremen has an own public research budget and thereby a relatively high autonomy in RTD policy (€ 265.5 million in 2002). The crucial source of funding for this budget, however, is the federal government (share of 64 %). Consequently, the state government is not in control of the amount of funding available. For example, even though it is slightly raised its own contribution to the research budget in 2002, a significant overall decrease resulted as in that year the contribution of the federal government was particularly low. It becomes clear that Bremen is characterised by a high degree of autonomy

in policy design: own ministries exist, e.g. for research and trade and industry, which again have own budgets and programmes to promote science and innovation. However, these budgets depend on external funding from the federal government and can increase and decrease for reasons out of control of the regional government. In this sense, Bremen's situation is comparable to that of other European autonomous regions (Koschatzky, 2005b) which receive transfer payments from the national government and implement their own policies to a large extent based on these funds. Moreover, Bremen's possibility to influencing the research profile of local research institutes mainly funded by national sources is much lower than is Competencies in the field of university policy.

Bremen's R&D expenditures reached 2.18 % of GDP in 2005. This is above the EU-27 average of 1.82 %, but below the German average of 2.48 %. In Germany, the most R&D-intensive regions are Brunswick with 5.81 %, Stuttgart with 5.25 % and Upper Bavaria (Munich) with 4.75 % (Eurostat data). In Bremen, public and private expenditures are about equal (1.26 % and 0.91 % respectively), while in Stuttgart, for example, public R&D accounts for less than one tenth of the whole R&D carried out in the region. Hence, Bremen can be regarded as a publicly driven research system in which the publicly funded science sector plays a major role, while the regional industry displays weaknesses in financing and carrying out own R&D activities. Within the publicly funded R&D activities, 50 % are performed by universities and 50 % by non-university institutions. Building on this basic situation, the regional government has expanded the public research sector to the best of its ability and created a research

range that should partly compensate for the industrial research deficit within the regional science and innovation system.

3.3. Objectives, policy instruments and coordination

The framework for regional technology and innovation policy until the year 2010 is the programme “InnoVision 2010”. Its major objective is to make Bremen one of the top 10 German technology regions by 2010. In 2001-2003 the city of Bremen reached the 24th position among 117 German cities regarding R&D input indicators and the 28th position regarding R&D output indicators (Stenke and Willms, 2004, pp. 3-4). Against the background of these performance indicators and on necessary budget adjustments, a reassessment process of the programme has been started in 2004. The “Development Strategy for the High-Tech Region Bremen” represents the continuation of the programme InnoVision 2010. Originally, “InnoVision 2010” stressed the following scientific and innovation fields in which competence clusters should be created in Bremen: telecommunication and information technology, media and entertainment (T.I.M.E.), health economy, environmental technology, space and aeronautics, logistics, blue biotechnology and design (Free Hanseatic City of Bremen, 2004). In the meantime, regional discussion and mediation processes resulted in determining the following new focuses: mobile solutions, e-logistics, innovative materials, ecological intelligence (e.g. offshore wind energy, ocean research), future market health care (Timm and Gundrum, 2005).

Originally, InnoVision 2010 had a total budget of € 764 million (2002 - 2010)

provided by the regional ministry of education and science and of economic affairs and ports. Of that budget, € 310 million should be devoted to R&D. Decreasing tax income and anticipated reduced transfer payments from other federal states lead to a reduction of R&D spending within InnoVision to around € 30 million for the remaining five years.

An essential feature of InnoVision 2010 and the new development strategy for Bremen is the targeted linking of regional science focuses with innovation fields directed at enterprises. This requires a close collaboration between the ministries of economic affairs and science and education. It is not the rule in Germany that science and economics ministries in the federal states cooperate closely in joint programmes like InnoVision 2010. For this reason, the case study Bremen can be regarded as an example of good practice for a policy coordination process between scientific and economic policy interests. Until 2007, the technology advisor of the regional government provided the link. He was the former president of the university of Bremen and had many and varied contacts to the science scene, enterprises and politics. Bremen as a small region has an advantage here because the number of organisations, stakeholders and actors, and thus of possible interfaces, is limited. Networking is working well this way, exploiting the advantages of spatial proximity. Policy coordination within the regional system is admittedly a demanding task here too, but possible at limited transaction costs.

With regard to own regional policy objectives, it can be meaningful from the perspective of the region of Bremen to create own structures to develop the

regional technology and innovation base. From the perspective of the economy as a whole, however, doubts remain whether small regions with limited budgets and regionally oriented policy priorities taking the regional socioeconomic conditions into account, possess the necessary financial and human resources to create scientific excellence and to build-up a competitive research infrastructure, or whether a pooling of resources would not be a more promising strategy. Although the University of Bremen is a big player in the region, with its income of € 245.1 million it has just 10 to 15 % of the budget of large American universities. Regionalisation of science, innovation and technology policy should therefore go hand in hand with interregional coordination of priorities and measures. Recent devolution processes in other European countries or the federal system in Germany by which regional governments gained increased autonomy might lead to a higher self-orientation in policy-making. In Bremen, policy priorities are only coordinated within the region. With the governments of the adjacent federal states, for instance, information is exchanged, but no coordination affecting the structure-building process takes place.

4. CONCLUSIONS

The governance of innovation poses special demands on regional governments. In order to build competitive research infrastructures, not only autonomous decision-making powers are required, but adequate financial resources to implement promotional measures as well. A fundamental challenge exists in the coordination of own measures with those on other political levels and in the strategic

use of promotional funds (EU, national government) to meet own targets.

These are tasks which not every region can fulfil in the same manner and quality. The budgets for research and innovation at the disposal of regional governments are of importance. Not every regional government is in the position to build up a science and research infrastructure which can survive in international competition (Tödtling and Trippl, 2005). The German federal system, for example, is presently led by the hypothesis, that each – even small – federal state has the possibility to create efficient research infrastructures. As a consequence, practically identical structures of political governance for science and innovation exist in the 16 federal states (ministries, official bodies, organisations). From this a considerable need and outlay for coordination results, not only between the states and the federal government, but also between the single states. With regard to devolution and the regionalisation of innovation policy, the question of balance arises between political autonomy of the regions on the one side and the costs resulting from the necessary coordination of multi-level governance structures, on the other. Due to the fact that policy instruments converge between nations and regions as a result of creating an institutional fit with superior (European) policies (Holzinger and Knill, 2005; Lenschow *et al.*, 2005), the parallelism of approaches increases the risk for waste of resources, at least from the viewpoint of the overall efficiency of the whole system.

With a view to the shortages in public budgets in many *Länder*, but certainly in other regions as well, the question is rather whether innovation and technology policy with its partly high budgetary demands is

the appropriate policy approach for the devolution of political powers not taking the regional potentials for technology and innovation policy into account. Technological excellence can only be guaranteed by building specialised research profiles. This specialised profiling does not work if every autonomous region pursues its own interests. With a view to the German experiences, a regionally undifferentiated regionalisation of technology and innovation policy is not meaningful. On the other hand, by an intelligently implemented and coordinated innovation policy regional

governments can deliver an active contribution to building transfer bridges between scientific knowledge and industrial needs and transform available knowledge into value added and jobs, within or outside the region. Even if, as the term “innovation paradox” shows, not all regions possess innovation policy competences (Oughton *et al.*, 2002), innovation policy is still more suitable to demolish regional bottlenecks in the innovation behaviour of enterprises, than for example a science policy which usually requires large investments and strategic far-sightedness.

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