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**The Regionalisation of Innovation
Policy in Germany – Theoretical
Foundations and Recent Experience**

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Abstract*

In recent years, not only has the "network paradigm" become the starting-point for policy measures aiming at a better exploitation of innovation potentials, but also the region, i.e. sub-national spatial entities, has been made an important platform for innovation policy implementation by national governments. Specifically, the cluster concept and other theoretical approaches of the "new economic geography" contributed to the popularisation of regional development concepts. A substantial feature of this focus on the region is that measures, which have so far had a national orientation (and for those the question about the distribution of innovative potentials in space was not or was only implicitly raised), have to be adapted to the specific structures and potential of individual regions. However, not every region in a country can develop into a high-tech island equipped with leading-edge technology, industry and research. For many regions and their economic actors, the only development option is to carry out supplementary functions for other regions, clusters and economic activities or to focus on the exploitation of endogenous potential and strengths.

Regional innovation and technological policy can thus contribute to regional development and to regional cohesion, but not in every case. Depending on the regional starting conditions, the regions of a national innovation system qualify themselves in different ways for certain support measures. Measures supporting the development of regional competence centres only make sense if the respective regions already possess a critical minimum level of technology and knowledge-oriented enterprises as well as scientific potential in research institutions. The same applies to technological clusters, which also group around a core of innovative enterprises and R&D institutes. In this case the region represents the political action framework, but it is primarily used for strengthening national technological competitiveness. On the other hand, other regions offer only limited or no starting points for innovation activities, so that it therefore has to be assessed as to whether they are suitable for innovation promotion at all.

On the basis of these reflections this paper describes the regionalisation of national innovation and technological policy in Germany and discusses the regional economic implications of current promotional measures of the federal government. The BioRegio contest, the EXIST programme (promotion of university-based start-ups), and the InnoRegio contest confined to the new federal states will serve as examples. These measures are directed towards regions with different innovation and networking potentials and thereby contribute in a different way to the improvement of national technological competitiveness, in the creation of new employment opportunities, and thus to regional development.

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1. Introduction

Since the beginning of the 1990s, but specifically within the last few years, the "region" (i.e. sub-national spatial entities) has not only gained importance in theoretical discussions, but, and perhaps as a result of convincing new theories, also in national technology and innovation policy. This can be observed at the supra-national level of the European Union, but also at the level of different European countries (Koschatzky/Sternberg 2000: 494-499). The cluster concept in particular, and other theoretical approaches of the "new economic geography" contributed to the popularisation of regional development concepts. The assumption is put forward in this paper that regions are indeed relevant platforms for national and supra-national policy implementation, not only with regard to economic development in general, but also with regard to the promotion of technological development, innovative activity and innovation diffusion. A substantial feature of this focus on the region is that measures, which have so far had a national focus and for those where the question about the distribution of innovative potentials in space was not or only implicitly raised, have to be adapted to the specific structures and potentials of individual regions. Nevertheless, not every region within a nation is qualified in a similar way for all innovation policy instruments and objectives. Different regions fulfil different functions in a national innovation system.¹ Only a few regions can develop into high-tech islands equipped with leading-edge technology, industry and research, while in many others innovative potential is non-existent or still not fully utilised. For these regions and their economic actors the only development option is to carry out supplementary functions for other regions, clusters and economic activities or to focus on the exploitation of endogenous potentials and strengths.

Looking at the theoretical contributions with respect to regional development made within the last ten years, it is the objective of this paper to shed some light on the reasons why regionally-oriented innovation policy approaches became quite popular during the second half of the 1990's and to discuss possible goal conflicts between a growth-oriented national innovation and technology policy and a balance-oriented regional innovation policy. Germany will serve as an example.

Since many books and papers have been written about the different theoretical approaches of the "new economic geography", the following section will not repeat these concepts, but will give a short overview of the determinants affecting innovation and the space differentiating factors used by these models and concepts.² It is these determinants and factors which convinced policy makers to regard the region, i.e. a sub-

¹ For definitions of national innovation systems and a detailed discussion of this concept cf. Freeman (1987); Nelson (1993); Edquist (1997).

² For an overview on these concepts cf. Koschatzky (2000).

national spatial entity within a national innovation system,³ as an important implementation platform for technology and innovation policy measures aiming at national or even supranational objectives. Objectives, goal conflicts and central elements of a regionally-oriented innovation policy are elaborated on in more detail in section 3, whereas section 4 presents some recent German policy examples. Section 5 will give some concluding remarks.

2. Determinants affecting innovation and spatial differentiation: an extract from regional innovation models

Although regional economics has been dealing with the distribution of economic activity in space for several decades, it was the models of Lucas, Romer, Krugman and many other economists which, by introducing external effects and allowing the regional accumulation of knowledge, re-discovered spatial aspects in economic theory.⁴ Specifically, the work of Krugman about geography and trade laid the foundation of a revival of economic geography (Krugman 1998). This "new economic geography" is not only fuelled by models of the new growth theory and the new trade theory, but by many other theoretical concepts dealing with the regional distribution of technological development and innovative activity. Among the most popular are Porter's reflections about the factors influencing the competitive advantage of nations (Porter 1990), the different contributions to the cluster concept (Porter 1998) and the theory-based empirical studies about knowledge spillovers and their spatial reach (e.g. Anselin *et al.* 1997; Beise/Stahl 1999). These regional and national innovation models and concepts discuss the term "region" and explain regional innovation processes on different spatial aggregation levels:

- On the *macro level*, the concepts about national innovation systems and the "learning economy" deal with the impacts of national institutional framework conditions on innovation processes and on the competitiveness of firms.
- The *micro level* is defined by different network and milieu-oriented approaches. Clusters, milieux and industrial districts are usually small spatial units, in which spatial proximity plays an important role for the organisation of production and innovation processes.
- The concepts of regional innovation systems and learning regions can be assigned to the *meso level*, since they deal with institutional and governance structures which

³ So-called Euregios are examples where regions can also be defined as spatial entities between different bordering national innovation systems.

⁴ See for example Lucas (1988); Romer (1986, 1990); Grossman/Helpman (1990); Krugman (1979, 1991).

are usually not present on the micro level, but are nevertheless an important element of certain regions.

Although all of these approaches use the term "region", there is a different understanding about what defines the spatial context and which spatial entities make up a region. Spatial *proximity* is more closely defined in the concept of industrial districts than in the concept of regional innovation systems. Measures for innovation promotion in an industrial district are to be organised differently than in a regional innovation system which is characterised by a higher degree of financial and political autonomy.

Despite the already mentioned differences between the individual concepts, there are several *common aspects in the explanation of innovation and regional development*:

- All concepts of the micro and meso level emphasise the importance of *spatial proximity* between the protagonists of a production or value-added chain as well as for innovation. Proximity advantages are explained by *positive external effects* and thus productivity and cost advantages, which can be realised by a flexible and specialised division of labour between small firms, operating in spatial proximity. According to the concept of industrial districts,⁵ external effects predominantly develop from localisation advantages, i.e. from regional specialisation. In contrast to this, the innovative milieu approach⁶ argues with diversified economic structures in a region. The mechanism for stimulating co-operation and innovation is the existence of a *regional culture and identity*, which creates the basis for trustful co-operation, and from which informal, hierarchy-poor and horizontal *networks* between the regional actors develop. On the other hand, according to the concept of learning regions⁷ and in part also of regional innovation systems,⁸ spatial proximity supports the *generation of collective learning processes* and the exchange of information and knowledge, especially when the knowledge is tacit and therefore spatially immobile.⁹
- While according to new growth theory and spillover approaches the necessity for a *spatial concentration* of knowledge givers, research establishments, enterprises and physical infrastructure for the realisation of knowledge externalities as well as ag-

⁵ See for instance Pyke/Sengenberger (1992); Braczyk *et al.* (1995)

⁶ Cf. Aydalot (1986); Aydalot/Keeble (1988); Maillat *et al.* (1993, 1995); Ratti *et al.* (1997)

⁷ Cf. Florida (1995) who was the first using the term "learning region"; see also Hassink (1997); Morgan (1997).

⁸ Cf. Cooke (1992) and Cooke (1998) for an overview on the origins of the concept

⁹ See the literature on learning and knowledge economics, e.g. Nonaka (1994); Nonaka/Takeuchi (1995). See also Foray/Lundvall (1996). Storper (1995) used the term "untraded interdependencies" for describing localised routines, knowledge and learning processes. For regional examples of localised and local learning see Asheim/Cooke (1999).

glomeration advantages (- disadvantages) derives, network and milieu-oriented approaches¹⁰ also allow the possibility for the development of *decentralised production and innovation clusters*. The emergence of clusters, industrial districts and milieux is not necessarily attached to urban agglomerations, but can also take place independently from these. Regional innovation differences are thereby no longer explained only by locational parameters, but by the ability of economic actors in a region to establish intra- and inter-regional information and production networks, to participate in network integration and to profit from these networks by collective learning processes.

- Apart from institutions of the technological infrastructure such as research and educational establishments, predominantly *small firms* which flexibly operate according to post-fordistic production concepts are the driving economic force in the industrial district and innovative milieu approach, while in clusters even *larger firms* can develop. Important prerequisites for the survival of all these regions are permanent learning processes, co-operative non-opportunistic behaviour as well as the detecting and the flexible adjustment to changing market conditions.

With regard to the role of *spatial proximity* in innovation processes and thus the localised character of innovative activity it can be assumed from the different approaches that spatial and cultural proximity between knowledge producers and knowledge users is *important*¹¹

- when new technological trajectories emerge,
- in the early phase of innovation processes,
- when technologies are science-based which is especially the case in young technologies,
- when relevant knowledge is of tacit character (which demands face-to-face contacts),
- when knowledge and information are localised, and
- when technology producers and technology users have to co-operate closely for meeting specific user needs.

Proximity is *unimportant*

- in cases of incremental innovation with a low level of uncertainty,
- when it comes to standardised technologies and the production of mass consumption goods, and
- in cases of process innovation.

¹⁰ Cf. Coombs et al. (1996), DeBresson/Amesse (1991), Staber (1996), Tijssen (1998), Tödting (1999) for different aspects of innovation networking.

¹¹ Cf. Koschatzky (2000: 49-50)

Another possibility for looking at the different concepts is to group them around a systemic development path, starting at the emergence of innovative regions. As the examples of many regions make clear, the *historical coincidence* is usually a more sustainable triggering force than public planning. This becomes particularly clear by the confrontation of the success story of Silicon Valley with publicly planned technology regions (cf. Saxenian 1994; Sternberg 1994, 1995). As a matter of fact, the coincidence of a location decision, as for example assumed by the theory of geographical industrialisation (Storper/Walker 1989), can be the starting point for the future development of many regions. Depending upon locational prerequisites, natural resources and infrastructure equipment, which change their weight and quality in time, as well as accumulated knowledge, interaction ability and effects of learning processes, *different futures* for the individual regions are possible. Referring possible development trajectories to the concepts mentioned in this section, whereby this reference can only take place synoptically, then development paths will be marked which not every region might go with success. Nevertheless, these possible trajectories point to theory-based development options which might contribute to the stimulation of regional innovation activities and thus to securing income and employment in the regions.

The *creation of innovation-oriented development foundations* is sketched by the *industrial district approach* and the *cluster concept*. In both approaches spatially linked and specialised firms produce in close dependency on other firms and minimise transaction costs by spatially close supplier and customer interactions. The regional labour market is the institution by which knowledge and experiences are exchanged, whereby the innovative potential of industrial districts is predominantly based on production-oriented learning and thus on incremental innovations. *Traditional clusters* possess a comparable innovation orientation, while *innovative clusters* start on another development level. Here young industries come together, which are engaged in emerging technologies. Production is mainly knowledge-based and innovations are of a radical nature. Over time innovative clusters can develop into traditional clusters, in particular if routines and path dependency prevent constant renewal. On the other hand, *innovative milieux* can emerge from industrial districts, or a part of an industrial district can develop into a part of an innovative milieu.

In cases when the bases for *collective learning processes* are laid by the emergence of an innovative milieu, for which inter-industry and inter-regional networks are necessary (by which the close specialisation of an industrial district is overcome), then the *concepts of the technological district* (Storper 1997) or of the *industrial district as learning region* (Asheim 1996, 1997) describe further development options. Since all these approaches deal with processes on the micro level, they can be applied predominantly universally, because even in larger regions subspaces with appropriate features (e.g. clusters) can emerge.

On the other hand, *regional innovation systems* and *learning regions* only offer limited development perspectives for all kinds of regions, due to their demand for institutional structures and "governance" features. However, spatial differentiation is possible, since not all regions with appropriate institutional prerequisites are automatically regional innovation systems or learning regions.

Despite the different regional and sector specifics which have to be regarded, some general *success factors of regional innovation strategies* can be derived from the discussed concepts. These are:

- an innovation-oriented local or regional political control system with appropriate financial authority;
- a rich, in learning, knowledge transfer and qualification aligned institutional structure;
- intensive local and regional networking, enhanced by national and international cooperative linkages between regional actors, which facilitate mutual knowledge exchange and enable collective learning processes;
- a creative and entrepreneurial-oriented human capital which contributes to a continuous renewal of the regional enterprise stock.

Above all, the emphasis on innovation networking as a key element for the utilisation of so far underdeveloped innovation potentials as well as the importance of spatial proximity at least in early phases of technological development and innovation processes made the "region" an interesting political action field. In a limited spatial entity with a limited number of actors, public funds for initiating and supporting network building can be allocated much more precisely and perhaps also more efficiently than in measures without a regional focus. These aspects in particular contributed to the *popularity of regionally oriented policy supporting measures*. Nevertheless, since regions differ in size, structure and economic strength, the specificity of regions has to be regarded in policy action. According to the different theoretical concepts and their empirical analysis, *three ideal types of region* can be identified:¹²

- (1) *Globally interlinked centres of national and international technological and scientific excellence*. Examples are the Silicon Valley, the Greater Boston Area, the Île-de-France, Tokyo and Singapore.

In the theoretical and empirical literature (cf. Amin/Thrift 1994; Anderson/Andersson 2000; Sassen 1996), these regions are named as "global cities", "global hubs", "gateway regions", or "technological clusters" and "competence regions". Their common characteristics are:

- globally acting transnational companies,

¹² For more details cf. Koschatzky (2000: 287-292).

- a specialised, scientifically excellent research infrastructure with international co-operative linkages,
- a great deal of localised knowledge and learning,
- a pronounced entrepreneurial climate supported by national and international venture capital,
- high innovation and R&D expenditure and advanced technological competencies of the firms,
- an excellent innovation, transportation and communication infrastructure defining the reference for many other regions.

(2) *Regions which are intensively integrated in national and international innovation networks.* Examples are Baden-Württemberg, Rhône-Alpes, Lombardia, Catalonia.

The regions are important national locations of technological development and the homebase of many large national and international enterprises (cf. Braczyk *et al.* 1998 for a description of some of these regions). Their major characteristics are:

- complex production and innovation networks,
- learning processes mainly organised within the production environment,
- a well developed innovation, communication and transportation infrastructure meeting national and international standards,
- close linkages between industry, science and administration,
- at least partial political and financial autonomy.

(3) *Regions with underdeveloped innovation potentials.* Examples are old industrial districts and regions in economic transformation. Regions of this type are characterised by heterogeneity. They can be seen as traditional industrial clusters, industrial districts (to some extent) and peripheral-rural regions. A common feature is the industrial basis, which can be partly highly specialised, consisting of predominantly small and medium sized and few large-scale enterprises. These are supported by a standard supply of technical and advisory services. The political and financial autonomy is less than in the type of region (2) and permits the endogenous controlling of regional economic development in a limited way only. The regional knowledge-base consists of a high proportion of codified knowledge, which is complemented by production and market experiences. External and spillover effects can only be realised to a small extent.

This theory-based regional typology should make it clear that according to regional framework conditions different innovation influencing effects are possible and that a relationship exists between the technology and innovation-relevant factor endowment of a region and the innovation behaviour of its firms. These different regional starting

conditions have to be taken into account by a regionally-oriented innovation and technology policy.

3. Regional innovation and technology policy

The terms "innovation and technological policy" are often synonymously used, although innovation policy represents the intersection of research and technology policy (Meyer-Krahmer 1989: 1). With regard to a broad definition of innovation, innovation policy aims at the support of science and 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. Technology policy is defined more closely and is understood as the "... policy concentrated on scientific-technical areas" (Meyer-Krahmer 1997: 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 (Dreher 1997: 24).

Technology policy has the following *tasks* (following Meyer-Krahmer 1997, 1998; Dreher 1997):

- Set-up and structuring of the research landscape of a country;
- creation of framework conditions for basic research, application oriented research and industrial research;
- finding new technologies by the promotion of initiatives for technological forecasting, for the development of visions and for the consensual development of future technological-social trajectories;
- promotion of the supply of new technologies (institutional or project-related promotion, financial assistance);
- promotion of technological demand and regulation of technology application by financial and advisory assistance, public procurement, definition of technical standards, norms and regulations, target group oriented demonstration of technical applications;
- conscious influencing of technological development regarding certain objectives (e.g. competitive ability, living conditions, infrastructure);
- promotion of the set-up and development of an innovation infrastructure by further training of technicians and engineers, the set-up and development of technical-, information-, market-, management consulting and financial institutions as well as the networking of these institutions on the professional and regional level;

- moderation and co-ordination of other actors of technology development and technology application including the networking of other technology-relevant policy areas (cross-sectional task of technology policy).

The *intervention of the government in technological development and diffusion* is not indisputable (Dreher 1997: 26-31). Therefore the question has to be raised as to whether government, be it local, national or supra-national, has the authority to intervene in innovation processes which are usually organised by market forces. In general, firms are very dependent on strong links with their external world. Production and marketing would not be possible without these links. If firms are unable to manage these core competencies, they will not survive. It would be market distortion if the state were to intervene at this stage. The situation looks different when it comes to the point that overall public interests are tackled. This might be the case when the market is unable to adjust according to principles of social wealth and economic prosperity. Since innovative activity not only contributes to the economic success of firms, but to the technological development, competitiveness and employment capacity of a whole nation, it is the task of the government to create framework conditions which enable the economic actors to contribute to public priorities and wealth through increased innovative activity. One means for stimulating innovation is, according to theory as well as practice, the initiation, establishment and promotion of innovative links between firms and their external environment. With these objectives the government should assist those firms and institutions which are discriminated in network-building and knowledge exchange with regard to size, resources, competences, and location compared to others. The assumption is that innovative potential in branches, technologies and regions which has not been utilised so far could be exploited. Here, innovation policy is strongly linked to industrial, economic and regional policy.

With regard to the principle of subsidiarity, the government's role should be confined to the setting of a favourable legal and institutional environment, and should stimulate but not govern processes. It should withdraw from innovation promotion when such processes could be organised by economic forces alone. Another objective of public intervention could be the improvement of the scientific and technological excellence of a nation. In this case technology promotion should not only bring those actors and competences together which already have the potential for scientific progress and economic growth, but also those whose potential could be further exploited and synergy effects be realised by joint efforts in research and product development. Again, when the objective is fulfilled, governmental support should be concluded.

In the case of regional technology and innovation policy, another aspect of political intervention has to be discussed. Usually, technology policy and, to some extent innovation policy as well, aim at the improvement of the economic and technological competitiveness of firms and thus, when it is national policy, of the nation also. This

growth objective makes it necessary to concentrate all financial and other resources for achieving an optimal allocation, irrespective of their geographical distribution. As a matter of fact, national technology policy is not usually in a position to take regional problem situations adequately into account, since neither its goals nor its instruments are adapted to coping with regional peculiarities. A policy oriented towards the optimisation of national innovation resources generally tends to increase regional disparities. Since important research institutions and industrial research laboratories are usually located in areas that are already economically favoured, public promotion of these locations tends to underline and reinforce existing regional disparities (Koschatzky 1997: 185-187). On the other hand, the new instruments of innovation policy not only regard the region as a mere implementation platform for national policy measures (as they still do), but also do want to contribute to regional development. This *balance objective* might provoke a *conflict of objectives* in those cases where financial resources are limited and the regional orientation of policy actions would favour regions and regional firms which are not yet in a position to really contribute to the improvement of national technological competitiveness. In this case, regional innovation policy is characterised by an innovation-oriented regional policy (Ewers/Wettmann 1980). 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 the broad innovation promotion in a multiplicity of regions with the possible consequence of decreasing national technological competitiveness.

However, the question has also to be raised whether a strict separation between growth and efficiency-oriented technology policies and balance-oriented regional policies can still be held, bearing in mind that regions on behalf of their inhabitants and their prosperity try to persist in national, supranational and global competition. An efficiency-oriented, regionally implemented "picking the winner" strategy - although economically deductable from neo-classical equilibrium models - does not provide an answer to the question about the perspectives of regions without prerequisites for high-tech developments and cannot alleviate existing disparities between regions.

Thus, from the regional viewpoint, the conflict between balance and growth orientation defuses itself, since each region should have its own interest in pursuing a growth oriented strategy, which refers to the endogenous strengths and potentials. However, these strengths do not necessarily correspond to leading-edge potentials in the interregional comparison, which can oppose the (national) efficiency target. On the other hand, there is much empirical evidence for the fact that that a regional orientation of innovation policy pursuing intraregional growth strategies might go hand in hand with interregional competition by building up regional innovative competencies

(cf. ISI *et al.* 2000). Nevertheless, in practice there is a goal conflict between technology policy and region-oriented innovation policy which thus defines the framework for public action.

As already pointed out, regions are equipped with a specific permutation of production factors; these can only be considered to be optimally allocated if they are made the basis for regional technology and innovation promotion. With regard to regional and sector specifics, *public regional innovation promotion* therefore has three tasks (Koschatzky/Gundrum 1997: 212):

- the activation and careful complementing of regional resources for the development and application of new technologies (regional innovation conditions);
- the co-ordination and interlinking of these resources in regional innovation networks, bringing in all the relevant actors in industry, science and policy;
- the integration of these regional networks into national and international clusters of technology development and production, through the creation of active interfaces and the promotion of supra-regional co-operation.

Through their enterprises and research institutions, regions are usually integrated into international and national technology networks. Depending on the types of region (i.e. global hubs, regional innovation systems or regions with under-developed innovation potentials) which determine a national innovation system, there is usually little scope for regionally-specific technology development, although new technologies may definitely have a regional origin. However, because of the existence of regional focuses in technology, they can be made the starting-point for an endogenous regional development strategy. An innovation- and technology-oriented regional policy is thus subject to restrictions which, although they may limit its scope for action, may also lead to promotion approaches that are sometimes very specific. When formulating measures, it is important to bear in mind that regional promotion activities are embedded in national and supranational science and technology policy, and cannot be considered in isolation from these levels. Enterprises, as well as research and development institutions, have the option chance to participate in national and supranational promotion programmes. Regional programmes must be oriented according to these higher-level promotion lines and must make use of them. Despite the existence of national and supranational (i.e. European) regional promotion, the amount of funding which can be made available for regionally-specific measures is limited, especially when the region itself makes the major financial contribution.¹³ Promotion measures thus have to be planned and implemented, with the involvement of regional and local actors, in a form

¹³ This aspect refers to the concept of governance and its implications for regional innovation policy, which is a constitutive element in the concept of regional innovation systems (Cooke 1998).

that will meet with a high degree of acceptance and will generate a correspondingly large regional impact.

With regard to the theoretical foundation of a regionally-oriented innovation policy, its major purposes should be the *promotion of regional clusters*, the *improvement of the efficiency of regional innovation systems* and the *stimulation of competition between regions* (cf. ISI *et al.* 2000):

- A *promotion of clusters* seems appropriate for industries and technologies which are in an early phase of their life cycle. In order to structure critical masses, the localising effect of "tacit knowledge" and spatially limited spillovers demand a high degree of regional concentration during that early development phase. The cluster approach seems to be less suitable for mature industries or technologies. In cluster promotion, region-oriented innovation policy can have positive effects not only for the private sector, but also for regional development. Nevertheless, miracles should not be expected: At least with a sectoral or technologically non-discriminating promotion a kick off towards a permanent change of the promoted regions on a higher growth path cannot be assumed. At best, catching up processes of less innovative regions can be accelerated by a constant allocation of public money over time. Regarding technology or sector-specific promotion, however, long-term and sustainable growth impulses can be given, especially if the technology or industry emerges as "key technology", and if the external effects are localised over a longer period of time. Silicon Valley is the most well-known example of such a case. In the long run the strong specialisation of a region might lead to lock-in situations (Grabher 1993), causing obsolescence and resulting in mono structures as was the case in coal mining and steel producing regions. This danger can be effectively avoided by a mix of technologies and industries of different maturity stages.
- For national measures for *improvement of the efficiency of regional innovation systems*, three starting points exist: (i) the improvement of the integration of regional innovation systems into the national innovation system, (ii) the strengthening of the constituent elements of regional innovation systems and (iii) the better networking of the elements of regional innovation systems. In these cases national innovation and technology promotion should be limited to supporting and stimulating functions. The central, regional or local governments have the function of creating suitable basic conditions for enabling firms to innovate and – where this is efficient – to allow for spatial concentration. Incentive systems by public financial assistance also seem to be possible, but only to the extent that they strengthen the regional self-initiative and the motivation for the development of endogenous objectives and supporting measures. This concerns both regions with technological potentials and spatial units, in which innovation conditions are still underdeveloped.

- The third element of a regionally-oriented innovation policy is the *stimulation of the competition between regions*. Competition between regions and their institutions represents an experimental procedure for uncovering superior institutional arrangements, because without the competition of alternative solutions it is not known which constitutional arrangements or political orders are better suited to serve the interests of the population.

In Germany, several programmes and measures have been implemented during the last few years which were not only assigned to these elements of a regionally-oriented innovation policy, but which also aimed at the promotion of different types of regions pursuing different objectives. These will be presented in the next section.

4. Regional innovation policy in Germany: Some examples of recent evidence

In Germany, due to its federal political system, several policy levels act and interact closely with regard to regional economic and innovation promotion. The most important are the federal government, the federal states governments and the European Commission (cf. Figure 1). One example in which these three levels work closely together is the "Gemeinschaftsaufgabe Verbesserung der regionalen Wirtschaftsstruktur" (common task for improving the regional economic structure). It is jointly funded by the European Commission within its European Fund for Regional Development, the federal and the federal states governments and promotes regional development in objective-1 regions (East Germany) and 5b regions (mainly regions in former West Germany closely located to the former border between West and East Germany). Its major instruments are infrastructural measures (involving transport, telecommunication and energy systems), regionally-differentiated investment grants and tax reductions which should stimulate intraregional or external economic potential and temporarily increase the mobility of production factors oriented towards the region. Quite recently, a share of funds has also been allocated to innovation promotion. The major objective is to reduce socio-economic disparities with reference to the national average and to create and secure employment opportunities. In the following, only measures of the federal government directed towards the regional level will be presented.

Figure 1: Actors and implementation levels of technology and innovation policy in Germany

Implementation	Supranational (EU)	National (Federal Government)	Subnational (States)	Regional
Actors levels	Technology Policy		→	Innovation Policy
Supranational (EU)	Technology and innovation promotion (Actions, Programmes and projects under FP 5)	Co-ordination with the member states, participation at EU programmes	RIS, RIS+, RITTS and TRIPS- projects	RIS, RIS+, RITTS and TRIPS- projects
National (Federal Government)	financial contributions to EU budget; involvement in formulation of FP 5	Instruments and measures of technology policy	Common tasks (Improvement of regional economic structure, university extension programme), institutional funding	BioRegio, EXIST, InnoRegio (for regions in the new federal states)
Subnational (Federal States)	Participation competencies via federal government	Common tasks (Improvement of regional economic structure, university extension programme)	state specific promotion policy, institutional funding, infrastructural development	regional priority settings in the promotion and development of innovative regional clusters
Regional	political influence on EU technology policy	political influence on federal government's technology policy	political influence on federal state's innovation policy	infrastructural development (e.g. technology centres), network promotion, information, consultancy/advice, qualification, marketing

Source: Koschatzky (2000: 261)

With regard to the possibilities for implementing regionally-oriented policy measures, Germany is in quite a favourable position due to its decentralised distribution of innovative clusters and regions (cf. Table 1) Over half of all nation-wide R&D employees in industry have their workplace in 8 regions, while the concentration towards a few major centres of R&D activity is much higher in other European countries. Only in the USA, is the distribution similar to that of Germany. This not only applies to industrial R&D activities, but to other innovation aspects as well. According to the inventors address, 42 % of all patent applications in 1998 came from 10 regions, leaving 58 % to the remaining 87 German planning regions. For applications from industry, ten regions contributed to a share of 44.5 % of all respective patent applications, while for research institutions it was 62.6 % (ISI *et al.* 2000). So only in research, patenting activity is concentrated in a few regions, although the distribution of universities, polytechnics and other research institutes is fairly evenly dispersed since they have been a popular instrument of regional policy during the past decades. This patent behaviour in research institutes and especially in universities points to the fact that the innovative and technology transfer potential of many universities and their respective regions is still not fully utilised.

Table 1: Spatial concentration of industrial R&D in selected countries

Approx. half of the nation-wide R&D employees in...can be found in the agglomerations...

Germany (1997)	France (1995)	UK (1995)	Italy (1995)	Spain (1995)	USA (1995)
Munich (12 %) Stuttgart (12 %) Darmstadt (9 %) Rhine-Neckar (6 %) Berlin (4 %) Düsseldorf (4 %) Brunswick (3 %) Cologne (3 %)	Paris (Île de France) (48 %) Rhônes-Alpes (11 %)	London (South East) (41 %) East Anglia (11 %)	Milano (Lombardia) (33 %) Turin (Piemonte) (24 %) Rome (Lazio) (10 %)	Madrid (32 %) Barcelona (Cataluna) (29 %)	New Jersey Essex (9 %) Boston (8 %) Los Angeles (7 %) Philadelphia (6 %) Chicago (5 %) Detroit (4 %) New York (4 %) San José (3 %) Washington D.C. (3 %)
8 regions	2 regions	2 regions	3 regions	2 regions	9 regions
53 %	59 %	52 %	67 %	61 %	49 %

Source: adapted from ISI *et al.* 2000 (contribution by NIW)

Recently, Germany's federal government has paid great attention to the regions in the implementation of technology policy measures. Taking the three types of region defined in section 2 and the three central elements of a regionally-oriented innovation policy summarised in section 3 as a structuring principle, these measures can be attributed to different policy objectives for promoting technological and regional development. All three of the following measures are network-oriented, are based on the hypothesis that spatial proximity positively affects knowledge exchange and thereby innovative activity, define "region" by the spatial reach of networking and thus not automatically by political boundaries, and follow the principle of competition among regions.

- (1) *Increasing national competitiveness in biotechnology by promoting well advanced German "first league" regions:* The objective of the *BioRegio contest*, which was launched in 1996, was to stimulate firm foundations and the location of foreign biotechnology companies in Germany, to accelerate growth in existing biotechnology enterprises and to ensure the supply of sufficient seed and venture capital to improve the competitive situation of Germany in biotechnology. Through this, BioRegio aimed at overall national objectives and addressed regions in which firms and research institutes were located which already had a potential for being competitive on an international scale. In a competition procedure three regions with appropriate research potential were selected: Munich, the Rhine-Neckar Triangle (Heidelberg, Ludwigshafen, Mannheim) and the Rhineland (Cologne, Aachen, Düsseldorf, Wuppertal). Each will be subsidised by 25.56 million € from the Federal Ministry for Education and Research (BMBF) until 2001. The already existing scientific and industrial research and the advantage of spatial proximity between industry, research and venture capitalists were made the starting point for network generation in and between the regions and international biotechnology research, testing and production. With respect to the

number of firm foundations in biotechnology, BioRegio contributed to reaching top European positions during the last few years. According to the German Biotechnology Report 2000 by Ernst&Young, Germany has outrun the British biotech-industry in the number of firms. Of the 1,350 European biotech-companies, 279 (20.7 %) are located in Germany. This corresponds to a growth of 25 % compared to 1999 (BMBF 2000a).

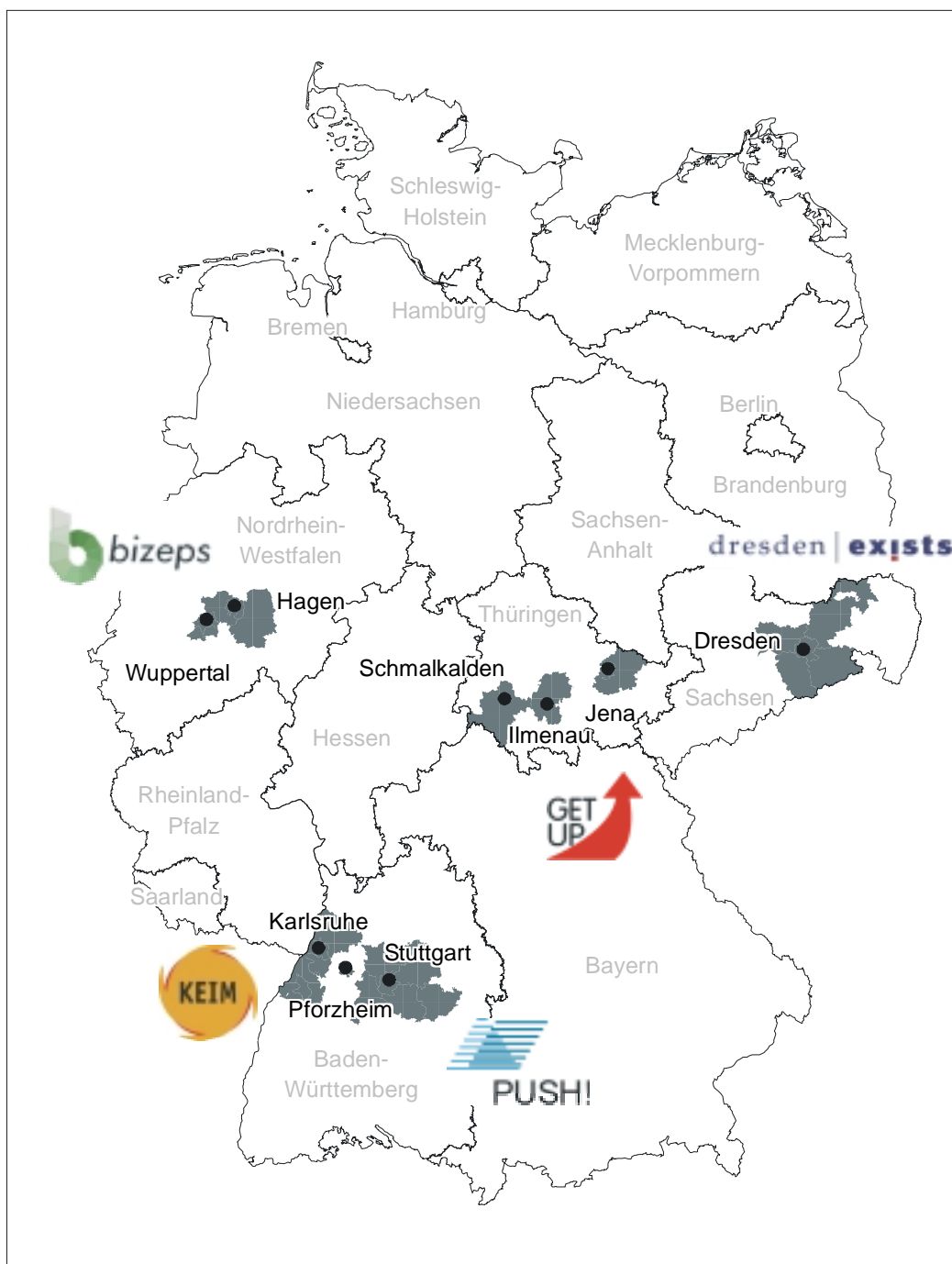
(2) *Improving the entrepreneurial climate at higher-education institutions by networking promotion in German "first league/second league" regions:* In December 1997, the "EXIST-University-based start-ups" programme was launched by the federal Ministry for Education and Research (BMBF) as a contest. Its general objective was that concepts for regional co-operation between universities, polytechnics, the business sector and further partners should be initiated. Four guidance objectives are pursued (BMBF 2000b):

- The permanent creation of a "Culture of Entrepreneurship" in teaching, research and administration at higher-education institutions targeting students, university personnel and graduates;
- increasing knowledge spillover into economic value added;
- the goal-directed promotion of the large potential for business ideas and entrepreneurs at higher-education institutions and research establishments;
- a significant increase in the number of innovative start-ups and the resulting creation of new and secure jobs.

Following the call for proposals, 109 concepts were submitted. To qualify for participation, at least three different partners from a region had to work together, and one of the partners had to be a higher-education institute (university or polytechnic). In March 1998, a jury selected 12 out of the 109 concepts which seemed to be the most promising (i.e. university-based networks in the regions Stuttgart, Karlsruhe/Pforzheim, Munich, Berlin/Brandenburg, Hamburg, Rostock/Mecklenburg-Westpommern, Gelsenkirchen/Bocholt/Bochum, Wuppertal/Hagen, Kaiserslautern/Trier, Saarbrücken/Saarland, Dresden, Ilmenau/Jena/Schmalkalden). These regions were given the opportunity to make their ideas more concrete until July 1998. In August 1998, five of them were awarded prizes for the best regions (cf. Figure 2): the networks "bizeps" (Wuppertal/Hagen), "dresden exists" (Dresden), "GET UP" (Ilmenau/Jena/Schmalkalden), "KEIM" (Karlsruhe/Pforzheim), and "PUSH!" (Stuttgart). Since the end of 1998, these five regional initiatives have been working for the realisation of their concepts. Funding, which amounts to 15.34 million € p.a. for the whole programme, has been granted until the end of 2001. To this end, good practice models for the motivation, training and support of founders for new firms and of entrepreneurship have to be set up. Universities and polytechnics have to work together with different external partners from industry, education and training, consultancy, the financial sector and administration. Accompanying measures are public relation

activities, the "EXIST-Seed" programme which provides grants to students, graduates and faculty members for promoting promising ideas, and the "EXIST-HighTEPP" (High Technology Entrepreneurship Post-graduate) programme which aims at the training of young academics, the support of start-up projects and the training of managers for dynamic high-tech firms in the biotechnology, pharmaceutical and information technology industries.

Figure 2: The five EXIST regions in Germany



Since the economic structure, the industry mix and the prerequisites for building up networks are different in these five regions (cf. Table 2), different models and strategies for promoting entrepreneurship at higher-education institutions will emerge. So far it is too early for an overall evaluation of the different activities and the dynamics within these five networks.¹⁴ Nevertheless, at the end of July 2000 approximately 240 start-ups which can directly or indirectly be attributed to EXIST resulting from a one and a half year's activity.

Table 2: Characteristics of the five EXIST regions

	bizeps	dresden exists	GET UP	KEIM	PUSH!
Population	1.7 million	470000, within commuting area approx. 1.0 million	461000	1.3 million	2.5 million
Students	20000 plus 44000 in Germany at "FernUniversität Hagen"	24100	24300, Jena alone 17800	23400	over 40000
Students per 100000 inhabitants	1170 (without Hagen)	2410	5280	1800	1600
No. of firms in high-tech fields	889 of which 861 SMEs 28 large firms (share of all regional firms: 3.1%)	457 of which 442 SMEs 15 large firms (3.3%)	209 of which 200 SMEs 9 large firms (4.3%)	625 of which 605 SMEs 20 large firms (3.2%)	1609 of which 1,491 SMEs 118 large firms (7.3%)
No. of high-tech firms per 100000 inhabitants	52.3	45.7	45.4	48.1	64.4
No. of closely integrated network partners	21	32	over 60	15	60

Source: internal material of EXIST evaluation (ISI)

- (3) *Promotion of innovation and networking in regions of the new federal states:* The main objective of the *InnoRegio contest*, which is confined to the new federal states, is the sustainable improvement of the employment situation in eastern Germany and the strengthening of their competitive ability (cf. Koschatzky/Zenker 1999). In order to achieve this objective, concepts and projects are to be developed on the regional level aiming at the utilisation of innovation potential. For

¹⁴ The scientific monitoring and evaluation of the five regional networks is being carried out by the Department "Innovation Services and Regional Development" of Fraunhofer ISI.

initiating networking activities, innovation dialogues are started up. The establishment of regional networks should be fostered, in which people from different fields of activity should engage in joint innovation and learning projects. They are expected to develop ideas and visions in new co-operation beyond administrative borders or department barriers. It is assumed that regional networks bring the creativity, competence and motivation of different actors from research, business and society together in a new way. These networks are expected to be the basis for developing a competitive research, education and economic profile of the region and thereby create new employment and market opportunities.

The first phase of the contest started in April 1999 with the call for proposals (BMBF 1999). Up to the deadline on 15 August 1999, more than 440 proposals had been delivered which showed a great variety of ideas. They ranged from the special use of modern information technologies, to future-oriented education projects and specific forms of "soft tourism". From these applications the jury pre-selected 50 concepts from which 25 qualified as "InnoRegios". The central evaluation criteria of the jury were the novelty of the approach, the persuasive power of regional co-operation and the expected benefit for the region. The 25 regions were given 153,370 € each by BMBF for elaborating their strategies for regional development until summer 2000. Following the decision of an independent jury, the implementation of these strategies will also be financially supported in most of the 25 regions with a total sum of approximately 230 mill. €. Financial contribution ranges from 4.1 mill. € for the Regional Innovation Alliance Oberhavel up to 20.5 mill. € for the BioMeT Innovation Network Dresden (BMBF 2000d).

Although all the programmes and contests mentioned above are based on network-building, they aim at different objectives. In the case of InnoRegio, network formation is used as an instrument for bringing people together and for formulating a joint regional innovation strategy. In this way, bottlenecks and economic problems should be overcome and employment should be secured. Innovative is all that is new to the region, so that innovation is not confined to technological progress. These strategies should also provide development chances to regions which so far have only less developed innovation and economic potential. Another strategy is employed by the BioRegio and the EXIST contest. Both are mainly aimed at improving the technological and economical competitive advantage of Germany. In the case of BioRegio, scientific excellence in biotechnology research is linked with industrial needs and interests, so that not only can the share of new products reaching the market increase, but also so that new firms for biotechnological product and process development can emerge. EXIST, on the other hand, aims at improving the entrepreneurial climate in Germany in general and at universities, polytechnics and research institutes in particular by transferring good practice strategies, developed in five model regional networks, to other regions and by stimulating similar activities in other locations.

5. Conclusions

Although BioRegio and EXIST are showing initial indications for the successful implementation of single measures, the question whether the regional and network-based approach itself is suitable for the pursued objectives is difficult to answer at this point. The question concerning the opportunity costs of these programmes is a rhetorical one, since all major technology and innovation policy programmes of the last years have either the contest idea, the regional orientation or both, in common. What can be said is that with these three contests a *change of paradigm in the German technology and innovation policy* has been observed, which brings the classical boundaries between technology and regional structural policy into question, but also touches on the political action fields of the federal government and those of the federal states. The "region" in its diversity is increasingly regarded as a relevant platform for national innovation policy. The three programmes described in section 4 utilised the strengths of certain regions in a different way:

BioRegio represents a continuation of the classical instruments of technological research promotion, whereby the contest as well as the explicitly spatial character of the promotion by the federal government were taken up as new elements. However, the measure is not directed at regional development, but uses the regional level as a starting point for an attempt to contribute to increasing Germany's biotechnological competitive ability by the establishment of regional networks. It was therefore confined to a few German "*high-tech*" regions. With this objective, BioRegio is oriented towards overall economic efficiency criteria.¹⁵

Also **EXIST** pursued predominantly national objectives and uses the region as a platform for the creation of network-induced synergies for the increase in the number of university-based start-up companies. For the founders of new (innovative) firms, a familiar regional environment is an important success- and uncertainty reducing factor. In Germany, approximately 70 % of firm founders founded their new business within 25 kilometres of their place of residence or their breeding institution, respectively (Schmude 1994: 79). Therefore spatial proximity between universities, information-, consulting- and financing institutions and the firm founder plays an important role in the promotion concept, and thus *regions offering promising network potentials and transfer-oriented universities/polytechnics* were best suited for this programme. With regard to BioRegio in the short and medium run, and more in the long-term with regard to EXIST, also regional economic implications are to be expected by the programmes. These will lead rather to a reinforcement of regional disparities in the case

¹⁵ A new programme aiming at the promotion of specific regional biotechnological profiles is the "BioProfile" contest. From May 2001 onwards, three regions will receive financial promotion up to 51.1 Mio. € in total for a period of five years (BMBF 2000c). By this, the regional base of German biotechnological research and commercialisation will be broadened.

BioRegio, since research and production clusters are promoted, which already have a high degree of scientific excellence at the beginning of public promotion. EXIST is, in contrast to BioRegio, rather neutral with respect to an increase or decrease in spatial disparities, since also regional initiatives outside the large German agglomerations are also promoted. Besides, positive development impulses in those regions are to be expected which did not win the competition but which test similar concepts in self-initiative or with federal state supports. By its university orientation, EXIST touches both federal and federal states authority, without coming into conflict with federal states sovereignties.

Compared with the two other measures, **InnoRegio** is much more oriented towards regional policy, explicitly pursues spatial balancing objectives and is much more dependent on co-ordination with the federal states governments due to its explicit regional orientation. The federal governments' justification for the execution of this programme is derived from the efforts for the creation of equivalent living conditions in West and East Germany and on the fact that InnoRegio is an approach for all East German federal states. The concept is similar to the RIS (Regional Innovation Strategy) programme of EU's DG Regional Policy, which uses the development of innovation-oriented regional development concepts as instruments for a more efficient allocation of the structural funds (cf. European Commission 1997). Since InnoRegio does not have a technological focus, but defines innovation as all which is new for the region, many *regions even without pronounced innovation potentials qualified for entering the contest*. In this case, clear boundaries between direct technology and innovation promotion and regional economic promotion and structural policy diminish. Political efficiency criteria are aimed at the regionally feasible and not at an optimisation of overall economic resource allocation.

InnoRegio and the RIS projects of the European Union exemplify the convergence between the promotion of innovation and regional development. With InnoRegio, the BMBF, usually technology-oriented, started up a supporting measure in which it was open to a broader understanding of innovation and made the region, understood as spatial entity smaller than single federal states, into its action platform. On the other hand, the classical infrastructure-oriented regional policy of the European Union (and concomitantly those of the federal government and the federal states governments) changes increasingly in the direction of a network- and project-based innovation-oriented regional promotion. Since both developments stress the importance of the regional level as well as of innovative concepts for regional development, it can be assumed that the initiation and promotion of regional innovation processes and networks will have a high priority on the political agenda also in the future.

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