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PAPER 23:

THE CHANGING ROLE OF THE REGIONS IN GERMAN TECHNOLOGY POLICY

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I. Introduction

In the era of globalization with its ever increasing competitive pressure on firms and their employees new knowledge – and particularly new technical knowledge - has become the most important production factor. Moreover, the way that new technical knowledge itself is produced has rapidly changed in recent years: Knowledge production becomes more and more complex, such that more and more people have to interact in this specific production process and the halflife period of new technical knowledge becomes shorter and shorter which means that enterprises that want to stay on top have to speed up the process of knowledge production. These fundamental changes in the way that new technology is produced challenge traditional technology policy approaches and call for policy innovations (Dohse 2001). Indeed, as the OECD has documented, in most industrialized countries policymakers try – more or less successfully – to reform their traditional technology policy approaches (OECD 2000).

The focus of the current paper is on policy innovations in Germany as German technology policy has undergone a particularly remarkable change in recent years: Traditionally, the reference units of German technology policy were single firms, technologies or sectors. Since the mid-90's the German Federal Government has discovered the *region* as a new reference unit for technology policy. Policy instruments such as the 'Bioregio contest', the 'City Contest Multimedia' or the 'Competition of Nanotechnology Competence Centers' have drawn a bt of attention nationally as well as internationally. In contrast to these early instruments that were restricted to single technologies, the newly established 'InnoRegio contest' encompasses different fields of technology but is geographically restricted to east Germany.

As the aim of the paper is to come to a general assessment of the new region-oriented technology policy in Germany rather than to discuss each single policy instrument that belongs to this category the discussion is focused on the two prototype models of the new region-oriented technology policy, namely the BioRegio contest and the InnoRegio contest. Before analyzing and comparing these prototype models in detail it is necessary to define what is meant by region-oriented technology policy in the context of this paper: In an important article on the Japanese "Technopolis" initiative Sternberg has defined region-oriented technology policy (ROTP, for short) as "… a national technology policy pursuing

spatial goals" (Sternberg 1995). We use a slightly different definition, i.e. we understand region-oriented technology policy as *a national technology policy making use of the regional level in order to pursue national goals*. ROTP in Germany in the above-mentioned sense focusses on three targets: generating regional high-tech clusters, stimulating interregional competition for technology, and improving the well-functioning of regional innovation systems (Dohse 2000a).

II. Prototype I: BioRegio

Aims and conceptual design

Compared to other countries, especially the US and the UK, biotechnology had a slow start in risk averse Germany. Falling behind in a so-called 'generic' high tech industry was a matter of serious concern for German policymakers in the early 90's. Therefore, the BioRegio contest was designed to transform a dormant sector into one intended to be globally competitive by stimulating biotech firm start ups, the growth of existing companies and the provision of venture capital (BMBF 1997).[1]

All regions wishing to participate in the contest had to give a presentation of their respective strengths in biotech from the lab bench to the market as well as proposals for future development of biotechnology in the region. An independent jury was installed by the Federal Research Ministry to find the three best organised regions with the most promising development concepts on the basis of the criteria outlined in table 1.

[Table 1]

The number and the internal structure of the regions participating in the contest was not predetermined by the Federal Research Ministry, nor were the institutions taking the lead in the formation of the BioRegios. In some regions the local or state governments coordinated the regions' activities, in other cases it was industry or research institutions themselves. In all regions enterprises, research institutes and government officals cooperated very closely.

All in all, 17 BioRegios formed to participate in the contest, although the number of potential participants could have been higher.[2] Map 1 shows how heterogeneous the participants in the contest are: Some of them are single cities (and their hinterland) such as Freiburg (3), Jena (6) or Regensburg (No. 12 in map 1). Others are networks of neighbouring

[1] The ambitious long run aim of the contest is to make Germany the number 1 in European biotechnology (BMBF 1997).

[2] BMBF officials expected up to 30 regions to participate.

cities such as Braunschweig-Göttingen-Hannover (9) or Heidelberg-Mannheim-Ludwigshafen (15) or they cover whole federal states such as Berlin-Brandenburg (1). The most populous region (Berlin-Brandenburg) has more than six million inhabitants, compared to just a little more than onehundred thousand in the smallest BioRegio (Jena).

[Map 1]

The three regions selected by the jury as winner regions were Munich (8), Rhineland (13), including the cities of Cologne, Aachen, Düsseldorf and Wuppertal, and the Rhine-Neckar Triangle (15) with Heidelberg, Mannheim and Ludwigshafen. It was pointed out that these regions all have a comprehensive scientific basis in modern biotech research, substantial enterpreneurial activity in the field of biotechnology and a promising regional development concept for biotech industry. The East German region of Jena received a 'special vote' for its 'especially positive new-orientation' in the field of biotechnology after re-unification.

Being chosen as a 'model region' has two advantages: On the one hand, public funds amounting to 150 million DM are reserved for the three winners in the BioRegio contest. On the other hand, the winning regions receive priority in the appropriation of funds from the "Biotechnology 2000"-program of the Federal Research Ministry for a time span of five years. The latter advantage seems to be the more important one since the total amount of public biotech funding in Germany (about 1.5 billion DM from 1997 to 2001) is about ten times higher than the direct BioRegio award and the jury's judgement on the regions capability and concepts is of crucial importance for the spatial distribution of funds from the larger budget.[3]

The actors' perspective

In June 1999 the Kiel Institute performed an e-mail survey among German biotech firms (participants in the BioRegio contest and non-participants), trying to shed some more light on the strengths and weaknesses of such a region-oriented technology policy instrument from the perspective of the actors that perform innovative activities and apply for government funding. The aim of the investigation was not to perform a final and all-comprehensive evaluation of the specific BioRegio instrument, but rather to shed some light on the more basic question if - and to what extent - it makes sense to include the regional level into national technology policy making. Therefore, we gave prominence to what may be called the

[3] Considering institutional funding and the financing of research institutes, the total amount of government funding for biotechnology is even higher (approximately 1 billion DM in 1998).

'strategic efficiency' of the instrument (i.e. checking whether the assumptions on which the BioRegio instrument is based are appropriate in their perception of problems and causes) rather than checking its 'operative efficiency' (the concrete implementation and administration) in depth (see Dohse 2000b for details). [4]

Main results

The BioRegio instrument is widely known and quite well accepted by the German biotech community, although - not surprisingly - the assessment varies between those who receive funding from the programme and those who don't. The assumption underlying the BRC[5] that there was a technology gap between Germany and the leading biotech nations (the US and the UK) when the BRC started in the mid 90's was shared by all 33 respondents; 79 % of the responding firms found this to be definitely true, 21 % answered that this was partly true (Dohse 2000b: 1124). Such a gap was identified primarily in applied resarch and commercialisation, less so in basic research. A vast majority of firms believe that the competitive stance of the German biotech industry has - at least in part - improved since the contest started.

The firms' assessment concerning the most important obstacles to biotech innovation in Germany (table 2) lends support to the thesis that the problems addressed by the BRC (insufficient technology transfer between firms and universities, lacking communication and cooperation among the regional key actors,[6] lacking acceptance of biotech in the public) are of paramount importance, although the important problem of over-regulation is only partly (as far as the regional level is concerned) and indirectly addressed by the BRC. By contrast, lack of public funding and lack of venture capital seem to be of less importance and only a minority of firms views lack of highly qualified researchers as an effective obstacle to biotech innovation in Germany. Comparing our results with an earlier survey among small and medium-sized biotech firms (FhG ISI 1995) indicates that problems of venture capital and finance (ranking high in the ISI study) have become less acute in recent years, which is in

[4] We tried to keep the questionaire as short as possible and renounced on asking questions concerning confidential or firm-specific matters in order to secure an acceptable return. 33 questionaires (33 %) were returned to us. 75 % of the responding firms participated actively in the Bioregio contest and half of them received funding from the BioRegio programme. About 25 % of all respondents are located outside the BioRegios and have neither participated nor received funding. These are referred to as 'non-participants' in the remainder of this section.

[5] Abbreviation for BioRegio contest.

[6] It's interesting that the lack of communication and cooperation within the region is especially emphasized by the non-participants from outside the BioRegios (table 4). This may indicate that these firms have a locational disadvantage further increased by the BioRegio contest.

accordance with the trends reported elsewhere (Schitag Ernst &Young (1998), Ernst&Young 1999).[7]

[Table 2]

The most important *advantages* of the BioRegio instrument appear to be the enhancement of communication and cooperation among the regional key actors, the establishment of an innovation prone regional environment, the furthering of research cooperation within the BioRegios and the stimulation of interregional competition for technology (table 3). Those respondents who named further advantages emphasized the 'change of consciousness' brought about by the BioRegio contest: The regional actors have become aware of their region's potential, the social acceptance of biotech within the regions has improved, and the BRC itself may be seen as a world wide marketing success for German biotech industry.

[Table 3]

The most important *shortcoming* of the BioRegio contest - according to the actors' view - is that it misses to reduce regulation at the national level (table 4). Furthermore, it is widely held among biotech firms that the 'picking of winning regions' may do injury to innovative firms located outside the winner regions or even outside any of the 17 BioRegios, and that the new instrument neglects the less favored regions at the periphery. The criteria for the selection of winning regions are seen quite critically (especially by the 'non-participants' from outside the BioRegios) and 60% of all respondents (36% of those who receive funding) have the impression that the winner regions were known before the contest started. 88% of the responding firms (even 75% of those who receive funding) agree that the BRC leads - at least partly - to free rider effects and still 36 % of all respondents are critical about the efficiency of such form of government intervention into the market process.

[Table 4]

A vast majority of firms (75%) views the BRC as a successful instrument that should be continued, and that has helped forward the international competitiveness of German

[7] Further obstacles named by the respondents include unfavourable corporate tax legislation in Germany (especially concerning 'stock option' models for the participation of employees), lack of economic and marketing skills of university researchers and a hostile environment to innovation and firm start-ups.

biotech industry (table 5). It is interesting that even those firms which don't receive funding view the BRC as a success story: 70 % of them say that the BRC has been successful and should be continued with and an even higher percentage (90 %) say that the BRC has reached its objective to help forward the competitiveness of German biotech industry. 72 % of all responding firms agree that the BRC has contributed to a considerable job creation and an even higher percentage of respondents agree that it has contributed to an improved venture capital provision. This is in accordance with the fact that the number of venture capitalists engaged in biotechnology grew in number from two in the 1980's to more than seventy by 2000 (Cooke 2002: 172).

[Table 5]

A majority of all respondents believes that the BioRegio funding does not reach the most innovative biotech firms (table 5); however this result varies strongly between the sub-groups: from those firms that receive funding from the BioRegio-programme 72,7 % answered that the BioRegio funding reaches the most innovative firms whereas of those firms that don't receive funding it is just 23,5 %.

Interregional competition for scarce public funding is viewed as a means of enhancing the efficiency of technology policy by a majority of firms, although this result isn't robust: Among those who were successful in attracting funding it is 75% that agree, among those who don't receive funding it is only 47 %.

Some respondents made suggestions about what should be changed (or could be improved) with the BioRegio instrument. Three firms claimed that the BRC should be succeeded (or complemented) by an integrated *national* concept for the support of biotech innovation. Others suggested to give up the restriction on regions or to make sure that each innovative firm can be associated with a Bioregio in order to prevent discrimination. Finally it was suggested to better consider recent trends in the BioRegios (i.e. to shuffle the cards new each year) and to give more weight to a region's development potential than to the already existing structures.

The German biotech industry before and after the contest

In recent years the number of biotech firms increased more rapidly in Germany than in any other European country and the most firm start-ups could be observed in the 17 regions participating in the BioRegio contest. In 1999, i.e. four years after the BioRegio contest started, Germany surpassed the UK and for the first time rated number 1 in European biotechnology according to the number of firms. In 2001 the number of German biotech firms

was 330, compared to (approximately) 270 in the UK and less than 200 in France: "Germany can now claim to be Europe's most densely populated biotech kindergarten" (Ernst & Young 2001: 5). Nevertheless, taking the size and maturity of the companies into account, the UK is still dominating the European biotech sector, although Germany is also catching up according to these criteria (Ernst & Young 2000, 2001).

A closer look at the current biotech map of Germany shows that a quite impressive biotech sector is emerging and that there is a strong tendency towards clustering. Up to now, seven larger biotech clusters have developed in Germany: The three winning regions Munich, Rhine-Neckar Triangle and Rhineland; the Berlin area, the Hamburg area, the Frankfurt-Wiesbaden area and the Freiburg area, which is part of the trinational 'BioValley upper rhine' [8] (Dohse 2000b, Ernst & Young var. issues). Despite its relatively small size BioRegio had an important symbolic and practical impact on the German biotech innovation system: "More than any other federal initiative it has produced rapid, positive results and galvanized entrepreneurship in respect of new firm formation, also giving a significant boost to Germany's lagging venture capital industry." (Cooke 2002: 171)

III. Prototype II: InnoRegio

While the major aim of BioRegio was to initiate a catch up process in a generic high tech industry the main objective of InnoRegio is to close – or at least to reduce – the *regional* innovation and development gap between east and west Germany. Indeed, one may argue that InnoRegio with it's budget of 500 million DM is an important building block in the Federal government's strategy of "rebuilding the East".

InnoRegios are, according to a definition by the Federal Research Ministry, regional units, smaller than states (Bundesländer) in which people and institutions from private enterprises, science, education, policy, administration and private organizations cooperate in order to generate technical, economic and social innovations (BMBF 1999:6).

There were 444 rather heterogenous projects that participated in the so-called 'qualifying phase' of the InnoRegio contest that lastet from April till October 1999. The applicants had to present their regional innovation profile, to outline the expected revenue that the InnoRegio funding would generate in their respective region and to explain their strategy of network-building and intra-regional cooperation in later stages of the contest. From these more than 400 applications an independent jury selected 25 approaches. Selection criteria were, according to the Federal Research Ministry, the origininality of the approaches, the

[8] The upper rhine region consists of the Freiburg area in Germany, the Alsace in France and the Basel area in Switzerland.

sustainability of intra-regional cooperation and the expected revenue of funding for the respective region (BMBF 1999). It seems, however, that regional proportionality aspects have also played a major role in the jury's decision as the percentage of winner regions from a state is commensurate with the percentage of applications from this state[9] (table 6).

[Table 6]

The winning projects got the privilege to participate in the second phase (the so-called development phase) of the contest. Each of them received up to 300.000 DM for the development of a realization concept that had to be presented until summer 2000. These realization concepts were again assessed by the jury on the basis of the criteria in table 7.

[Table 7]

When comparing these criteria to the selection criteria of the BioRegio contest it becomes quite obvious that the existing hardware (number and size of existing companies and research institutions in the region) that dominated the BioRegio decision steps back in favour of what may be called the 'software', i.e. development concepts for the future, originality of the approaches and networking strategies. The concepts chosen on the basis of the criteria in table 7 get generous funding (up to 500 million DM) in the third, so-called realization phase of the contest.

Common Features and Differences

What do BioRegio and InnoRegio have in common and what are the differences? At first glance, both instruments might seem rather similar: Both aim at stimulating the clustering of innovative activities and inducing a technology push, not only in those regions that receive funding but in the country as a whole. Both address the regional level in order to pursue national goals. The national goal behind the BioRegio contest is making Germany the number 1 in European biotechnology whereas in the case of InnoRegio it is rebuilding the German East. Both instruments are designed as an invitation to competition between regions and employ independent jurys as referees to find the winners, and both pursue a strategy of improving the scope and quality of cooperation within regional innovation systems.

[9] The city of Berlin is the only exception.

[Table 8]

However, a closer look reveals substantial differences: While BioRegio starts from the premise that biotechnology is a key technology of the 21st century and the necessity of federal funding is derived from the expectation of substantial positive externalities of biotechnology, InnoRegio is not focussed on a specific technology but funds a wide variety of projects ranging from modern information technologies and innovative educational projects to specific forms of sustainable tourism (table 9)

[Table 9]

The regional focus of InnoRegio is restricted to east Germany, whereas no regions were excluded ex ante (there was no 'closed shop') from the BioRegio contest. The participants in the BioRegio contest were whole cities or networks of cities whereas the participants in the InnoRegio contest are in fact no regions at all but rather single projects or institutions within these regions. This might explain why there was a large number of participants in the InnoRegio contest compared to a relatively small number of BioRegio participants. The decisive criteria in the BioRegio decision were 'hardware criteria' (existing firms and research facilities located in the region), whereas 'soft factors' gained more prominence in the InnoRegio decision.

The major difference between the two contests is, however, their different philosophy concerning the actual goals of technology policy. The objective of BioRegio is increasing Germany's international competitiveness in a generic technology, i.e. BioRegio pursuits a clear-cut national growth objective. In contrast, InnoRegio tries to pursuit two goals in one, namely regional income convergence and national growth, and it is hard to make out which is the dominant goal.

IV. Strengths of the new Policies

Taking regions seriously

A major policy innovation that distinguishes ROTP from the traditional technology policy pursued in Germany is that the new approaches are taking regions seriously. The role of the regions is not a passive one, they are not mere recipients of public funding – as is the case in traditional regional policy - but they are active players in the innovation process. A central hypothesis of this section is that there are indeed good - theoretical as well as empirical – reasons for taking regions seriously:

- There can be little doubt that government spending in the past has generated unintended spatial effects that have been far more consequential than the intended effects (cf. Sternberg 1996, Sternberg 2002:10). Furthermore, we know that the social marginal return of federal R&D investment is typically much higher in technologically strong regions than in technologically weak regions. Thus, it makes sense to exploit the spatial differentiation of a county in order to foster national technological competitiveness (Dohse 1998, Cooke 2002, Sternberg 2002).
- A slightly different line of argumentation is the following: in the age of progressive globalization certain factors of production become essentially ubiquitious. Thus, the factors that give producers a competitive advantage are not those which are ubiquitiously available but those which are bound to a specific location. Storper (1995b) speaks of 'untraded interdependencies' that characterize a region. These 'untraded interdependencies' are not static and irreversible but endogenous to political action such as the BioRegio or InnoRegio contest.
- A third line of argumentation views the regions as governance levels best suited to internalize knowledge spillovers. Empirical studies suggest that knowledge spillovers are localized (Jaffee et al. 1993) and that intrasectoral spillovers seem to be of less importance than intersectoral spillovers (Glaeser et al. 1992). This calls for a shift of focus from the national to the regional level and for performing a region-oriented rather than a sector oriented policy.

The recent innovations in German technology policy may also be seen as an attempt to build up sustainable 'regional innovation systems', a notion that was suggested just recently by Cooke et al. 1997 and Braczyk et al. 1998. Regional innovation systems are conceptualized as systems of collective order based on mutual understanding, trust and reciprocity among the members of the regional innovation community (Cooke 1998: 16). The regions themselves are viewed as places of collective technological learning and technological competence is seen as a regionally developed and rooted asset (Braczyk and Heidenreich 1998: 416). The new policies fit quite well into the *regional innovation system* concept as they share the assumption that the regional environment is crucial for the innovation process and aim at

fostering the establishment of a collective order of trust and reciprocity within the regions that may help overcome obstacles to innovation.[10]

In fact, the BioRegio (less so the InnoRegio) contest also comes quite close to another theoretical concept, that of functional, overlapping, competing jurisdictions (FOCJ), suggested by Frey and Eichenberger (1995). The BioRegios formed spontaneously - although on the basis of already existing structures - and are in principle *functional* (single purpose) regions. They *compete* with each other for public funding, mobile inputs, ideas and - in the longer run - market shares. Furthermore, they may be seen as *overlapping* as they need not (although they may) be identical with the usual administrative regions, and their composition may change with regard to the field of technology they try to promote or the kind of public good they offer. FOCJs have various advantages (Frey and Eichenberger 1995: 218):

- they are not determined and imposed from outside and above but emerge in response to the 'geography of problems',
- as functional regions they have the virtue of minimizing interregional spillovers, internalizing intraregional (knowledge) spillovers and of exploiting economies of scale,
- they stimulate the competition between regions which is a competition between governments and institutions.

While the first two advantages are self-explaining, the last point calls for some more elaboration: Why should the competition between regions be a good thing?

Stimulating competition among regions

A possible meaning of interregional competition is that the immobile factors of production that are bound to a specific region compete for complementary mobile factors in order to raise their marginal product and thus their income. Immobile factors of production are land, unskilled labour, regional amenities and so forth whereas capital, skilled labor and - perhaps most important - technological knowledge are to a certain degree mobile.[11] Such a kind of interregional competition may have positive as well as negative effects. As Krugman (1994) has reminded us, the obsession with competitiveness may lead to unhealthy policies such as bidding wars and protectionism. On the other hand, interregional competition (in the

[10] One should notice, however, that the regional innovation systems that these authors have in mind are not restricted to a single technology.

[11] There are, of course, substantial differences in the degree of mobility of different kinds of knowledge. Codified knowledge is highly mobile whereas tacit knowledge sticks (at least temporarily) to particular individuals and regions.

sense of a competition among governments, representing the immobile factors) may help to break up Olson-type institutional sclerosis, to re-shape the regional production system and to contest the cartel of the 'classe politique'. Institutional competition may be seen as an experimental mode for the discovery of superior institutional arrangements: Without the possibility of experimentation and without competition between alternative solutions we had no way to find out which institutional arrangements or political orders are best suited to serve the interests of a jurisdiction's citizens (Vanberg 1994: 29).

Reasons for stimulating regional high tech clustering

A core element of region oriented technology policy is the stimulation of regional high tech clustering. A necessary – although not sufficient – condition for the success of such a policy would be that the regional clustering of innovative activities does indeed yield substantial positive externalities. Whether this can be taken for granted is – in view of the current clustermania – hardly reflected. In this context, the following euphoric assessment of the OECD seems quite typical: "In many countries, clusters of innovative firms are driving growth and employment. Innovative clusters of economic activity are becoming magnets for new technology, skilled personnel and research investment. These groups of enterprises tend to be well established and stable, innovating through strong backward and forward linkages with suppliers and customers" (OECD 1999: 7).Empirical evidence is, however, sparse and covers only single fields of technology. Anyway, there exists evidence that the speed of intraregional diffusion of new technology increases with the number of adopters already located in the respective region which may be seen as a hint that innovations diffuse faster within geographical clusters (Baptista 2000).

V. Problems of the new Policies

Prototype A: BioRegio

(i) The philosophy behind the BioRegio contest is strenghtening the strong, dynamic regions and thereby improving the competitiveness of the country as a whole. As has been pointed out in the literature there is a clear trade off between such a kind of technology policy and regional development policy which aims at strengthening the less favoured regions (Dohse 1998, Temple 1998). However, if the strategy of upgrading national growth regions to international growth regions is successful it is likely that this would benefit even peripheral regions where technology-based growth cannot be generated at all - or only at prohibitively

high costs (Sternberg 2002:13). At least this strategy seems to be the most cost-effective policy (ibid).[12]

(ii) Finding the right criteria to evaluate and compare the regions' performance in an emerging high tech industry is a difficult and thankless task. It's even more difficult to weight these criteria against each other as the weighting scheme predetermines winners and loosers. The criteria used by the jury and presented in table 1 may be comprised in three broad categories (Dohse 200b: 1122):

a) The *already existing hardware* , i.e. the stock of firms and research facilities located in the region. Criteria c1 and c2 fall in this category.
b) The *political, financial and service environment* for biotech development in the region (criteria c4, c6, c7 and c9).
c) The *software*, encompassing the interaction between researchers of different branches and institutions (criteria c3, c8) as well as the strategies to convert know-how into new products (c5). Note that the categories *b* and escpecially *c* come rather close to Storpers notion of 'untraded interdependencies'.

More problematic than the choice is the weighting of the criteria[13]: The implicit weighting scheme used by the jury was not made explicit, although it seems that the *already existing hardware* was the decisive criterion, such that outsiders (regions at the periphery) had little chances from the beginning. The result of the contest is, therefore, not very surprising. The three winning regions (Munich, Rhineland and the Rhine-Neckar-Triangle) are all located in the industrial cores of Germany and accomodate some of the worlds leading life sciences and chemical enterprises. The dominance of the 'existing hardware' is also evidenced by the fact that the winning regions are locations of the so-called gene centres, which had received federal funding for several years.

It is understandable that the jury gave the highest weight to 'hard criteria' as they have the advantage of being objectively measurable and comparable. It is in contradiction, however, to theories such as Storper's that emphasize the importance of 'untraded interdepencies' as the sources of technological change and regional advantage.

[12] But even if one accepts the view that the final objective of technology policy should be (national) growth and not regional convergence one may ask whether it is not better to subsidize the *second best performers* who could get to the top with these subsidies. This may help to create a greater number of leading regions, which in turn may stimulate interregional competition not just for public funding but for the development of new ideas, new products and higher income.

[13] In principle, the criteria chosen seem to be useful and plausible, although one could imagine further helpful criteria such as patent activity on the hardware or business climate on the software side.

(iii) The BioRegio contest may be seen as an instrument for picking winners in two respects: picking a winning technology (biotech) and picking winning regions.[14] The picking of a winning technology is problematic because the underlying assumption that this technology will create substantial positive externalities in the future is unprovable ex ante which raises the obligatory question why one should think that bureaucrats are more clever than the market (Hayek 1972). A similar argument holds for the picking of winning regions. The BioRegio contest may be costly (apart from its direct costs in the form of tax-payers' money) as it fosters the development of some selected regions and suppresses the development of other regions, at least in relative terms.

Prototype B: InnoRegio

While the BioRegio contest obviously pursues a growth objective, the InnoRegio contest pursues two objectives at once: overall economic growth and regional convergence. On the one hand, it aims at strengthening the innovative potential of Germany as a whole, on the other hand, it intends to start a catch-up-process of lagging regions (East Germany vis-à-vis West Germany, East German regions with special structural problems vis-à-vis more prosper regions). Achieving both objectives with one single instrument is hardly possible, because there is a clear trade-off between these two objectives: The growth or efficiency objective requires to invest taxpayer's money in those regions in which they yield the highest social marginal return. This is usually the case in regions that can already boast with a certain amount of research infrastructure and technological competence. Thus, the growth objective frequently requires a "strengthening of the strong", as was the case in the BioRegio contest. By contrast, regional convergence demands for the support of regions with structural problems which is problematic from an overall economic efficiency point of view. As is well documented in the literature, cluster building from a ground zero position is much more likely to fail than cluster building promoted from a strong science and financial base (Cooke 2002: 171).

A further problem is that the clear orientation of technology policy towards the regions, that characterizes the BioRegio contest, has at least partly been lost in the InnoRegio contest. While BioRegio addresses the region as a whole (including its local administration, its financial institutions etc.) and also intends to promote intraregional competition, the

[14] One may also use the less familiar term 'backing winners' here, since the selection of winning regions is not a fully blind bet but contains a strong element of knowing the good form of contestants before starting the contest.

InnoRegio funding is rather oriented towards single actors or innovative projects within the regions, such that the frontier towards mere project funding is fuzzy. Thus, the InnoRegio contest is further apart from the idea of competing functional regions than the BioRegio contest.

General problems

A general problem of region-oriented technology policy is the discrimination of innovative enterprises that are located outside the target regions of the respective programs. The determination of the adequate level of selectivity in funding is a difficult tight-rope walk: A clear-cut technological (and regional) focus as in the BioRegio contest implies a "presumption of knowledge" (Hayek), whereas a broadly scattered funding of small projects – as in the InnoRegio contest – might possibly have no effect at all, because the necessary 'critical levels' are not reached.

Furthermore, it still is unsettled whether the regional clustering of innovative activities in a special technology area really produces substantial positive externalities. To a significant extent, this depends on the position of the corresponding industry in the industrial life-cycle. The formation of clusters seems to be suitable for stimulating the growth of industries and technologies that are in an early stage of their life-cycle (like biotechnology, microprocessing or nanotechnology), but it seems less appropriate for mature industries and technologies.

VI. Combining the prototypes: "Innovative Regional Growth Cores"

In spring 2001 the BMBF has launched a new initiative called "Innovative Regional Growth Cores"[15] that directly builds upon the experiences with the two prototype models discussed so far. One may argue that this new programme combines various elements of the two prototypes: Like the InnoRegio Contest it is restricted to east Germany, does not focus on a single technology and supports intraregional cooperation projects. Unlike InnoRegio – and in resemblance to BioRegio – the new initiative is strictly growth oriented and attaches great importance to the economic potential of the promoted networks. The presentation of regional development projects as concrete as business plans is required in order to get funding from this three-year, 150- million -DM–programme.

The effort to combine the strengths of the prototype models BioRegio and InnoRegio in this new initiative shows that a process of learning by doing and stepwise optimisation is

[15] The German title is "Innovative Regionale Wachstumskerne".

going on in the BMBF. Nevertheless, even with regard to the new initiative "Innovative Regional Growth Cores" there remain some doubts:

- The restriction of the new programme to East Germany is not compatible with overall economic efficiency
- The central premise underlying the new programme is that intra-regional networking (or cooperation) between East German firms is the bottleneck in the development of "innovative growth cores" in East Germany. One might ask whether it is really necessary to financially support such cooperation if it is in the firms own interest.
- Furthermore, one might ask if it is perhaps more importat to integrate partners from more distant locations (e.g. from West Germany or from abroad) into these networks to further stimulate their growth/success.
- The new programme is financed with money from the German UMTS licenese auction. As is well-known the suppliers of cellular phone networks had to pay an immense amount (100 billion DM) for these licenses. Even independent observers say that the price was much too high and is likely to become a substantial handicap for the growth of the German telecommunications sector. Thus, one might argue that small-scale technological transformation of selected regions in East Germany is bought dearly by hampering the large-scale transformation of the country towards the information society.

VII. Conclusions

As has been argued before there are good reasons to consider a countries spatial structure when designing policies to enhance national competitiveness. However, in practice good policies are hard to implement. The German Federal Government has experimented with rather different concepts of region oriented technology policy (ROTP) and it has become clear that no ideal concept exists. We might, however, draw some careful policy inferences from the comparison of the two prototype models of ROTP:

i. ROTP should – in a spatial sense – be as open as possible, i.e. the regions participating in a competition for government funding should form spontaneously and no regions should be excluded from this competition (i.e. there should be no closed shops).

ii. ROTP should consider Tinbergen's law, i.e. it should not try to pursuit more objectives than it has instruments available.

iii. ROTP should identify and build upon existing strengths of the regions; 'strengthening of the strong' is more promising than subsidizing the weakest regions. Such a policy may increase regional disparities, although this needn't always be problematic: If the strategy of upgrading national growth regions to international growth regions is successful it is likely that this will also benefit peripheral regions.

iv. ROTP should be complemented by a national policy creating suitable regulatory framework for the development and diffusion of new technologies.

v. As spatial clustering of innovative activities is not desirable per se we need more empirical research on the long-term interrelation between spatial clustering and national economic growth as well as on the determinants of successful clusters.

vi. Interregional competition for federal funding – which is an integral part of both prototype models discussed here -only makes sense in countries with a dispersed regional innovation structure, i.e. it might be a suitable strategy for polycentric countries like Germany or the US or for supra-national technology policies in the European Union.[16] It makes little sense in small countries or in countries with a monocentric regional structure such as France or the UK.

[16] See Gehrke and Legler (2001: 36) for an overview of the concentration of innovative activities in major European countries and in the US.

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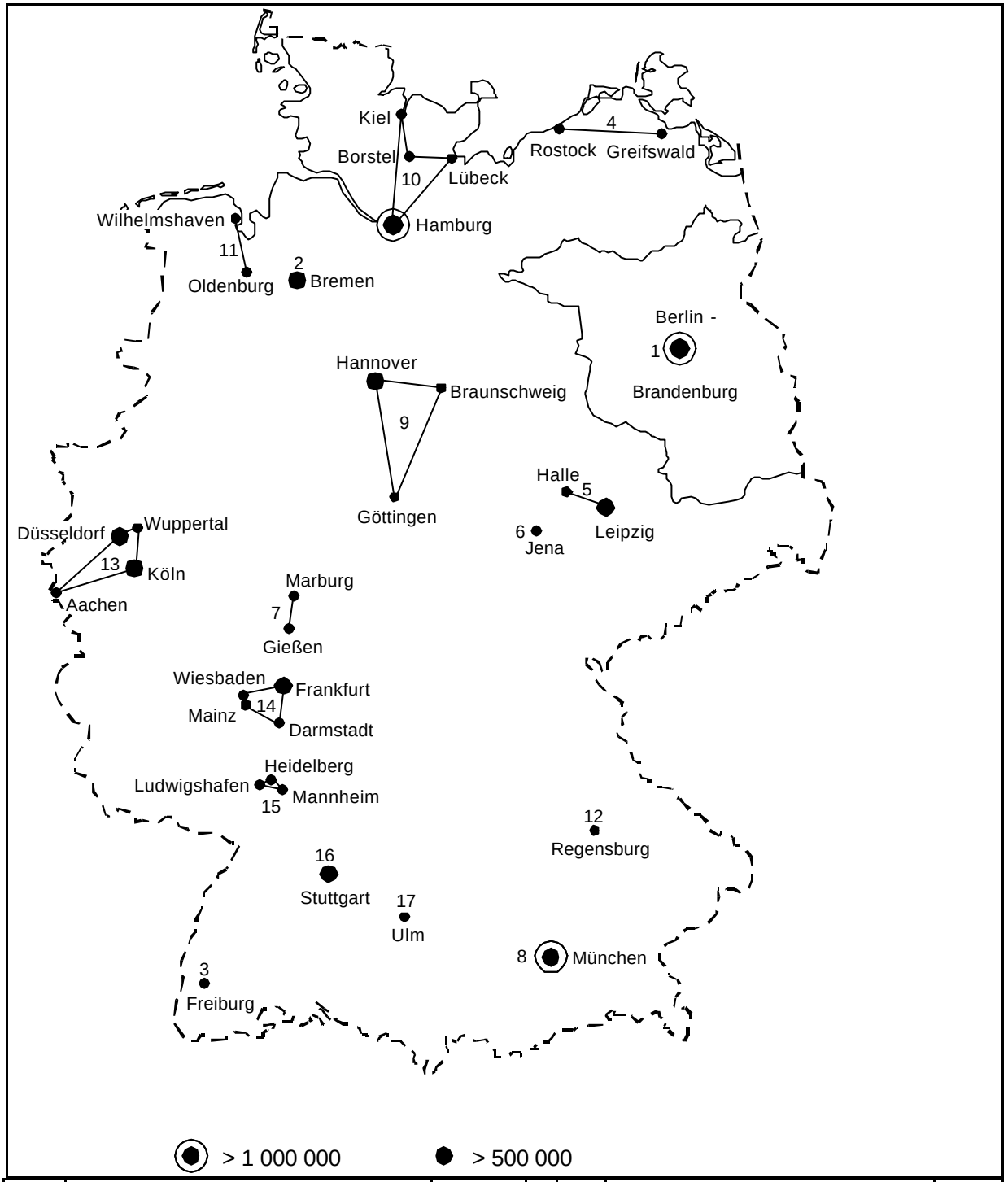
Maps and Tables

Map 1: Participants in the BioRegio Contest



No. in map	Name of BioRegio	inhabitants (million)			continued	
1	BioTOP-Initiative Berlin-Brandenburg	6,013		10	Bioinitiative Nord	2,172
2	Region Bremen	0.549		11	Region Nordwest- Niedersachsen	0,214
3	BioRegio Freiburg	0.199		12	BioRegio Regensburg	0,125
4	BioRegio Greifswald-Rostock	0,288		13	**BioRegio Rheinland**[a]	2,165
5	BioRegion Halle-Leipzig	0,752		14	BioRegio Rhein-Main	1,239
6	*BioRegion Jena*[b]	0,101		15	**BioRegion Rhein-Neckar-Dreieck**[a]	0,616
7	BioMIT Mittelhessen	0,149		16	BioRegion Stuttgart/Neckar-Alb	0,585
8	**Initiativkreis Biotechnologie München**[a]	1,236		17	BioTechnologie Ulm	0,115
9	BioRegioN	0,901			all BioRegios	17,419

[a] winning region [b] special vote

Table 1: Criteria by which the model regions were chosen

C1: Number and scale of existing companies oriented towards biotechnology in the region
C2: Number, profile and productivity of biotech research facilities and universities in the region
C3: Interaction (networking) of different branches of biotech research in the region
C4: Supporting service facilities (patent office, information networks, consulting)
C5: Strategies to convert biotechnology know-how into new products, processes and services
C6: A regional concept to help the start-up of biotechnology-based companies
C7: Provision of resources through banks and public equity to finance biotechnology companies
C8: Cooperation among regional biotech research institutes and clinical hospitals in the region
C9: Local authorities approval practice with regard to new biotech facilities and field experiments

Source: BMBF (1996).

Table 2: Obstacles to biotech innovation in Germany

	Answers (in per cent)		
	definitely true	partly true	not true
Insufficient technology transfer between firms and universities	50	44	6
Lack of communication/co-operation betw. reg. key actors	36	55	9
Over-regulation	36	48	15
Lacking acceptance of biotech in the public	27	55	18
Risk averseness of German entrepreneurs	27	48	24
Lack of venture capital	24	42	33
Lack of research cooperation between firms	19	63	19
Lack of public funding	15	42	42
Lack of highly qualified researchers	6	21	73

Source: Own survey.

Table 3: Advantages of the BioRegio contest

	Answers (in per cent):		
	definitely true	partly true	not true
The BRC furthers ...			
... communication and cooperation among regional key actors	70	24	6
... evolution of an innovation prone regional environment	58	39	3
... research cooperation within the BioRegios	48	45	6
... interregional competition for technology	33	48	18
... break up of innovation-hampering political and administrative structures.	21	52	27
... faster diffusion of knowledge within the regions	21	48	30
... intraregional competition	3	55	42

Source: Own survey.

Table 4: Problems of the BioRegio contest (BRC)

	Answers (in per cent):		
	definitely true	partly true	not true
BRC doesn't reduce regulation at the national level	50	37	13
Neglect of less favored regions at the periphery	39	39	23
BRC leads to free rider effects	38	50	13
Injury to innovative firms located at peripheral regions	34	47	19
Winning regions were known in advance	27	33	40
Most recent developments in the regions not considered	24	42	33
Criteria for selection of winning regions not appropriate	21	55	24
Efficiency-deterring intervention into the market process	12	24	64

Source: Own survey.

Table 5: General assessment of the BioRegio contest (BRC)

	Answers (in per cent):	
	yes	no
Is the BRC a successful policy instrument that should be continued with?	75	25
Has the BRC made Germany more competitive in biotechnology?	91	9
Has the BRC contributed to creating new jobs to a considerable degree?	72	28
Has the BRC contributed to an improved provision of venture capital?	84	16
Does the BRC funding reach the most innovative biotech firms in Germany?	43	57
Is interregional competition for funding a suitable means of increasing the efficiency of government support for technology?	58	42

Source: Own survey

Table 6: Regional distribution of InnoRegio –applicants- and -winners

State (Bundesland)	applicants		winners	
	abs. number	percentage	abs. number	percentage
Berlin	35	8	1	4
Brandenburg	102	23	5	20
Mecklenburg-Vorpommern	60	14	4	16
Sachsen	115	26	7	28
Sachsen-Anhalt	81	18	5	20
Thüringen	47	11	3	12

Source: BMBF 1999, own calculations.

Table 7: Decision criteria in the 2nd Phase of InnoRegio

c1:	Novelty and originality of the approaches
c2:	Impact on the region's competitiveness and employment situation
c3:	Dynamic (long run) potential of the projects
c4:	Expected regional return of the projects
c5:	Sustainability of the development induced by the projects
c6:	Plausibility and maturity of the presented concepts
c7:	Quality (intensity) of cooperation
c8:	Regional embeddedness of the actors
c9:	Financial contribution of the region itself
c10:	Applicability of the approaches to other regions

Source: BMBF (1999: 15).

Table 8: Common Features of the Two Prototype Models

Both instruments …
… aim at stimulating clustering of innovative activities and inducing a technology push
… address the regional level in order to pursue national goals
… employ a competition of regional units for public funding
… install an independent jury in order to chose the winners
… try to improve cooperation in regional innovation systems

Table 9: Differences between BioRegio and InnoRegio

BioRegio	InnoRegio
restricted to biotechnology	not restricted to a single technology
not restricted to particular regions	restricted to east Germany
strengthening of the strong, dynamic regions	focussing also on problem regions
growth objective	growth and convergence objective
participants are (networks of) cities	participants are single projects
small number of participating regions (17 applications)	large number of projects participated (440 applications)
"hardware" criteria dominated	"software" criteria dominated