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Sub-National Capabilities to Perform a Strategic Innovation-
Policy, the Example of Biotech in Munich

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Abstract:

In this paper we argue that sub-national public units do have a wide range of innovation policy related tools and thus the opportunity to conduct a proper and effective innovation policy, independently from superior policy levels. However, as the following example of Bavarian technology and innovation policy in the field of biotechnology discloses, several crucial particularities have to be taken into account. These are on the one hand organisational specifications of the promoted industry, on the other hand the connectivity to policy programmes on higher policy levels. To examine that kind of policy measures, the authors have applied a new biographical method on the firm level. In so doing we thoroughly examined knowledge and financial flows of biotechnology companies in the Munich area and were hence able to soundly qualify the impact of sub-national policy measures. As a consequence the authors were enabled to identify key institutional arrangements, as the focus on one specific location (clustering), the setting up of public support organizations as well as public Venture Capital (VC), and others. The surprising result of our survey: Munich firms benefited much more from sub-national policies than from any other policy level.

Keywords: Regional economies; knowledge economy; biotechnology; Germany, sub-national innovation policy; Bavaria,

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I. The institutional and theoretical endowment of sub-national innovation policies

The ability of states to build up an innovative commercial industry, whether “clustered” or not is seen in the literature as considerably low (Meyer/Krahmer 1999; Hilpert 2001, Martin/Sunley 2003, Feldman/Francis 2003, Mayer-Schoenberger 2007). In recent times capability seems to be reduced even further by macro-developments as globalisation and Europeanization. However there are examples where a congruent and long lasting policy measure has well led to such a result. Namely the Munich Cluster for biotechnology which has developed without any historical predecessor as for instance the pharmaceutical industry. Even more surprisingly, it seems that this kind of process can be traced back not to national or supranational, but to specific sub-national policies.

It is widely acknowledged that biotech industry relies on a wide range of surrounding institutional arrangements, which last form favourable regulation, availability of venture capital to excellence of publicly financed research organisations (Kaiser, 2003). Thus empirical studies in that sector have often applied a systemic approach, stemming originally from the National Innovation Systems literature.

Systemic analytical concepts of innovation processes consider innovative actors, such as firms, universities and non-university research laboratories, as organizations that interact with each other under conditions set by an institutional environment in which these organizations are embedded (Braczyk et al. 1998; Cooke 2001; Dosi et al. 1988; Edquist 1997; Freeman 1987, 1995; Lundvall 1992; Nelson 1987, 1993; OECD 1999a, 1999b, 2001; Kaiser/Prange 2004). Analyzing innovation processes under a systemic approach provides the advantage that differentiations in institutional, infrastructural or cultural conditions for innovation, which exist among countries, regions or sectors, become visible. These conditions determine the relationships among private industrial actors, public administrations and the science and education systems, as well as the forms and intensity of their interactions.

Starting from its initial perspective on the “National Innovation System”, the approach has been diversified since the early 1990s by studies that recognized the evolution of autonomous systems of innovation at the local, the regional, the European and even the global level (e.g., Acs 2000; Braczyk et al. 1998; Cooke et al. 2000; Dalum et al. 1999; De la Mothe and Paquet 1998; Howells 1999; Mytelka 2000). Whereas a first group of scholars stressed the

importance of local institutions and networks, transfer mechanisms, regional labor markets, as well as specific socio-cultural environments a second group pointed to the internationalization of markets, technologies and corporate activities as well as the ongoing Europeanization of public policies. They both have in common that they called the dominance of national institutions into question as they emphasized the growing importance of institutional arrangements below and beyond the nation-state level. A third strand of the literature has almost dismissed a territorial perspective and has instead concentrated on sectoral innovation systems, thus pointing to the fact that certain technologies have specific knowledge bases, actors, etc. (cf. Carlsson 1997; Malerba 2002). As our analytical focus is here on the local level, we assume that there is a partially autonomous sub-national innovation system and that there is a specific design of a sectoral institutional environment, in which the Munich biotech cluster is embedded.

The application of a systemic approach towards innovation allows us to look closer on recent changes that have occurred within the triple helix of university-industry-government relationships which are certainly crucial for commercialization in science-based sectors. These relations, along with the internal transformations within each of the spheres of an innovation system, have been stresses especially by the so-called Triple Helix thesis (Leydesdorff/Etzkowitz 1996; Benner/Sandström 2000; Etzkowitz/Leydesdorff 2000; Leydesdorff 2000).

The Regional Innovation System approach can be seen as complemented by the cluster and innovative milieux strand of literature. In this context, the literature on innovation, knowledge and regional agglomeration has placed some emphasis on local networks, inter-firm collaboration and regional knowledge spill-overs from, publicly-funded research institutions to spin-off firms, as a major source of regional competitive advantage and innovation (Breschi, Lissoni 2001). This point of view is anchored in the further increasing tendency of many industrial and service sectors to cluster in relatively few places around the world. The biotech industry is leading that tendency with an incontestable drive to concentrate in certain places. This trend seems to be accelerating, even if modern means of telecommunication as well as decreasing costs for travelling and transport support new forms of (virtual) proximity (Morgan 2004). As well as the systemic innovation strand of literature, the cluster approach has led to numerous empirical studies about necessary institutional arrangements and success factors for the development of a sustainable biotech Industry.

Most of those studies rely on macro indicators, such as patent applications, means for research and venture capital-investments. We do not contest that such analysis yielded valuable results, but suggest a slightly different approach. By descending to the firm level, and looking close at salient events in firm history as well as usage of public support measures, we think of being capable to find some new insights into the interplay of institutional environment including innovations policies and firm development.

Our approach to sketching a biotech firm's innovation biography is based on the following principles: We capture the whole lifetime of the company, which is feasible in the case of Munich biotech firms given that most of which have a corporate history of less than 15 years. We assess all of the corporate activities and interrelations with extra-firm organizations and institutions. We start by mapping the respective innovation practices that are related to these corporate activities and go on to evaluate the interrelationship between these activities. Finally we identify and systematize the knowledge flows, financial flows and the organizational innovations that play a crucial role for the initiation and execution – as well as success or failure – of the firm's innovation process. As a consequence we are able to qualify specific policy measures and their impact on the firms' development and can thus rate those much more precisely than studies covering macro- and highly aggregated indicators.

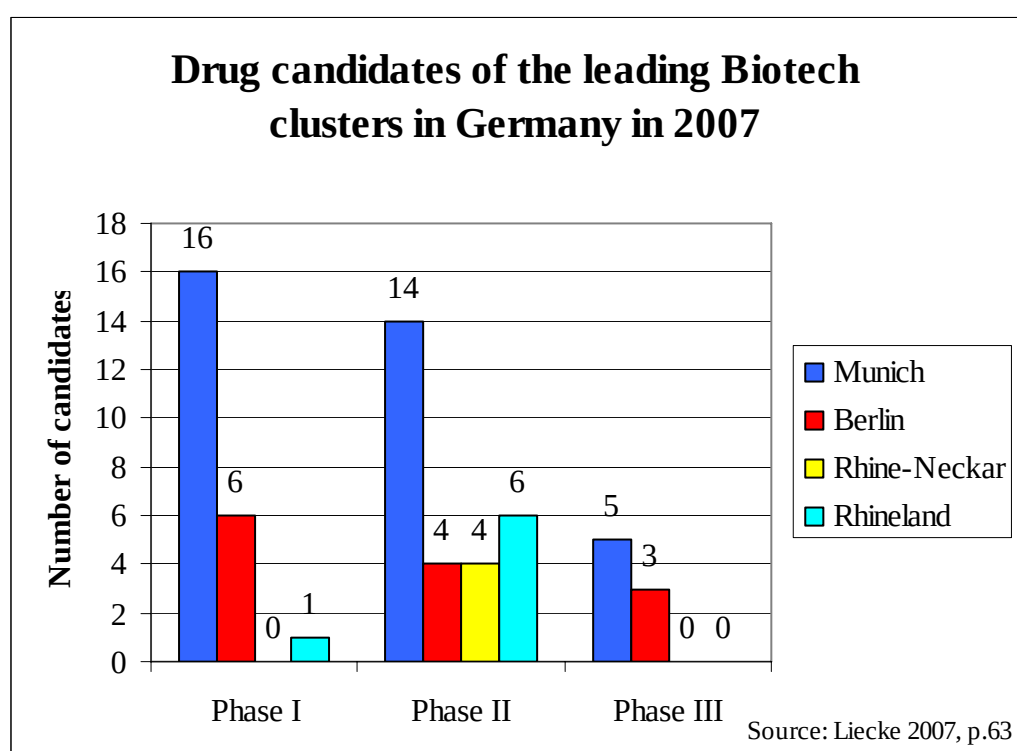
We applied our approach onto five Munich Biotech companies, which have beforehand revealed to be the most successful and stable ones in the region. All of those are public companies namely Medigene AG, Micromet AG, GPC Biotech AG, 4SC AG and Willex AG. They account for the lion's share of revenues and research expenditures in the Munich area, and even in Germany.

II. The Munich Cluster

Since the mid-1990s the Munich cluster for pharmaceutical biotechnology, which is mostly centered at the location of Großhadern/Martinsried, has emerged in a dynamic process of formation of new small and medium-sized research companies. The number of those companies has risen steadily from 32 in 1997 to about 100 in 2006. More than half of them (63) can be characterized as core biotechnology companies that are specialized in the development of therapeutical products (BioM 2004a). As a result, the Munich cluster gained a

leading position among Germany's biotech locations. This holds especially true in view of therapeutic drug candidates which are currently undergoing pre-clinical and clinical trials. Before approval drugs have to pass three clinical testing phases and thus a close look at the so called pipeline yields valuable insights about the future potential of a firm or a region. In 2007, the number of drug candidates introduced in the development process by firms at the locations of Cologne, Heidelberg, Berlin and was between 4 and 13; Munich-based firms had 35 (see fig. 1).

Fig. 1



Public research organizations played an important role in this commercialization process. The most important actors in this respect, the Technical University, the University of Munich, the Max-Planck-Institute for Biochemistry and the Institute of the Society for Environment and Health (GSF) provided (and still provide) the knowledge-base for a number of academic spin-offs. Between 1995 and 2000 alone, 30 of the 52 new established biotechnology companies were founded out of these organizations (Kaiser 2003, 849). Furthermore, the emergence of a pharmaceutical biotechnology industry, along with similar developments in other “new technology” industries, also motivated the establishment of various intermediary institutions

which are aimed at supporting the creation of start-up companies by providing different resources and services.

Since the year 2002, however, the number of new biotechnology company formations in the Munich area has been entering a phase of stagnation. Whereas in the period of 1997 to 2000 about 17 new biotechnology firms were established per year, there were only about six annual start-up companies from 2000 - 2006 (BioM 2007). The Munich biotechnology cluster thus has clearly entered into a phase of consolidation in which growth exist mostly within the already established companies.

III. History and self-conception of Bavarian innovation policy

A close look at the past of Bavarian led industrial- and innovations-policies shows two unique underlying principles that revealed itself as key issues for later biotech-policies: the state induced concentration of innovation-related actors in a single agglomeration, -thus to strengthen the already strong locations-, and the willingness and capability to invest high amounts of money over long periods. This kind of government action is fed by a positive track record in earlier “future”-industries as for instance, defence, nuclear or microelectronics.

Bavaria started off after WWII as a predominantly agricultural country. Some industrial cores existed though, mainly around the Munich, Nuremberg and Augsburg Area. In addition the country “benefited” from large relocation efforts especially of the aviation sector by the German war industry at the end of WWII into the allegedly safe south. In the following years the regional government, insisted on its constitutional right to autonomously conceive research and education frameworks and policies. By constructing large scale aviation-research facilities all clustered in the Munich area, many companies were incited to relocate their production and research units to the same location. A defence minister on the federal level, stemming originally from Bavaria supported that kind of industrial policies by providing generous contracts designated for the rebuilding of the federal army, to firms of that region. As a consequence and proof of Bavarian promotional success, two thirds of the whole German aviation and defence industry were concentrated within that cluster in 1970. (Trischler 2004, 146).

In the early 1950s Bavaria discovered the field of nuclear technologies as a further “future” sector and undertook similar efforts to concentrate research and industry in the Munich era.

High financial amounts were spent for a large scale research plant. Industrial partners were, as usual at that time, larger industrial companies, as for instance Siemens. The overall balance of those measures is ambivalent though. Indeed a high quality of research in the Munich area was obtained, but commercialisation in shares of workforce or industrial revenues stumbled. Reasons therefore are at least twofold, on the one hand other German Länder entered a strong competition in that sector, on the other nuclear industry revealed itself as a dead end, at least in Germany. Here public opposition grew onto one of the highest levels in any industrialized countries and thus the industry suffered soundly, especially from the 1980s on, from a lack of public orders.

The 1970s with its focus on the promotion of the microelectronics industry were marked by a twofold change in Bavarian policies. First, the privileged region included, apart from Munich, from now on another town, Nuremberg, and the industrial partners were not exclusively large multinational companies but also small- and medium- sized enterprises. Also the building up of young and innovative companies, spun-off from publicly financed research organisations obtained direct public support for the first time. The Bavarian success in that technology field was, even more than nuclear technology before, challenged by technology programmes of other Länder. Especially Baden Württemberg comprising a large number of SME in related technology areas set up an ambitious programme.

A positive side-effect of Bavarian industrial and technology policy in the past, was the establishment of a highly potential venture capital branch in the Munich region. The reasons therefore are twofold, firstly the regional policy efforts in aerospace/defence and microelectronics had led to a high number of young start-up companies which were attractive especially for VC-firms, and secondly; Bavaria interpreted in the 1980s federal law concerning the taxation of VC-Portfolio Managers much more liberally than other German Länder and thus established a competitive and first mover advantage. Consequently the presence of VC-companies turned into a crucial pillar for Bavarian success in the biotech industry.

IV. Specific Bavarian Instruments promoting Biotech Innovation

In the mid nineties the Bavarian Government decided to sell most of its stakes in publicly held companies and in so doing gained privatization revenues of all in all 4.2 billion Euro. Bavaria invested these means in several technology supporting programs, for the building up and strengthening of what was to be judged as key-industries. (for Bavarian innovation policy in the field of feature film production see Kaiser/Liecke 2007). A large part, some 500 M. Euro of that sum were channelled into the biotechnology sector, geographically concentrated into the Munich area. In so doing Bavaria developed several policy instruments to support both the research and commercial side of the industry. The most important impacts and developments are to be presented in the following. By applying our biographical method on the Munich firms mentioned in Section I, we found ourselves able to identify crucial policy measures for the firms' development. As we have already stated before, they were predominantly conceived and executed on the regional level. In the following we show how those institutions exactly supported the set-up of the biotech cluster and asses their impact as well as their interplay.

IV.1 Concentration and upgrade of public research

Large parts of the privatization funds dedicated to the biotech-sector, were used to upgrade and concentrate publicly financed research organisations in the Munich area. In so doing several departments of the University of Munich, comprising those for pharmacy, chemistry and biology were relocated to a campus area in Martinsried near Munich. Currently the Bavarian Government has decided to build up a completely new biomedical centre, for some 135 M. Euro. The expenses for all those measures were predominantly beared by the Bavarian state. Federal or European grants were touched, albeit not fundamental to the policy decisions. As a consequence today two universities, two university hospitals and three Max-Planck institutes are concentrated on the Martinsried-Campus. The latter are specialised in large-scale basic research, and are thus of great importance for the cluster itself, whether as a cooperation partner or as a source of spin-off firms. Most of today's Biotech firms in the region are indeed spin-offs and so three out of our panel companies are. This supports the widely common argument that first class research is one of the most important pre-conditions for a successful cluster. In addition all of the firms we thoroughly examined, benefited from the local research base, whether through formal or informal R&D collaboration, or by the presence of a highly skilled labour force.

IV.2 Modifying the financial system towards the availability of VC

The pharmaceutical biotechnology sector mainly consists of young spin-offs or start-up firms, which are engaged in a highly complex, very long-lasting, capital intensive and uncertain R&D process. To succeed in overcoming those difficulties and bringing a product to the market, the emerging industry relies heavily on the availability of capital.

Germany traditionally has a bank-centered financial system that is widely considered to favor established industries and thus disadvantage high-risk technologies that potentially create radical product innovations. In such a system corporate investments in VC seemed to be not very attractive, as they were taxed at a 56 per cent corporate tax rate, and no capital gains tax rates reduction could be achieved. Therefore, since the mid 1990s the German federal government aimed to modify the framework conditions for the provision of private VC, and in addition to install a complex and potent state owned system of VC risk sharing. In fact, the federal state established a public investment company (“Technologiebeteiligungsgesellschaft”, tbg) which absorbed up to 80 per cent of the risk of VC-investments through guarantees, and facilitated those further through generous co-financing options. However, there were some requirements to receive tbg funding. The funded company was not allowed to have more than 50 employees, annual turnover had to be less than five M. Euro, and a large company ownership had to be less than 25 per cent.

The Bavarian Government supplement the federal measure through the up-setting of a state owned venture capitalist, BayernKapital, in 1995, providing financial aid to Bavarian start-up companies. “BayernKapital”, spent till today about 128 M. Euro exclusively for young Bavarian knowledge based firms (mainly in key-industries like: biotechnology, medical devices, environmental technology, information and communication technologies, and software). Subsequently the number of private VC-firms in the Munich area rose enormously to more than 40 in the year 2004, the highest concentration of VC in the whole of Germany. The importance of BayernKapital is underlined by the fact that no other German Land possesses a similar organization. All the examined successful firms in the cluster benefited from financial support of BayernKapital. For one of the companies it played an encouraging role to relocate their business from Berlin to Munich.

BayernKapitals’ (BK) investment strategy relied on two principles: co-financing; means a private investor has to be engaged before BK turned active, and, interest was solely realized through a specifically German financial construction, the so called silent partnership. Both principles proofed to be well suited for company support in a surging market but turned

problematic in a general decline. Co-financings have revealed as extremely pro cyclic, means if there is a lot of market coordinated private capital available, co-financings put something on top. But in the opposite case – declining markets, vigilant private investors- co-financings can hardly contribute anything to help companies over that shortfall. The tool of silent-partnership has proved to be problematic as well, as it is widely unknown by international investors and re-payment procedures were often not clearly codified. Since 2005 BayernKapital has readjusted its strategy and conducts investments only in market usual participatory forms.

As a consequence of those two institutional shortages, public investments collapsed alongside private investments in the difficult years of 2002 and 2003, marked by the bursting new-economy bubble. In fact, tbg and BayernKapital invested a total of 30 M. Euro into the Munich Biotech Cluster in the year 2000, but only 0.7 M. Euro in 2003 (BioM, 2004b see page 23). The drop out of state owned financing organizations was problematic, as they were supposed to invest mainly in the seed phase of startup or spin-off firms. Those early phases are often eschewed by private venture capitalists, since the costs of evaluation and monitoring make it more lucrative to engage in fewer but larger firms. (Adelberger 1999). Today the situation has slightly improved, due to a recovering VC-market, but not through adjusted responses of state owned organizations.

IV.3 Strengthening project based research

Already in 1990 the Bavarian government installed the “Bayerische Forschungstiftung” (Bavarian Research Association, BRA) which was conceived to support application oriented research, mainly through collaborations between Bavarian research organizations and companies. The overall associational funds amount today to some 350 M. Euro, releasing annual research means of approximately 25 M. Euro in recent years. Objective of the association is thereby to support key industries and further advance already strong sectors, as amongst others medical technology, biotechnology, information and communication technologies. In so doing the BRA supports one of the underlying principles of Bavarian Innovation policies; invigorate the already strong.

Four out five of our biotech panel firms took or take part in research projects financed by the BRA. However some specific formalities to assess BRA funding have turned that kind of research promotion partly into a blunt instrument. Commercialization of research results is often hindered by the associational requirement to publish results. Consequently intellectual property protection becomes, especially for young and small companies exceedingly difficult

if not impossible. The consequence that follows is that small companies hesitate to engage in potentially fruitful research collaborations, as they “fear” to invent something, that can’t be patented afterwards. This shortfall is well known in the Bavarian administration but the status of the association as charitable organization blocks any kind of modification efforts.

Another deficit of the BRA, at least from a small company point of view, is the extremely high requirement standards for eligibility, regarding report obligations, and financial conditions of participating firms.

IV.4 Setting up an innovative networking organization

A further leveraging factor for the Munich biotech development was the state initiated building up of an independent intermediate organisation in 1997. The so called BioM AG is responsible for intra- and inter- cluster partnering and networking. The organisation became a crucial actor in the regional innovation system, due to its endowment with both, public and private VC. The organisational form as a public company (Aktiengesellschaft AG) is unique in Germany and opens up a lot of room of manoeuvre to the executives. This allows them also to employ experts on a much higher salary level than public administration is usually permitted to offer. Consequently an internationally eminently respectable biotech researcher and founder could be attracted for the CEO position.

Apart from “normal” network tasks, such as consulting and partnering, the organisation features - unique in Germany- a (small) seed-capital fund which holds investments of some 11 M. Euro. Over a 10 year period, 1997 – 2007 the BioM AG has invested seed funds in approximately 40 start-up companies, predominantly in the Munich area (own research). In the beginning the BioM AG was strictly focussed on the provision of seed-capital, means to establish a company. In later cluster development stages however the BioM started to act as a reliever for more mature firms that faced financial difficulties.

The ability to invest autonomously VC into start-ups, lifted the status of the network-organisation clearly as it turned from a more consulting and representing institution into an active player closely informed about current shortfalls in and problems of biotech start-ups. The close relation to the Bavarian government in turn, established a tight and catalysed connection between government and companies. In addition the BioM is closely linked to the BayernKapital and usually assigns capital seeking companies to it.

The BioM AG has always been with priority by the Bavarian Government, as an interview partner mentioned “The CEO of the BioM AG just has to call the ministry of economics, and he gets at once an appointment with the Minister of economic affairs”. However in recent years BioM started to engage itself on a national and even European level. In so doing it initiated alongside with other German biotech cluster a working party of Bioregions on the national level. The working party in turn influenced successfully some national biotech related promotion-programs. In addition the BioM AG was crucially involved in the foundation of an independent national association BIODeutschland in 2004, which has developed to the official organ of the German biotech companies.

Especially in the beginning of the commercialisation stage of the Munich cluster BioM AG played an additional important role by massively representing the location on national and international fair-trades. The visibility of the cluster was in so doing strengthened. This has to be seen in the context, that other German Bioregions never had the means and financial funds to act comparatively. The central importance of the BioM AG regarding its multitude of functions is thus highlighted by all of the examined panel-companies.

IV.5 Establishing a highly subsidized biotech incubator

Also by financial means of privatisation revenues, a specific biotech incubator on the campus Martinsried was initiated by the Bavarian Government in 1995. About 25 M Euro were directly invested, a further 22 M leveraged. This constitutes, compared to other highly ambitious incubators as for instance the “Heidelberg Technologiepark”, a considerably high level of subsidisation. As a result the Munich incubator is able to charge comparatively low rents, and is working at full capacity since its construction. Remarkable as well is the fact that some of its earnings are also used for the support of start-ups, means that the incubator acquired interest in firms, although on a very low financial level. Three out of the five most successful Munich biotech firms were attended within that incubator.

As many Bio-clusters possess incubators, the one in Martinsried can hardly be seen as a source of competitive advantage. However it constitutes a necessary key component for a functioning cluster.

IV.6 Installing a Business plan-competition

The Munich Business Plan Competition (MBPC) is another important component in the regional innovation system respectively the regional innovation policies. It was initiated 1996 by the Free State of Bavaria and the management consultation McKinsey after the model of the MIT in Boston and is financially supported until today by the Ministry of Economic Affairs. According to the organiser of the competition around 480 new enterprises happened to be built-up and financed in the last 10 years, often possessing an emphasis within the field of technology. More than 3,250 new jobs could so be created. The competition is thereby benefiting from the high entrepreneurial potential of the region, the large number of promoters and supporters as well as the operational numerous VC-companies. The latter invested until today approximately some 265 M. Euro in founders or young enterprises. (MBPW 2008a). A majority of the laureates stem from the area Life Sciences. Since 1997, some 39 larger prizes were awarded, which of 12 can be assigned directly to the biotechnology, some further to the medical technology (own research). The competition receives its particular regional-specific importance, as it focuses specifically on founders from the Munich region. In addition similar successfully equivalents in other German Länder are missing. Besides of the concrete impact on the formation of biotechnology companies, the competition has proofed to be a useful vehicle for the establishment of a positive entrepreneurship climate in the Munich region. The competition was promoted from the beginning by the Bavarian state government. In the last years some 400.000 Euro annually were spent.

IV.7 Internalize favourable initiatives on the federal level:

In 1996 the German ministry of Research and Education launched a competition, which is today widely seen as initial jump-start for the German biotech sector as a whole (Dohse, 2000). Briefly summarised the competition addressed regions, to present their existing infrastructure for biotechnological research and commercialisation, as well as their potentials to build up on those. In detail the competition assessed a multitude of factors, as:

- number of already existing biotech companies and research units
- existing networks among different biotech Research facilities
- number and quality of supporting agencies, as: patent offices, consultancies and information networks

- potential sources for finance, whether bank centred or private equity
- specific competence of local/regional public authorities
- density of collaboration between regional research units and hospitals

The winning regions were picked by an independent jury, consisting of researchers, and industrial and labour union representatives. They finally elected the Munich region, the Rhineland region (a consortium of cities by Cologne, Aachen, Dusseldorf and Wuppertal), and the so called Rhine-Neckar Triangle (established by the cities of Heidelberg, Mannheim and Ludwigshafen). Those three winners received an one-time financial assignment of 25 M Euro each, and in addition privileged access to the federal support program Biotechnology2000. “The political intention behind this strategy was to further strengthen already strong and established locations.”(Kaiser 2003, 846).

The Munich candidature was conceived by the „Initiativkreis Biotechnologie“, a predecessor of the BioM AG. In so doing the “Initiativkreis” received far ranging financial and personal support by the Bavarian government. A further important factor regarding the Munich candidature was the inauguration of a key-person, who had short time before co-founded a biotech firm, as central node in the uplifting network. That extensive support by the Bavarian government to push the Munich region in the competition is not self-evident, as the other winning regions had to rely solely on private initiatives.

The Bavarian Government perceived the winning of the competition as a signal to further allocate financial means to the cluster of Martinsried in the following years and thus apply consequently their principle of further invigorating an already strong region. This indicates a fundamental difference to other German Länder, as for instance Baden-Wurttemberg with its promising and also winning location of Heidelberg, drew a completely different consequence. There the government decided after the competition to further support other Baden-Wurttemberg biotech locations to establish an element of regional compensation.

V. Conclusion and policy recommendations

Our research on the most prominent biotech firms resulted in the insight that all of them have benefited from Bavarian support policy, more than from any other political level. The

differing kinds of support can be concluded as follows, collaboration with a comparably highly effective network organisation, usage of state VC, incubation in a science park, collaboration with proximate research organisations. The following table briefly summarises the different policy measures on the sub-national level and links them to the benefiting firms.

Table 1: Bavarian policies and its benefiting firms

Specific Bavarian policies	Benefiting Panel-Firms
Strengthening Research Base	Medigene AG, Wilex AG, Micromet AG
Businessplan Competition	Wilex AG
Incubation	Wilex AG, Micromet AG, 4SC AG
Strengthening project based research	Medigene AG, GPC AG, Wilex AG
Bavarian Public VC	Medigene AG, Wilex AG, Micromet AG, GPC AG, 4SC AG
Networking through BioM	Medigene AG, Wilex AG, Micromet AG, GPC AG, 4SC AG

Source: own research

By implementing those policies the government covered the whole biotech specific innovation process, from public financed research, where most of the young innovative companies spin-off over the specifically high needs of VC, to enduring partnering activities by regional network organisation.

Compared to national policies (see tab. 2) one can identify a clear domination of Bavarian instruments.

Table 2: Federal policies and its benefiting firms

Specific Federal policies	Benefiting Panel-Firms
Public VC	Medigene AG, Willex AG, Micromet AG, GPC AG, 4SC AG
BioRegio Contest	GPC AG, Willex AG, Micromet AG,
Means for Project research	GPC AG, Medigene AG, 4SC AG

Source: own research

In this contribution we argued in contrast to wide parts of the literature that sub-national innovation policy, merely on its own, was capable to crucially promote a world leading biotechnology cluster in the Munich area. As a result we can clearly highlight the role of regional innovation systems (Cooke 2001) as decisive in innovation-processes. Also the role of clusters and localised knowledge spill-overs is of high importance and not overestimated as recent publications (Morgan 2004) suggest. In fact only three significant measures were drawn up on a higher political level: the BioRegio contest, public VC-initiatives by the tbg on the federal level, and the introduction of less restrictive regulation in the early nineties induced by the European level.

Bavarian biotech-innovation policy was marked by the need for stamina over a particular long period of time and by a multitude of concrete policy measures. Some of them were innovative and crucial some rather complementary to policy programmes on a higher policy level. In so doing the Bavarian government has applied a systemic innovation concept, improving the institutional endowment of biotechnology firms regarding public research, education, VC and (partially) regulation.

However we are well aware that German Länder still possess a high level of competences, especially in the field of research and education, which other regions especially in Europe lack. Thus the empirical finding we presented can hardly serve as best-practice example for less favoured regions in terms of legislative freedom, but might indicate that in fact the region as responsible unit is more suited to implement long-lasting and effective innovation policies than other levels of political action, due to its proximity to all relevant actors. Less favoured regional units are thus reliant or even dependent on fitting policy actions on higher levels. This kind of obedience is even aggravated as the European level, is more and more dismissing its earlier position to strengthen regional capabilities.

Our finding poses a few further research questions. For instance; why were other German sub-national units not willing or able to copy Bavarian strategies? In so asking especially the case of Heidelberg in Baden Wurttemberg becomes a puzzle, as there preconditions regarding the quality of local biotech research and education at least equalled if not excelled the conditions in Munich. One answer lies probably in the polity of Bavaria, comprising a strong centralistic element which favours the capital region for public investments and initiatives. Another one lies in the fact that the country is governed over a fifty-year period by one party that believes in the positive outcomes of conductive policy measures. As the biotech sector has proved to be one, that needs a dense institutional network and a multitude of public measures, starting from the support of public research organisations, incubation, and favourable environment for venture capitalists, just to name the important ones, one can conclude that a sector with its need for mentoring and an interventionist policy tradition, have fruitfully met. However given the fact that in the United States public policy support is extraordinary strong especially for emerging clusters, such as North Carolina or Maryland, a further aggravation of framework conditions or a reduction of public policy efforts could seriously harm the further development of the Munich cluster.

From an economic point of view the Bavarian engagement yielded ambivalent results. In deed Bavarian state lead measures nearly established a leading European location for biotech research and commercialisation. But the amounts invested did not (yet) have any strong impact regarding new jobs, firms-revenues or tax-revenues. The years to come will proof whether regional firms are able to finish their development projects and bring self developed medical treatments on the market. So far no German biotech has managed to do so.

The success and partial shortfalls of Bavarian innovation policy -especially in the financial sector and the institutional design of the Bavarian Research organisation - gives us sound references, to draw several generalized policy recommendations:

- **Public innovation policies are in need to apply a systemic view on innovation processes.** Non-systemic public innovation policies are like to create unintended negative externalities. A systemic view also provides for a clear understanding whether a “best practice” solution established in another country is likely to have the same positive effects in other institutional environments.

- **Intermediary organizations that are set-up by public actors need a considerable freedom of operation.** As we have shown by the example of the BioM AG, cluster management organisations are potentially capable to develop a high degree of pro-activity and dynamics if they have executive freedom and a generous endowment. In fact they are very close to the firms' needs and current developments and are suited to act as a catalyser to the relevant government ministry.
- **Public innovation policies that aim to initiate or foster private engagement are in need of a specific exit strategy which foresees both cyclic and deviant behaviour of private actors.** As the case of public VC-investment has shown, public activities both at the national and the regional level were not designed in a way that allowed either for a constant engagement in early stage investments nor for stabilizing start-up companies in critical times.

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