Regional variations in scientific disciplines

(working title)

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Abstract:

The basic idea of this dissertation proposal is, that each level of government (regional, national and supranational) has a unique set of abilities (influence, power, know-how, funding) to target different tasks in the science funding system. Additionally each scientific discipline itself has a unique set of properties. Successful science policy therefore has to deal with these structures to better support the needs of individual scientific discipline. In order to do this different levels of government have to use their specific strengths and advantages.

This dissertation proposal suggests to analyze science policies on the one hand and structural properties of scientific disciplines on the other. It will do this by using a number of soft (e.g. liklyness to relocate) and hard factors (e.g. growth in publications). Subsequently it be analyzed whether there are regional variances in the properties of these scientific disciplines and how they could be used to create a taxonomy of different fields within different regions. Based on these findings it will be tried to find universal arguments how different governance levels could be adapted to different functions in research policy.

Science, Technology and Innovation (STI) are important pillars of any modern society and economy. Their importance is even growing the more diversified and complex a society and economy is. (Pichler, Stampfer & Hofer, 2007) Public policies, especially public funding, play a decisive role in this domain, since without this intervention significant parts of science, particularly basic science would not be funded by private means. (Salter & Martin, 2001) This is because basic research is an high-risk, high-uncertainty and, quite often, an high-cost endeavor.

In the current discussion, arguments mainly focus on the extent to which public funding should be expanded. One important goal in this context was formulated by the EU as part of the Barcelona Goals. All member states are prompted to increase their STI-funding (both private and public) to 3% of their GDP. (European Commission, 2005)

Since public intervention in this area is regarded as essential, questions arise how and by whom these funds should be distributed. Traditionally this was the domain of a strong and financially potent nation state, but over the last decade other players on other levels of government have emerged and entered the field of science policy and science funding. Based on the 3% goal they started to develop their own programs and policies. (BMVIT, BMWA & BMWF, 2007) This inevitably raises questions about the allocation of power and funds across different government levels, both in the policy arena, but also more fundamentally in the scientific arena.

The changing role and importance of different government levels is a phenomenon also visible in other policy areas. The European integration provided an important stimulus for the diffusion of influence across different levels of government. In the last years there has been some research done on various forms of this *Multi-Level-Governance* (Hooghe & Marks, 2001; Hooghe, 2003; Marks & Hooghe, 1996, Marks & Hooghe, 2005; Bache, 2005) They showed that European integration not only led to a shift of power from national actors to supranational actors, but also to the growing importance of regional institutions. They increasingly try to deal with European institutions directly and try to align their policies to discussions and goals formulated in the supranational arena.

Another motivation for increasing activities of regional and supranational actors is the growing complexity of modern economies and societies problems: their scope is not identical with the scope of the traditional nation state, but sometimes smaller (e.g. cluster initiatives) or far bigger (e.g. the ITER project) than what can be efficiently handled by a single homogenous national actor. Vice versa do policy actions have diverse externalities, arising from the provisions of public goods - from planet wide in the case of global warming to local in the case of most services. To internalize these externalities, governance must be multi-level. This is the main argument for multi-level governance. (Marks & Hooghe, 2005)

Marks and Hooghe showed that multi-level governance structures lead to two different types of institutions. (Hooghe, 2003) On the one hand institutions that are firmly rooted in one policy level, have a long and stable development and are responsible for a broad set of issues. Contrary to that, a second type of institution exists that bridges these settings. These are very flexible, short-term initiatives which cross different levels of government and are quite often dedicated two one specific problem.

The approach by Marks and Hooghe therefore provides some valuable ideas on how a multi level governance system is developing and what sets of institutions, programs and policies are to be found in such an environment.

It does not, however, provide a clear description how different functions should be allocated between the different levels, other than based on the different externalities of policy issues. In reality this boundary is sometimes not clear at all and a level might have advantages in dealing with a certain problem, which cannot be explained by the scope of the problem alone. Additionally it could be argued that different policy arenas have different sets of externalities. In the case of STI policy other theoretical models of this arena and its properties might be helpful.

In this context the ideas of the Systems of Innovation approach can provide some valuable input. Such a system theoretically includes all institutions which are active in a given geographical area, and which produce, accumulate or distribute knowledge as well as all structural components relevant in this environment. These include standards, norms, educational and support systems, but also physical infrastructure. An analysis of such a System of Innovation therefore tries to look at the complex relationships between all this components in a given area. (Edquist, 1997; Kuhlmann, 1999; Cooke, Boekholt & Tödtling, 2000) One of the important resources in such a system is knowledge, either as codified knowledge or as tacit knowledge. This includes knowledge where one is not even aware of having this knowledge, or where it is difficult to transmit it via language in a codified form. Therefore it requires a great amount of closeness, trust and same (or common) norms and languages between the different actors. As a consequence tacit knowledge requires a great deal of geographical proximity between the different actors. This eventually leads to the development of networks between players from academia, business and also government in certain geographic areas.

Over the last years a number of funding initiatives where based on this innovation systems approach and tried to boost the efficiency and productivity of the science system. While most of these initiatives have been regional initiatives to strengthen regional networks and clusters , other programs influenced by this approach have a national or European focus. For example the development of a European Research Area is directly targeted at strengthening core properties of a the system of innovation, like physical infrastructures, human capital and a better coordination of various “support” systems like public science funding in various levels. (European Commission, 2007)

Nevertheless it has to be taken into account that different scientific fields have different properties and that the way they produce, accumulate and share knowledge as well as other internal structures might need different policies which are more tailored to the field's needs. The proportion of tacit knowledge versus codified knowledge, for example, may vary. Likewise the need for physical infrastructure might be completely different from field to field, so that knowledge might be centered in some fields on huge facilities, where in others knowledge is more evenly distributed. So while some fields may benefit hugely from European funded research infrastructures, other might not since they do not need such expensive infrastructures. (e.g. some social sciences). Therefore a closer look at individual scientific fields is needed.

Although some fields (like bio-tech) were analyzed extensively, this was more case based and not done a in more universal or quantitative way. In the Systems of Innovation approach some research was also done based on a technological innovation system, where the focus of analysis was not primarily geographic in nature, but based on the qualitative analysis of a certain product or technological knowledge field.

This leads to the question how the different specifics of various scientific disciplines and fields can be measured in a more quantitative and universal approach. It is certainly not valid to collect only anecdotal evidence and to generalize the findings, since the diversity of specific fields is the core idea of this approach. Therefore a comprehensive framework is needed to analyze scientific fields and find relevant structures and sensible modes of governance. Based on this findings it should be possible to obtain more precise arguments for Multi-Level Governance in STI. A suitable framework for this purpose is the notion of “search regimes” developed over the last years by Bonaccorsi. (Bonaccorsi, Thoma 2005; Bonaccorsi 2004, Bonaccorsi 2005, Bonaccorsi 2007) He showed that individual scientific fields have often a unique set of structures and dynamics and that these can be shown by quantitative methods like bibliographical analysis. This framework was tested in a number of scientific fields ranging from nanotechnology to computer science and high energy physics. (Bonaccorsi 2004, p. 9)

The variables he analyzed included the rate of growth in a field, the degree of diversity and the level of institutional, human or physical complementarity in a given field. All this properties constitute a specific search regime for a field or discipline. In addition he argued that the efficiency of science polices largely depends on the way the supportive public policies fit to the this search regime.

However, research on the effects of these variables on science policies on different governmental levels is relatively undeveloped. Furthermore it could be useful to look into intra-regional variants of these factors and also look for other variables which might also help to describe field-specific structures.

Therefore the idea I suggest for further analysis is, that each level has a unique set of abilities (influence, power, know-how, funding) to target smaller or bigger tasks in the whole science funding system, whereas each scientific field or discipline has a unique set of structures, which can be described by a number of general variables. This leads to the research question:

> *“Under which conditions can a multi level set-up of public science funding play a decisive role”.*

The underlying hypothesis was that suitable science policies could vary from discipline to discipline and from region to region.

A *multi level set-up* in this context describes the set of public institutions found on the regional, national and supranational level and their policies and programs.

Public science funding means science funding provided by government bodies as defined under §184 of the Frascati-Manual. Accordingly “science” should be defined as:

> *Research and experimental development (R&D) comprise creative work*
>
> *undertaken on a systematic basis in order to increase the stock of knowledge,*
>
> *including knowledge of man, culture and society, and the use of this stock of*
>
> *knowledge to devise new applications.*
>
> *(OECD, 2002)*

A *decisive role* in this context means that science and research policy distributed across different levels of government has more effect than a policy enacted by a single entity alone has. The term *conditions* refers to the idea of regional and field specific properties of scientific fields. Therefore a given set of these properties would define a certain condition, under which a regional oder supranational science funding program might or might not be useful.

The proposed approach is therefore threefold. First a closer look at the set-up of multi level governance science funding in Europe from a bottom-up perspective is needed. Using the Multi-Level Governance approach developed by Marks and Hooghe (Marks & Hooghe, 1996) different government levels should be analyzed, regarding their science policies, influence, funding power etc.

Second, the internal structures of a given set of fields should be analyzed. Here not only Bonaccorsi's search regimes framework could be used, but also data on mobility, entrepreneurship, cooperation and influence gained in the IAREG project. In this project over 2000 scientists from six different disciplines from all European universities in the Top 500 of the 2008 shanghai ranking were surveyed. Data could be analyzed both for specific regional variations of certain structures but also for field-specific variations. In the survey data was collected on issues like mobility, cooperation, entrepreneurship, influence on diffrent stakeholders, commercialization and governance.

For example it could be assumed that mobility differs from discipline to discipline, due to a certain culture within this scientific community or through external factors. A well-tailored funding program for example, could look at this variable for a given set of fields and then develop specific actions to deal with low mobility. (Assuming that a high mobility of scientific personnel is regarded beneficial for the efficiency of a system of innovation.) Or, to provide another example, assuming the variable mobility is similar in different fields, but shows significant regional variation. Here regional programs to deal with this issue could be helpful. Of course these examples are very one-dimensional, later in the process a more detailed picture will eventually emerge. But given the first early results from the IAREG data, such variations are indeed to be found (see chart 1). Respondents were asked if the would relocate to another (world) region, given an improvement in certain living and working conditions. In our pretest for Austria, respondents behavior seemed very dependent on the discipline they are in. When we started to analyze European results it turned out however, that the affinity for relocation was also different from country to country (see chart 2). A next step would be to look at different variables within an given discipline in all countries.

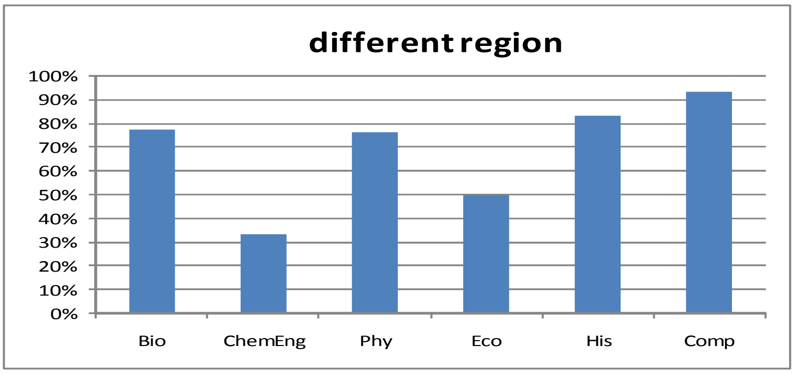

Chart 1: "Would you accept a university post in a different region, assuming improved conditions?" --- different region by discipline (AT only)

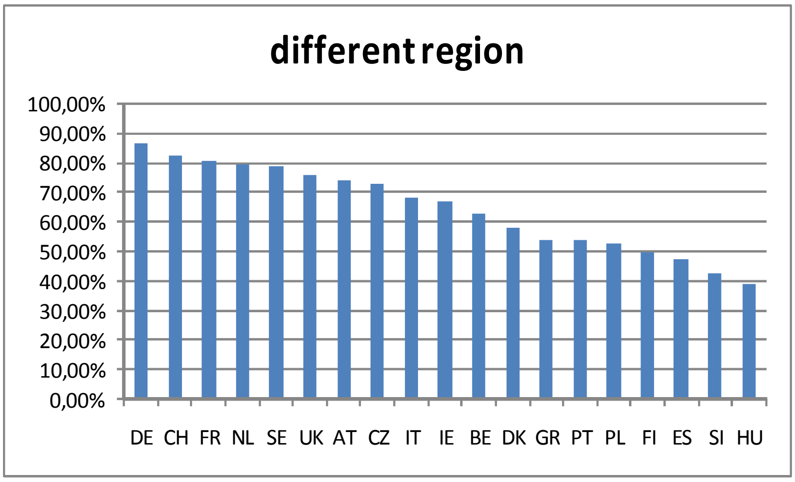

Chart 2: "Would you accept a university post in a different region, assuming improved conditions?" --- different region by country (all countries)

Subsequently based on the different variations of field variables found, a taxonomy of regional regimes within different fields should be developed. It has to be noted that with the data gained in the IAREG project an analysis on NUTS2 level will also be possible, since we do have the respondents postal code in most cases. As a consequence one result *could be* that mobility also differs within a country and that it is higher in capital regions. Or that mobility is higher in regions which are dominated by natural or applied sciences, so that in reality the dominant science area controls the amount of mobility (or cooperation, or entrepreneurship) within one given region or type of region. (e.g. capital regions)

An open question remains on if and how the search regime framework can be integrated and combined with the IAREG data. The first used mainly a broad range of bibliographic data for its analysis, which allows a fine tuned analysis of individual scientific fields. In the IAREG survey, however, data was collected in six different disciplines ranging from very narrow specified fields like chemical engineering to broad disciplines like economics or physics.

In a third step this taxonomy should be analyzed in depth to explore the dependencies between public governmental structures and scientific structures. Here the information on the institutional set-up gained in the first step could be used to compare existing public policies and institutions with the properties found in specific regimes or fields. To come back to the example given above, it could be analyzed how in regions with a similar set-up of different science policies perform. Assuming we do have regions with a certain search regime we would then look at their individual science policies and programms and try to compare them.

So the dissertation proposal suggests to analyze current supranational, national and regional science policies on the one hand and structural properties of scientific disciplines on the other. It will do this by using a number of soft (e.g. liklyness to relocate) and hard factors (e.g. growth in publications). Subsequently it will be analyzed how regional variances in the properties of these scientific disciplines could be used to create a taxonomy of search regimes of different fields within these different regions(see Chart 3). Finally it could be analyzed which policies and programs are adequate for which regional regimes.

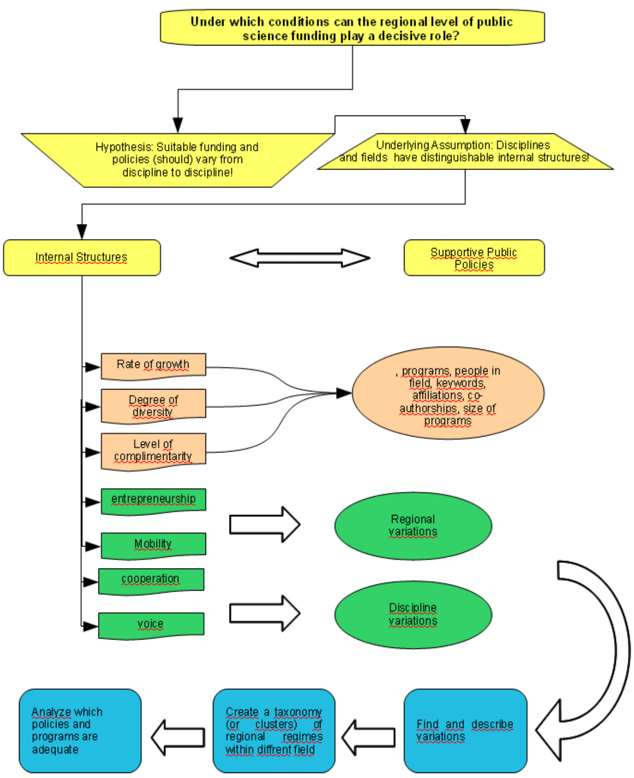

Chart 3: flow chart of thesis

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