PAPERS on Economics & Evolution

0611

An Assessment of the Regional Innovation Policy by the European Union based on Bibliometrical Analysis

by

Claudia Werker

The *Papers on Economics and Evolution* are edited by the Evolutionary Economics Group, MPI Jena. For editorial correspondence, please contact: evopapers@econ.mpg.de

ISSN 1430-4716

Max Planck Institute of Economics
Evolutionary Economics Group
Kahlaische Str. 10
07745 Jena, Germany
Fax: ++49-3641-686868

AN ASSESSMENT OF THE REGIONAL INNOVATION POLICY BY THE EUROPEAN UNION BASED ON BIBLIOMETRICAL ANALYSIS

Claudia Werker*

Abstract

The Lisbon strategy for growth and jobs seeks to use knowledge and innovation in the context of the European Research Area (ERA). To build the ERA the European Union (EU) implements – amongst others - regional innovation policy. Ample scientific publications have investigated how innovation drives regional dynamics. Therefore, we assess the goals of European regional innovation policy in the light of the scientific findings, which we collected and condensed by bibliometrical analysis. The general goals of the Lisbon strategy to at the same time stimulate growth and achieve cohesion of economic activities across the EU is not in line with the finding that positive cumulative and self-reinforcing processes go hand in hand with the agglomeration of economic activities. However, the goals of the specific innovation policies for the regional level are mainly in line with the scientific findings.

JEL Classification:

O31, O33, O38, R11

Keywords:

Region, innovation policy, European Union, bibliometrical analysis

Acknowledgements:

I am indebted to Werner Bönte, Thomas Brenner, Koen Frenken, Dirk Fornahl and Ulrich Witt for useful hints and discussions concerning this paper. Naturally, all remaining errors are my own.

* Dr. Claudia Werker, Max-Planck-Institute of Economics, Jena (Germany), email: werker@econ.mpg.de

Table of Content

1. Introduction

In 2000 – when launching the ten years Lisbon strategy (2001-2010) - the Commission of the European Communities (CEC) declared a competitive gap between the European Union (EU) on the one hand side and the US and Japan on the other hand side (cf. this and the following CEC, 2000). As reasons for this situation the CEC regards insufficient funding, the lack of a stimulating environment for basic and applied research as well as the fragmentation of research activities and resources. To close the gap between the EU and its global competitors the CEC has implemented an innovation-oriented strategy – the so-called Lisbon strategy. The major assumption underlying this strategy is that innovation is the most important driving force for economic development and growth. Accordingly, the CEC has coordinated research and innovation policy within the concept of the European Research Area (ERA), thereby taking into account all EU and national policies.

Regions are considered to play a crucial role in the European Research Area, because they bring policy measures close to the citizen, thereby following the subsidiarity principle, and because they bridge the EU level and the local level (cf. this and the following CEC, 2001a). In particular, the EU aims at stimulating innovative enterprises and the relationships within regional innovation networks. Regions can differ substantially with respect to their industrial specialisation, their connectedness with the national and global level, and in particular with respect to their potential to face national and global competition. Therefore, policy measures are best adapted to the region at hand.

In order to assess EU innovation policy for regions, we try to find out how innovation affects regional dynamics: In particular, we are interested in how knowledge and innovation are generated and disseminated within regional innovation networks and how in turn these networks shape innovation and knowledge. We start with some considerations about what innovation policy can mean on the regional level and what the evolutionary approach means for this kind of policy (Section 2). In order to base our analysis on broad scientific knowledge we collect and condense published scientific findings on regional dynamics (Section 3). This is done with the help of a

bibliometrical method developed earlier (cf. Schwerin/Werker, 2003). The thereby derived so-called structural regularities serve as a yardstick to assess the goals of EU innovation policy for regions (Section 4.). We conclude with a summary and some considerations about chances and limitations of the approach presented here (Section 5.).

2. Evolutionary Innovation Policy on a Regional Level

2.1 Innovation Policy for the Regional Level

In the following, we focus on innovation policy for the regional level. Innovation emerges when economic agents, for instance firms, individual researchers, R&D institutes or universities, implement novel combinations. Innovation policy addresses all actions of policy makers that are intended to influence the processes connected with the generation and diffusion of innovation. These processes go hand in hand with the complexity and uncertainty inherent in changing socio-economic systems. Innovation policy can be designed for the regional, for the national or for the supranational level, e.g. for EU level. By region we understand every entity that comprises a sub-national geographic unit smaller than a country. These units are normally closely interconnected with the national and global level and develop dynamically in this context. Nevertheless, they can be self-sustained, open and inter-dependent sites of economic activities and development (cf. Moulaert/Sekia, 2003). Regions can be characterized by internal coherence and can to some extent act as a collective entity. Aiming innovation policy for the regional level means focusing on emerging novelty, changing behaviour of innovative agents and changing institutions on the regional level.

It makes sense to regionalize innovation policy for the following four reasons (cf. for the following Fritsch/Stephan, 2005): First of all, innovation processes are taking place unevenly in geographic space. This is partly due to the variety in endowment with production factors and with industrial sectors. Second, innovation networks function differently in various regions. Third, innovation activity is crucial for economic

development and growth on the regional as well as on the national level. It is important to realise that economic development and growth on the two different levels might conflict. Fourth, using various policy approaches in different regions enables countries to gain much more varied experiences, thereby enabling regions to learn from one another.

2.2 Evolutionary Policy Making

In the following, we discuss how to design and implement innovation policy that is in line with the principles of evolutionary theory. Taking an evolutionary perspective when designing and implementing policy means "... adding the dimension of historical time to the picture, a dimension that allows the consequences of changing knowledge constraints to be accounted for" (cf. Witt, 2003, 79). The generation and diffusion of innovation is a dynamic process where institutional frameworks and individual actors as well as governmental bodies co-evolve. Therefore, innovation policy cannot be adequately guided by static policy conceptions. Innovation processes driving structural change and growth in regions comprise chance and necessity, i.e. they are not completely random (cf. Schwerin/Werker, 2003). The chance element is not accessible for evolutionary innovation policy. However, we show that evolutionary innovation policy can make use of the necessity element of structural change and growth in regions. This use of necessity for evolutionary policy is based on an earlier developed bibliometrical method, which draws on the broad knowledge available in scientific literature and which is at the same time open to advance in scientific knowledge (cf. Schwerin/Werker, 2003).

Evolutionary policy making departs from a completely different understanding than traditional policy making. The latter starts from the conception that economic processes are mainly deterministic and tend to the social optimum. Moreover, policy makers in this approach are fully informed. Consequently the fully informed policy makers can influence economic processes by taking care of so-called market failures in order to reach the social optimum. In contrast, evolutionary policy stems from a completely different concept and is rooted in the general concept of evolutionary policy, which acknowledges that policy has to cope with chance elements, uncertainty

and policy failures (cf. Lipsey/Carlaw, 1996, Metcalfe/Georghiou, 1997, Metcalfe, 1995, Teubal, 1997, as well as Hanusch/Cantner, 1993). In particular, policy makers operate under constraints of imperfect information and bounded rationality (cf. Lambooy/Boschma, 2001, Metcalfe/Georghiou, 1997, Metcalfe, 1995, as well as Hanusch/Cantner, 1993). In a situation thus characterised by continuous change and multiple overlapping causes and effects it becomes crucial for policy to be informed about scientific findings in the area it wants to influence (cf. Schwerin/Werker, 2003). This holds especially for innovation policy, as it tries to influence a particularly dynamic and uncertain part of the socio-economic system.

The particular concept used here departs from the fact that whereas the "chance" element in (regional) economic processes is not accessible in a systematic way by innovation policy the "necessity" element is (cf. this and the following Schwerin/Werker, 2003). As any policy, which tries to stimulate innovation, is connected with the uncertainty policy in itself is a process of trial and error. However, the component of error can be minimized if policy is based on scientific knowledge. This implies that changes of policy occur if the economic experts' understanding of the underlying mechanisms changes. The crucial aspect here is that we suggest to systematically exploit known as well as newly arising scientific knowledge on regional dynamics.

3. Structural Regularities on Regional Dynamics

3.1 Deriving Structural Regularities: The Method

We derive regional innovation policy from the broadest available amount of experts' knowledge (cf. the following Schwerin/Werker, 2003): This means that we systematically collect and assess all empirical studies, which currently exist for this topic, deliberately including different approaches like case studies, studies using econometrics, studies covering different empirical data sources. As a result, a set of studies will become available, which contains all recently discussed hypotheses for causal structures underlying the question in debate. Then, we carry out a consensus analysis. For all hypotheses explored in the empirical studies, the percentage of experts

who agree to them will be identified. In order to control for quality the group of these experts is confined to the authors of the existing empirical studies, which provide accepted or declined hypotheses that contain topic-related statements in already published material. If a certain hypothesis is tested in several studies by using different methods and if - as Robert Whaples (cf. Whaples, 1995, 139) has suggested - at least two thirds of all scholars agree on this hypothesis it is included into the set of structural regularities for the topic in question. This set then forms the basis for the guidance of economic policy, as it makes it possible to derive concrete policy measures. Even if there does not exist a consensus on a specific hypothesis its analysis still serves an important function, as it is the outcome of the scientific efforts that is interesting for policy makers who look for consensus in the published papers. Independent of this, dissensus drives science in parallel, producing new results, which might either contribute to existing consensus or provide new structural regularities or dispose of old ones.

A similar approach of collecting and condensing scientific published knowledge is taken in so-called meta-analysis. This approach is e.g. used for medical analyses in the so-called evidence based medicine as well as in social sciences (cf. Hunter/Smith, 1990). However, meta-analysis differs with respect to two to important aspects from the analysis carried out here. First of all, up-front a very specific hypothesis is tested. In particular, when testing how drugs work the research departments of the pharmaceutical industries work with very specific research design that are comparable with other studies testing the same drug. Second, and this is closely connected to the first point, statistical analysis can be and is used to calculate the overall empirical evidence of the hypothesis at hand. This is not possible here, as investigations on regional dynamics belong to social sciences where the research design can vary considerably from study to study. Consequently, we need to have a scholar familiar with the field who collects and condense the scientific findings into structural regularities.

The concept of structural regularities is dynamically open in the sense that the facts – and thus the justification for certain policy measures – have to be regularly checked against the latest empirical studies (cf. Schwerin/Werker, 2003). This means that if new studies emerge, the question whether a scientific consensus exists or not can be

raised anew. As a result, structural regularities are a variable entity, because the "facts" they considered secure knowledge in the past might be rendered unreliable if new pieces of information emerge or if new knowledge can be identified which has not been available so far. In order to base policy on the method introduced above it is necessary to institutionalise the generation of structural regularities and to perform such an analysis in regular intervals.

The assessment of regional innovation policy based on the structural regularities means that measures of innovation policy have to be in line with these structural regularities. It does not mean that policy makers are required to carry out specific measures. It means that the goals of innovation policy are assessed in the light of the structural regularities found. In particular the approach recommended here is by no means part of a technocratic approach where social scholars take over policy making. The structural regularities only serve the purpose to avoid the impression that for every policy measure you can find scientific reasons. When looking into the findings of this paper it becomes clear that there are quite a number of issues on which scholars do agree and which give a clear direction for policy. There is in principle nothing wrong with politicians' actions running against such an existing consensus among experts, because politicians have to take into account more aspects than just the narrow perspective that scientific experts have on a certain topic. However, politicians should have clear reasons for that other than some sort of one singular scholar's opinion. So, the purpose of this approach is to make it easier to control actions of politicians not to enable them to hijack public decision-making.

3.2 Current Structural Regularities on Regional Dynamics

In order to assess EU regional innovation policy we look into published scientific findings on regional dynamics. In particular, we want to know how innovation processes take place and how they are translated into economic development and growth. Naturally there is no clear-cut single hypothesis that corresponds with these questions. Therefore, we use a different way by putting together structural regularities based on different empirical studies (for the details see Section 3.1). The structural regularities found with our analysis serve as yardsticks to assess actual regional

innovation policy. We are particularly interested in the question whether tangible innovation policy is in line with the structural regularities we find.

The data for the following analysis stems from the Social Science Citation Index (SSCI). This database was used to find scientific papers that give insights into the processes of innovation, technological change and growth in regions. In order to find all papers relevant for the analysis we broadly searched with the following pairs of keywords:

- region* and technolog*,
- region* and innovat*
- region* and knowledg*

The sign * stands for right truncation, i.e. every word that begins with e.g. “region” is included, e.g. region, regions, regional, etc. All papers that contain any of the three pairs of words in the title are included in the analysis. The search was carried out for a three years period from the year 2001 until the year 2003, for which 216 paper were found. Papers that do not have an (adequate) empirical part are not taken into consideration for the analysis so that a total of 51 papers were analysed in detail. The papers considered stem from a wide range of different journals (for the exact figures how many papers were published in which journals see Appendix 1): Some journals provide only one or few papers on the topic, some journal that are specialised in the field of regional dynamics, like e.g. Regional Studies, provide more. We identify six structural regularities based on the above-described SSCI search. Please note that the results might change when repeating the exercise for older or newer publications.

Designing regional innovation policy requires insights into how regional dynamics are driven. Driving forces are on the demand side as well as on the supply side. Moreover, there are systemic influences that concern agglomeration processes as well as innovative agents on the demand and supply side. The demand side stimulates regional innovation processes via consumer preferences and their changes in time. Sometimes the information about consumer preferences is mainly transferred via market signals. Sometimes they are transferred in close cooperation between consumers and suppliers

(cf. e.g. Lundvall, 1992). We could not find any structural regularity for the demand side factors, because very little is published on this topic.

On the supply side, two kinds of factors are particularly important for regional dynamics, i.e. infrastructure and production factors. Infrastructure and production factors have traditionally been widely investigated by concentrating on their static effects only. In the two recent decades their dynamic effects have become centre-stage. It lies in the very nature of infrastructure and production factors that they lead to dynamic effects in the form of innovation and technological change, i.e. novel solutions, which affect individual firms, single sectors, several sectors or even the whole economy. Infrastructure and production factors have specific dynamics (cf. Werker/Athreye, 2004, 507-509). Infrastructure comprises the governance structure of a region that is relevant for economic development and growth (cf. Howells, 1999, 72f, and Malecki, 1997, 14f). To a large extent the government provides infrastructure. However, public-private intermediaries as well as the private sector also contribute to infrastructure. Regional infrastructure usually contains a set of formal and informal institutions, traffic as well as information and communication links and education and R&D facilities. All these elements of regional infrastructure govern the interaction between agents, mirror the interests of different groups in the region and evolve in time. We did not find any structural regularity on infrastructure, because this topic was not systematically investigated.

The second kinds of factors on the supply side, i.e. the production factors have been traditionally investigated in much detail. Production factors in the classical sense are land, labour and capital. When looking at the dynamics of these factors it becomes obvious that the production factor land is usually fixed. In contrast, the factor labour as well as the factor capital can change in time. In this context human capital, knowledge (cf. Malecki, 1997, 33) and physical capital, which can be accumulated into a capital stock are particularly interesting like, for instance, a machinery park that is added to, replaced and renewed. We could find three structural regularities on the crucial input factors for innovation, i.e. knowledge spillovers and human capital.

1) *Geographical distance matters for knowledge spillovers: They occur the more frequently the closer the recipient and the sender of the knowledge are located.*

All studies that analyse the relationship between knowledge spillovers and geographical proximity find that this relationship is positive (cf. Agrawal/Cockburn, 2003, Bottazi/Peri, 2003, Cooke, 2002, Greunz, 2003, as well as Zitt et al., 2003). As all studies support this hypothesis the Whaples criterion is met. All studies with the exception of Cooke (2002) use econometrics. The models employed are sufficiently different from each other to meet the criterion of variety of methods. Moreover, Cooke used case studies. Three of the studies make use of European patent data, (cf. Bottazi/Peri, 2003, Greunz, 2003, and Zitt et al., 2003) one of them US patent data (cf. Agrawal/Cockburn, 2003). In addition, Zitt et al. (2003) as well as Agrawal and Cockburn (2003) exploit European and US publication data respectively. Cooke (2002) uses material from regions in Germany, UK and the US. As the data covers Europe and the US we can conclude that the first structural regularity holds for Western advanced economies in general and for the EU in particular.

2) *Large firms, in particular multinational companies (MNCs), are a source of vertical knowledge spillovers, either by providing knowledge for local firms or by tapping into the local knowledge base.*

One specific source of knowledge spillovers, in particular vertical ones, is identified in structural regularity 2. Large firms, in particular MNCs, contribute to this kind of knowledge spillover either by being the knowledge source themselves (cf. Agrawal/Cockburn, 2003, Cumbers/Martin, 2001, Fromhold-Eisebith, 2002, as well as Zhou/Xin, 2003) or by using the local knowledge base (cf. Cantwell/Santangelo, 2002, as well as Santangelo, 2002). As all studies support this hypothesis the Whaples criterion is met. Three of the six studies are case studies (cf. Cumbers/Martin, 2001, Fromhold-Eisebith, 2002, as well as Zhou/Xin, 2003) and three are econometric analyses (cf. Agrawal/Cockburn, 2003, Cantwell/Santangelo, 2002, as well as Santangelo, 2002). This suffices for the criterion of variety of methods. The three econometric studies make use of US patent data; Agrawal/Cockburn, 2003 for US

firms, Cantwell/Santangelo (2002), for small EU countries and Santangelo (2002) for large EU countries. Although the latter two papers use the same method and the same kind of data they are able to support their hypothesis for different kinds of countries in the EU. The three studies based on case studies use material from four different countries, three of them in developing countries, one in a developed country. The four studies include various industrial sectors. Together with the aforementioned studies we have a strong enough argument to support the structural regularity for Western advanced economies including the EU as well as for developing countries.

3) *The presence of human capital positively influences regional development and growth. A lack of human capital hinders industrial and regional development.*

All studies dealing with this issue confirm that human capital is positively influencing regional development and growth or that a lack of it hinders it, thereby reaching a clear consensus. Ceh (2001), Holmen, (2002), Kim/Lee (2002) as well as Salinas Jimenez (2003) support the hypothesis that human capital has a positive impact on regional development and growth; Frenkel (2003) as well as Fromhold-Eisebith/Eisebith (2002) find that a lack of human capital hinders industrial and regional development. Holmen (2002) and Fromhold-Eisebith/Eisebith (2002) use the case study method whereas the four other studies employ different econometric tools. Thereby, sufficient variety of methods is achieved. The studies here cover different industrial sectors and geographically Indonesia, Israel, Spain, Sweden and the US. Therefore, we conclude that the structural regularity 3 holds for advanced economies including the EU. We are not able to support it for developing countries, though, as there is not sufficient evidence.

Concerning the systemic influences that concern agglomeration processes as well as innovative agents on the demand and supply side there exist a large literature on composition and functioning of regional innovation systems and a related discussion about how regional innovation systems are embedded into national or even global innovation systems (cf. the following Lambooy/Boschma, 2001, and Howells, 1999). In their global and national context regions display distinctive innovation systems with

respect to their infrastructure and the way their production factors are organized, in particular their industrial and technological specialization and organization. Moreover, agglomeration externalities stemming from proximity together with geographical distance to other regions often create an environment where specific localised interactions and learning processes can take place. It is important to note that at the same time these specialized and localized processes can be embedded in a national and global context, e.g. the New York garment industry, which produces in a localised innovation system but sells its products all over the US and the world (cf. Rantisi, 2002). The fourth and fifth structural regularities we found inform about the functioning of regional innovation networks. The sixth one gives an idea how agglomeration economies affect regional development and growth.

4) *The better firms are embedded in the regional innovation network the higher is the probability that they innovate and remain competitive.*

The firms' probability to innovate is positively influenced by the connectedness with their regional innovation network (cf. Cooke, 2002, Waters/Lawton-Smith, 2002, and Van Looy et al., 2003). All studies investigating this topic support the structural regularity 4. The first two studies mentioned above are based on case study findings whereas Looy et al., 2003, combines case study material with econometric analysis. Thus, there is sufficient variation in method. The studies cover Belgium, France, Germany, UK and the US and different industrial sectors, so that we can conclude that the structural regularity 4 holds for industrialized Western economies including the EU.

5) *Trust in network relationships is crucial for the creation and dissemination of knowledge and innovation.*

The soft factor trust turns out to be crucial for the creation and dissemination of knowledge and innovation (cf. Battenberg/Rutten, 2003, Edquist et al, 2002, as well as Fromhold-Eisebith/Eisebith, 2002). Edquist et al., 2002, use descriptive statistics to

come to their results whereas the other two papers are based on case study findings. Thus, the variety of approaches suffices. The studies include different industrial sectors as well as different countries, i.e. Indonesia, The Netherlands and Sweden. We, thus, with some caution, conclude that the structural regularity 5 holds for EU countries.

> 6) *Positive cumulative and self-reinforcing processes usually go hand in hand with agglomeration of economic activities, thereby supporting the so-called center-periphery paradigm.*

Regional economics is to a large extent about agglomeration and deglomeration of economic activities. The here found evidence shows that there is substantial support for structural regularity 6. This suggests that positive cumulative and self-reinforcing processes go hand in hand with the agglomeration of economic activities (cf. Cantwell/Santangelo, 2002, Driffield/Munday, 2001, Fritsch, 2003, Holmen, 2002, Larsson, 2002, Santangelo, 2002, Simmie, 2003, as well as Sohn et al. 2003). Naturally, the reasons these studies provide for the positive cumulative and self-reinforcing processes differ including knowledge spillover, human capital etc. (see also structural regularities 1-5 and Section 2). Larsson, 2002, and Holmen, 2002, use case studies to come to their conclusions whereas the other studies use different econometric models. The studies cover different industrial sectors and cover EU countries as well as the US and one region in Japan. We therefore conclude that the structural regularity 6 holds for industrialized countries including the EU.

4. European Regional Innovation Policy Assessed

4.1 EU Regional Innovation Policy: A Brief Overview of programmes and goals

In the following, we will assess whether or not regional innovation policy by the European Union is in line with the structural regularities derived (see Section 3.2). Policy can concern a number of different aspects, i.e. goals, level of operation (regional, national or EU), instruments, administration, decision competencies and source of finance (cf. Fritsch/Stephan, 2005). In the following, we concentrate on the

goals to assess European regional innovation policy. First of all, this is done for practical reasons, because whereas the goals of European policy are well documented the implementation of European policy is not or not systematically evaluated. Moreover, the analysis of the goals gives us very good insights into the understanding decision makers on the EU level have about regional dynamics. Therefore, we are able to assess whether or not their understanding is in line with the findings of the majority of the scientists investigating regional dynamics.

To assess the EU regional innovation policy as a whole we refer to the two major goals of the Lisbon strategy as well as to the specific goals of the EU programmes that aim at influencing innovation processes on the regional level. Following the Lisbon strategy, the EU tries to achieve two major goals by carrying out policies that stimulate innovation processes in regions: First of all, the EU tries to stimulate innovation in order achieve economic development and growth (cf. CEC, 2000). Second, the EU tries to stimulate innovation to achieve convergence between successful and laggard regions because it believes that every region can be economically successful (cf. CEC, 2001a). However, "the Commission's twin goals of competitiveness in the global economy and economic and social cohesion or convergence are not necessarily the same and may be contradictory. Inherently they comprise different policy positions: one is about winners and losers, while the other is about redistribution." (Lawton-Smith et al., 2003, 865).

A coherent EU regional innovation programme does not exist. However, the EU implements various policy programmes that purposefully affect the innovation processes on the regional level and that follow specific goals (cf. CEC, 2001a). The most important policies in this context are subsumed under the Structural Funds and the European Union Framework Programme. The Directorate General "Regional Policy" of the CEC implements the Structural Funds whereas the Directorate General "Research" of the CEC implements the Community Framework Programme. The EU regional innovation policy is not in one hand within the CEC, because two fields of interest of the CEC are concerned, i.e. regional policy and research policy. Therefore, the programmes relevant in this context do not form a coherent whole. This is notwithstanding the explicit effort of the CEC to co-ordinate the different kinds of measures within the Lisbon strategy.

Originally the Structural Funds concentrated on developing the physical infrastructure in less favoured regions in order to build capacity in terms of laboratories and equipment (cf. CEC, 2001a). Today, the structural funds are much more concerned with intangible investment in education, training, research and innovation. This change in policy is motivated by an existing good infrastructure, which is too a lesser extent still supported by the Cohesion Fund. In fact, our findings support this change in policy, as we could not find any clear evidence for infrastructure playing a crucial role in regional development.

Within the Structural Funds the so-called innovative actions are the particularly important instrument for EU regional innovation policy (cf the following CEC, 2001a and 2001b). The innovative actions are partly financed by the European Regional Development Funds (ERDF) and partly financed by the regions and countries themselves. Innovative actions are meant to give the regional policy makers the possibility to manage risk and change inherent in innovation as well as to exploit the synergies between regional policy and other EU policies, in particular those, which support innovative activities on the regional level and the emergence of the ERA.

Innovative actions are an experimental tool that explores the future orientation of the least-developed regions of the EU, in particular the Objective 1 regions, i.e. regions with less than 75% of the EU average per capita income and Objective 2 regions, i.e. regions that experience structural difficulties (cf. the following CEC, 2001b). Every region participating in innovative actions works with a thematic network that takes into account the specific characteristics of the region. Core aim of these networks is facilitate interregional exchanges and collective learning processes. In particular, they aim at regional economies based on knowledge and technological innovation and on information and communication technologies at the service of regional development.

Of the European Union Framework Programme currently the 6th (FP6) is implemented for the time period 2002 until 2006 (cf. the following CEC, 2002). The FP6 concentrates on research and innovation, human resources and mobility as well as research infrastructures in order to build a science and technology network in the EU, i.e. the European Research Area. It does so by connecting actions on the national and the regional level as well as on the EU level. The regional level is very crucial in this

context, as the subsidiarity principle is employed. This principle does not only imply that policy is implemented as close as possible to the citizens but also that only transnational projects, i.e. with partners from different countries, can get funding from the FP6. In practice, this means that FP6 stimulates networks all over the EU. The FP6 particularly concentrates on the stimulation and support of networks by programmes like Network of Excellence, Integrated Projects, Specific Targeted Research Projects, Specific Targeted Innovation Projects, Coordination Action, Specific Support Action and Specific Research Projects for SMEs. All these instruments have a different focus concerning number or kind of participants. There is also a particular programme to stimulate training and knowledge transfer by supporting mobility of scholars (i.e. Marie Curie fellowships). Moreover, the FP6 includes support for research infrastructure and for innovative activities

4.2 EU Goals Assessed Based on Structural Regularities

When assessing the EU regional innovation policy it becomes obvious that the ambiguity of the Commission's twin goals of global competitiveness and of cohesion stemming from the Lisbon strategy form a severe problem. In fact, it means that EU policy is contracting the structural regularity 6, which finds that agglomeration of economic activities usually goes hand in hand with positive cumulative and self-reinforcing processes. Moreover, this is in line with our finding as there is no structural regularity on convergence. Despite the fact that there are a number of papers investigating the question of convergence there is not consensus on whether or not regions converge (cf. Aronsson et al., 2001, Cappelen et al., 2003, and Salinas-Jimenez, 2003). The picture these papers draw about convergence and divergence of regions is rather hazy and time-inconsistent.

Concerning the specific goals of the programmes concerning EU regional innovation policy we find that they are mostly in line with the findings in the structural regularities. This particularly holds for structural regularities 1, 3, 4 and 5. As the structural funds, in particular the innovative actions, as well as FP6 aim at creating and disseminating knowledge, at stimulating the accumulation of human capital, at supporting agglomeration economies stemming from knowledge and technological

innovation (cf. CEC, 2001a and b, as well as CEC, 2002), they are in line with the structural regularities on the production factor knowledge, on the functioning of innovation networks as well as on agglomeration economies. These policies thereby increase the probability that knowledge spillovers take place and that regional innovation networks emerge and develop. It is, however, important to note that networks and trust-based relationships only develop over long time periods. To give an example: When looking in the Network of Excellence programme of the Communities 6th Framework Programme it becomes obvious that most networks comprise at least at their core already existing networks that they support and stimulate. In principle, there is nothing wrong with this. However, one has to be aware that – where there are no networks – nothing emerges because of the Network of Excellence programme. Last but not least, EU regional innovation policies provide better human capital so that regional development and growth is stimulated (see structural regularity 3).

It is not completely clear whether EU regional innovation policy is in line with the results of structural regularity 2. Structural regularity 2 provides a clear indication of the positive role that large firms and in particular MNCs have in regional knowledge transfer: At the same time, EU regional innovation policy mainly concentrates on stimulating small and medium sized firms (SMEs). However, there are of course quite a number of high-profile projects, which are heavily supported by the EU, e.g. the Airbus project, but which are not covered by the goals set in the context of regional innovation policy. It remains unclear whether there is any regional goal behind these kinds of projects.

5. Conclusions

In this paper we assessed EU regional innovation policy based on published scientific knowledge. We collected and condensed this scientific knowledge into structural regularities. Regional innovation policy is best based on the knowledge stock that is available to policy makers via the scientific knowledge provided in publications on this topic. In this paper, we showed how this published scientific knowledge could be put to use with the help of the concept of evolutionary innovation policy developed earlier. Regional innovation policy can improve a lot by using this method, as regions are parts

of socio-economic systems, which evolve in ways that cannot be fully anticipated. These dynamics pose a challenge to policy makers, who have to devise a framework that needs to co-evolve with the regional socio-economic system. With the help of the method used here structural regularities in regional dynamics can be distinguished from chance elements and can be regularly updated.

Addressing innovation processes on the regional level is not an obvious tasks, because innovation policy usually takes place on the national or even supra national level like the EU level. Thus, the question whether there is any need for regional innovation policy stands at the beginning of the analysis. Looking into the discussion on regional innovation systems leads to the insight that the dynamics of innovation, technological change and growth have a regional dimension that is worthwhile addressing via regional innovation policy (see Section 2). An answer to the question of how this policy could look like when taking an evolutionary and systemic perspective is not straightforward, especially because the usual market failure approach of standard economics does not adequately address regional dynamics with the help of its rather static approach.

Innovation policy can be largely covered on the national and even supra-national level. The so-called subsidiarity principle suggests that policy should take place as close as possible to the citizens, i.e. if possible and sensible on the regional level. The discussion on regional innovation systems as well as the structural regularities found on regional dynamics provide another reason to implement innovation policy on the regional level. This is because distinct processes, which can be influenced by policy measures, can be identified on the regional level

Published scientific knowledge plays a pivotal role in implementing regional innovation policy in a dynamic context. Not only can structural regularities serve as a yardstick for policy but also can policy makers update their policy based on newer findings in regular intervals. We show by way of example with the help of EU regional innovation policy that structural regularities can serve as guidelines for actual policy – not in the sense that structural regularities would suggest specific policy measures but in the sense that actual policy can be assessed. Here, the question of whether or not actual regional innovation policy is in line with the structural regularities is crucial.

It became clear that the general goals of the EU manifested in the Lisbon strategy, namely to at the same time stimulate economic growth and to achieve an even distribution of economic activities all over the European Union is not in line with the finding that positive cumulative and self-reinforcing processes go hand in hand with the agglomeration of economic activities (structural regularity 6). However, the goals of the specific innovation policies for the regional level are mainly in line with the scientific findings. The EU regional innovation policies are to a certain extent in line with the findings in the structural regularities 1, 3, 4 and 5 by improving regional innovation networks and the regional endowment with human capital. With respect to structural regularity 2, which suggests the importance of large firms for regional knowledge spillovers, we were not able to clearly indicate of whether or not the EU takes this into consideration.

Naturally, this approach of evolutionary policy can be used in different contexts other than regional dynamics, thereby addressing all kinds of policy fields. However, what made it so interesting to use it in this context is that regional innovation processes need a method that adequately takes into account the dynamics behind them in order to derive policy from it. Innovation policy is therefore always a good candidate for using this approach – much more so than policy fields that are more static and might therefore even benefit from the more static market failure approach.

References

Agrawal, A. and I. Cockburn (2003): The anchor-tentant hypothesis: exploring the role of large, local, R&D-intensive firms in regional innovation systems, in: International Journal of Industrial Organization, 21, 1227-1253.

Aronsson, T., J. Lundberg, and M. Wikström (2001): Regional Income Growth and Net Migration in Sweden, in: Regional Studies, 35 (9), 823-830.

Batenburg, R. and R. Rutten (2003): Managing innovation in regional supply networks: a Dutch case of "knowledge industry clustering", in: Supply Chain Management, 8 (3), 263-270.

Bottazi, L. and G. Peri (2003): Innovation and spillovers in regions: Evidence from European paptent data, in: European Economic Review, 47, 687-710.

Cantwell, J. and G. D. Santangelo (2002): The significance of European small country regions in the geographical division of labour of European Information and Communications Technology (ICT) corporations, in: International Journal of Technology Management, 24 (7/8), 663-679.

Cappelen, A., F. Castellacci, J. Fagerberg and B. Verspagen (2003): The Impact of EU Regional Support on Growth and Convergence in the European Union, in: Journal of Common Market Studies, 41 (4), 621- 644.

Ceh, B. (2001): Regional innovation potential in the United States: Evidence of spatial transformation, in: Papers of Regional Science, 80, 297-316.

CEC (2000): Presidency Conclusions of the Lisbon European Council, March, mimeo: Commission of the European Communities, Brussels.

CEC (2001a): The Regional Dimension of the European Research Area, October, mimeo: Commission of the European Communities, Brussels.

CEC (2001b): The Regions and the New Economy. Guidelines for Innovative Actions Under the ERDF in 2000-2006, January, mimeo: Commission of the European Communities, Brussels.

CEC (2002): The Sixth Framework Programme in Brief, December, mimeo: Commission of the European Communities, Brussels.

Cooke, P. (2002): Biotechnology Clusters as Regional, Sectoral Innovation Systems, in: International Regional Science Review, 25 (1), 8-37.

Cumbers, A. and S. Martin (2001): Changing Relationships between Multinational Companies and their Host Regions? A Case Study of Aberdeen and the International Oil Industry, in: Scottish Geographical Journal, 117 (1), 31-48.

Driffield, N. and M. Munday (2001): Foreign Manufacturing, Regional Agglomeration and Technical Efficiency in UK Industries: A Stochastic Production Frontier Approach, in: Regional Studies, 35 (5), 391-399.

Edquist C., M.-L. Eriksson, Hans Sjörgen (2002). Characteristics of Collaboration in Product Innovation in the Regional System of Innovation of East Gothia, in: European Planning Studies, 10 (5), 563-581.

Frenkel, A. (2003): Barriers and Limitations in the Development of Industrial Innovation in the Region, in: European Planning Studies, 11 (2), 115-137.

Fritsch, M. (2002): Measuring the Quality of Regional Innovation Systems: A Knowleldge Production Function Approach, in: International Regional Science Review, 25 (1), 86-101.

Fritsch, M. and A. Stephan (2005): Regionalization of innovation policy – Introduction to the special issue, in: Research Policy, 34, 1123-1127.

Fromhold-Eisebith, M. (2002): Regional cycles of learning: foreign multinationals as agents of technological upgrading in less developed countries, in: Environment and Planning A, 34, 2155-2173.

Fromhold-Eisebith, M. and G. Eisebith (2002): The Indonesian technology region of Bandung, in: International Development Planning Review, 24 (1), 41-57.

Greunz, L. (2003): Geographically and technologically mediated knowledge spillovers between European regions, in: Annals of Regional Science, 37, 657-680.

Hanusch, H./Cantner, U. (1993): Neuere Ansätze in der Innovationstheorie und der Theorie des technischen Wandels - Konsequenzen für eine Industrie- und Technologiepolitik, in: Meyer-Krahmer, F. (ed.): Innovationsökonomie und Technologiepolitik: Forschungsansätze und politische Konsequenzen, Technik, Wirtschaft, Politik, Schriftenreihe des Fraunhofer-Instituts für Systemtechnik und Innovationsforschung (ISI), Heidelberg (Physica Verlag), pp. 11-42.

Holmen, M. (2002): Regional Industrial Renewal: The Growth of 'Antenna Technology' in West Sweden, in: Technology Analysis and Strategic Management, 14 (1), 87-106.

Howells, J. (1999): Regional Systems of Innovation, in: Innovation Policy in a Global Environment, ed. by Archibugi, D., J. Howells, and J. Michie, Cambridge (UK), New York (US), Melbourne (AUS): Cambridge University Press.

Hunter, J.E., & F.L. Schmidt (1990). Methods of meta-analysis. Newbury Park, CA: Sage.

Kaiser, R. (2003): Multi-level Science Policy and Regional Innovation: The Case of the Munich Cluster for Pharmaceutical Biotechnology, in: European Planning Studies, 11 (7), 841-857.

Kim, S. and Y. H. Lee (2002): Public Sector capital and the Production Efficiency of U.S. Regional Manufacturing Industries, in: The Japanese Economic Review, 53 (4), 466-477.

Lambooy, J. G. and R. A. Boschma (2001): "Evolutionary economics and regional policy", in: *Annals of Regional Science*, 35, 113-131.

Larsson, A. (2002): The Development and Regional Significance of the Automotive Industry. Supplier Parks in Western Europe, in: International Journal of Urban and Regional Research, 26 (4), 767-784.

Leibovitz, J. (2003): Institutional Barriers to Associative City-region Governance: The Politics of Institution-building and Economic Governance in 'Canada's Technology Triangle', in: Urban Studies, 40 (13), 2613-2642.

Lipsey, Richard G., and Kenneth Carlaw (1996). A Structuralist View of Innovation Policy, in: Howitt, Peter (ed.), The Implications of Knowledge-Based Growth for Micro-Economic Policies. Calgary: University of Calgary Press: 255-333.

Lundvall, B.-A. (1992): User-Producer Relationships, National Systems of Innovation and Internationalisation, in: Lundvall, B.-A. (ed.): National Systems of Innovation and Interactive Learning, London: Pinter Publishers.

Malecki, E.J. (1997): Technology and Economic Development. The Development of Local, Regional and National Competitiveness, Harlow (UK): Addison Wesley Longman.

Metcalfe, J. Stanley (1995). The Economic Foundations of Technology Policy: Equilibrium and Evolutionary Perspectives, in: Stoneman, Paul (ed.), Handbook of the Economics of Innovation and Technological Change. Oxford and Cambridge, MA, USA: Blackwell.

Metcalfe, J. Stanley, and Luke Georghiou (1997). Equilibrium and Evolutionary Foundations of Technology Policy. CRIC Discussion Paper No. 3, The University of Manchester, Manchester: mimeo.

Rantisi, N.M. (2002): The Local Innovation System as a Source of 'Variety': Openness and Adaptability in New York City's Garment District, in: Regional Studies, 36, 6, 587-602.

Salinas-Jimenez, M.M. (2003): Technological change, efficiency gains and capital accumulation in labour productivity growth and convergence: an application to the Spanish regions, in: Applied Economics, 35, 1839-1851.

Santangelo, G. D. (2002): The Regional Geography of Corporate Patenting in Information and Communications Technology (ICT): Domestic and Foreign Dimensions, in: Regional Studies, 36 (5), 495-514.

Schumpeter, Joseph A. (1911/1987): Theorie der wirtschaftlichen Entwicklung: Eine Untersuchung über Unternehmergewinn, Kapital, Kredit, Zins und den

Konjunkturzyklus. Berlin: Duncker & Humblot, 7. edition., published first in 1911, unchanged reprint of the 4. edition of 1934.

Schwerin, J. and C. Werker (2003): "Learning innovation policy based on historical experience", in: *Structural Change and Economic Dynamics*, 14, 385-404.

Simmie, J. (2003): Innovation and Urban Regions as National and International Nodes for the Transfer and Sharing of Knowledge, in: Regional Studies, 37 (6&7), 607-620.

Sohn, J., T. J. Kim and J. D. Hewings (2003): Information technology and urban spatial structure: A comparative analysis of the Chicago and Seoul regions, in: Annals of Regional Science, 37, 447-462.

Teubal, Morris (1997). A Catalytic and Evolutionary Approach to Horizontal Technology Policies (HTPs), Research Policy. 25: 1161-1188.

Tonts, M. and J. Selwood (2003): Niche Markets, Regional Diversification and the Reinvention of Western Australia's Sandalwood Industry, in: Tijdschrift voor Economische en Sociale Geografie, 94 (5), 564-575.

Van Looy, B, K. Debackere and Pl. Andries (2003): Policies to stimulate regional innovation capabilities via university-industry collaboration: an analysis and an assessment, in: R&D Management, 33 (2), 209-229.

Waters, R. and H. Lawton-Smith (2002): Regional Development Agencies and Local Economic Development: Scale and Competitiveness in High-technology Oxfordshire and Cambridgeshire, in: European Planning Studies, 10 (5), 633-649.

Werker, C. and S. Athreye (2004): "Marshall's Diciples: Knowledge and Innovation Driving Regional Economic Development and Growth", in: Journal of Evolutionary Economics, 14 (5), 505-523.

Whaples, Robert (1995). Where Is There Consensus among American Economic Historians? The Results of a Survey on Forty Propositions, Journal of Economic History. 55: 139-154.

Witt, U. (2003): "Economic policy making in evolutionary perspective", in: Journal of Evolutionary Economics, 13, 77-94.

Zhou, Y. and T. Xin (2003): An Innovative Region in China: interaction Between Multinational Corporations and Loacal Firms in a High-Tech Cluster in Beijing, in: Economic Geography, 79 (2), 120-152.

Zitt, M., S. Ramanana-Rahary, E. Bassecoulard, and F. LaVille (2003): Potential science-technology spillovers in regions: An insight on geographic co-location of knowledge activities in the EU, in: Scientometrics, 57, 295-320.

Appendix 1: List of journals

Journal	Total number of papers	Number of papers analysed
Antipode	1	0
American Economic Review	1	0
American Journal of Physical Anthropology	1	0
Annals of Regional Science	10	2
Annals of the American Academy of Political and Social Sciences	2	0
Applied Economics	1	1
Applied Economic Letters	1	0
Australian Geographer	1	0
Business History Review	1	0
Canadian Journal of Forest Research	1	0
China Economic Review	2	0
Cities	2	0
Collegium Antropologicum	1	0
Contributions to Indian Sociology	1	0
Economic Development and Cultural Change	2	0
Economic Development Quarterly	3	1
Economic Geography	4	1
Economic and Industrial Democracy	1	0
Economic and Social Review	1	0
Economics of Transition	1	0
Energy Economics	1	0
Entrepreneurship and Regional Development	3	2
Environment and Planning A	7	3
Environment and Planning C	5	0
Eure-Revista Latinoamericana de Estudios Urbano Regionales	3	0
Europe-Asia Studies	1	0
European Economic Review	1	1
European Planning Studies	23	5
European Urban and Regional Studies	5	0
Gesundheitswesen	1	0
Geoforum	1	0
Geographical Analysis	1	1
Geographische Zeitschrift	1	0
Growth and Change	3	1
Habitat International	1	1
Health and Place	1	1
IIC-International Review of Industrial Property and Copyright Law	1	0
Industrial Relations	1	0
International Development Planning Review	2	1
International J. of Energy Research	1	0
International. J. of Industrial Organization	1	1
International J. of Technology Management	6	4

Journal	Total number of papers	Number of papers analysed
International J. of Urban and Regional Research	3	1
International Regional Science Review	10	2
Jahrbücher für Ökonomik und Statistik	1	0
Japanese Economic Review	1	1
Journal of Air Transportation Management	1	0
Journal of Anthropological Research	1	0
Journal of Business Venturing	1	0
Journal of Common Market Studies	1	1
Journal of Development Studies	2	0
Journal of ECT	1	0
Journal of the Japanese and International Economies	1	0
Journal of Monetary Economics	1	0
Journal of Regional Science	4	0
Journal of World Business	1	0
Land Economics	2	0
Mouvement Social	1	0
New England Economic Review	1	0
Oxford Bulletin of Economics and Statistics	2	0
Papers in Regional Science	3	1
Political Geography	1	0
R&D Management	1	1
Regional Science and Urban Economics	1	0
Regional Studies	25	7
Research Policy	4	1
Review of International Political Economy	2	0
Review of Economics and Statistics	1	0
Service Industries Journal	1	1
Scientometrics	2	1
Scottish Geographical Journal	1	1
Singapore Journal of Tropical Econommy	1	0
Social Science History	1	0
Social Science Quarterly	1	0
Society and Natural Resources	1	0
Space Policy	2	0
Small Business Economics	3	1
Soziale Weltzeitschrift für Sozialwissenschaftliche Forschung und Praxis	1	0
Supply Chain Management	1	1
Sustainable Development	1	0
Technovation	2	1
Technology Analysis and Strategic Managem.	1	1
Telecommunications Policy	1	0
Third World Quarterly	1	0
Tijdschrift voor Econ. en Soc. Geografie	3	2
Total Quality Management	1	0

Journal	Total number of papers	Number of papers analysed
Transactions of the Institute of British Geographers	1	0
Urban Affairs Review	2	0
Urban Geography	1	0
Urban Studies	4	1
Weltwirtschaftliches Archiv	1	0
World Economy	1	0
Sum	216	51