ENTREPRENEURSHIP AND POLICY IN REGIONAL INNOVATION SYSTEMS

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Abstract

We investigate the question how entrepreneurship and policy can contribute to the existence and success of regional innovation systems. With the help of an empirical meta-analysis we can show that there is ample opportunity for entrepreneurship and policy to positively stimulate regional innovation systems. The role of entrepreneurs and policy makers crucially depends on their environment, namely whether they act in a grassroots, network or planned regional innovation system.

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Region, innovation, regional innovation system, entrepreneurs, innovation policy

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1. Introduction

Whether or not regional innovation systems (RIS) have a positive impact on innovation, technological change and growth has been discussed controversially. On the one hand side a number of research results as well as current policy, e.g. on the EU level, suggest that RIS are important for generating innovation, technological and growth (cf. e.g. EC, 2001a and 2001b, EC, 2006, as well as Gebauer et al., 2005, Schwerin, 2004, or Rantisi, 2002). On the other hand side De Bruin and Lagendijk, (2005, 1153) intimate, that "… the role of regional innovation capabilities must not be overemphasized. Economic development is in the first instant dependent on national contexts". Cooke (2001) and Dosi et al. (2006) even suggest that too much active networking support by policymakers and an excess reliance on public intervention might be the reason for the technological gap between the EU and the US. Therefore, they recommend stimulating entrepreneurship, which is motivated by profit, and to re-orientate and concentrate policy on subsidising the science base where it can be effective. Whereas policy has been widely investigated in the context of regional dynamics much less has been done on entrepreneurship in RIS (cf. Cooke, 2007).

The aim of this paper is to better understand the role of entrepreneurship and policy in RIS. This will help to better understand how different RIS can look like and under which circumstances they have positive effects on regional dynamics in terms of stimulating innovation, technological change and growth. Using detailed insights into the functioning of regional innovation systems and the role entrepreneurship and policy play may enable innovative agents and policy makers to design more effective innovation strategies and implement more successful innovation policies.

In order to find out which role entrepreneurship and policy can play in RIS we have a closer look at the concept "regional innovation system" as our theoretical starting point for describing and explaining regional dynamics (Section 2). For our empirical analysis we use papers listed on regional dynamics in the Social Science Citation Index in the

time period 2001 to 2005. Section 3 describes the bibliometrical method employed to carry out the empirical meta-analysis. Based on our theoretical considerations and our empirical findings we give specific answers to the question to which extent and how entrepreneurship and policy contribute to RIS (Section 4). We conclude with a brief summary and first lessons for entrepreneurs and policy makers (Section 5).

2. Dynamics in Regional Innovation Systems

As regions we consider in the following geographical entities that are smaller than a country and bigger as a city. The motivation for this is twofold: First of all, we are interested in the geographical distribution of innovation activities on this level, because current political and academic discussion suggests that influential innovation processes are going on this level (see Section 1.). Second, the papers included in our empirical meta-analysis usually draw on data on this level, which for the EU would be the NUTS2 level.

The concept of "regional innovation system" belongs to the approaches explaining the geographical distribution of innovation activities and its dynamics. Other approaches dealing with these kinds of issues are the concepts of 'regional clusters', 'learning regions' and 'innovative milieu', which describe and analyse similar phenomena, i.e. the regional concentration of small and medium sized enterprises belonging to the same or vertically integrated industries (for an overview see Werker and Athreye, 2004, as well as Boschma and Lambooy, 1999, 414-416). We here use the concept of "regional innovation systems" as it is widely used in academic as well as in policy discussions (see Section 1).

The concept itself has mainly emerged from the national innovation system approach (cf. Howells, 1999, p. 70f) and tries to provide a theoretical and empirical way to systematize innovation processes in regions (see e.g. Morgan, 2004). As agents the RIS approach includes innovative firms, research organizations, universities and policy makers, both

public and private, as well as their relationships (cf. this and the following De Bruin and Lagendijk, 2005, Cooke, 2004, Gertler, 2000, and Howells, 1999). Moreover, it embraces the institutional setting, because "… the functional support system of public and private research intermediaries … [is] of central importance to the health of innovation systems and the clusters that may be embedded within them." (Cooke, 2004). Agents and institutional setting together produce pervasive and systemic effects leading to a situation where agents innovate more in the regional context than they would by themselves only, because of familial, communal, social as well as competitive relationships providing e.g. finance, assisting in research and production (Cooke, 2007).

RIS are part of national and global innovation systems. There exists a large literature on composition and functioning of RIS and a related discussion about how RIS are embedded into national or even global innovation systems (cf. the following Lambooy/Boschma, 2001, and Howells, 1999). 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. Regions are driven by dynamic specialized and localized processes, which can vary substantially because of the historical development, the infrastructure, the industry structure and other factors from region to region. It is important to note that regional dynamics are more or less 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).

Entrepreneurship and policy drive the evolution of RIS. Entrepreneurship is about an awareness of how to do business (Cooke, 2007). Entrepreneurship stimulates new products, processes, business models, and markets, driving industries and regions by creative destruction (Schumpeter, 1911 and 1942). Following the rather different ideas Schumpeter suggested in his 1911 and 1942 books the concepts of Schumpeter Mark I and II indicate that there are different environments requiring different types of entrepreneurship. Schumpeter Mark I describes a situation where entrepreneurs need to

translate a substantial technological invention into a marketable product or service whereas Schumpeter Mark II describes a situation where an already known product or service is improved incrementally and almost routinely. Winter (1984) suggested that Schumpeter Mark I is about early stages in an industry life cycle and Schumpeter Mark II about later stages. There are a number of possibilities how an industry can evolve from Schumpeter Mark I and Mark II, e.g. standardization processes (cf. Werker, 2003). From a regional point of view a single or a number of related industries important for a region can drive the regions evolution (cf. the following Brenner, 2005). RIS can emerge from entrepreneurship and policy, reach a substantial size because of sufficient demand, technological developments meeting demand as well as appropriate infrastructure. They can grow and eventually shrink again. Whether or not RIS reach a sufficient size to pilot agglomeration effects depends on the specific characteristics and the evolution of the RIS investigated.

Policy is the other driving force of RIS we want to particularly investigate. Under the heading policy we here subsume all actions of policy makers that intend to influence the processes connected with the generation and diffusion of innovation on a regional level. Measures intending to do so can be rather different like e.g. subsidies for universities and regional development agencies, R&D subsidies, networking activities of policy makers etc. Entrepreneurship and policy co-evolve with RIS and in the following we are particularly interested in how this co-evolution function and produces positive results in terms of innovation, technological change and growth.

RIS can take quite different shapes as they emerge partly from inherited advantages (e.g. ready available input factors) and partly from advantages constructed (cf. Cooke, 2007). In the following, we concentrate on the advantages constructed by either entrepreneurs or policy makers. Inspired by Cooke, 2007, we distinguish three kinds of RIS, i.e. grassroots, network and planned. At one end of the spectrum is the grassroots RIS, which is initiated from the bottom and maintained by weak and informal contacts between both policy makers and entrepreneurs. Typical example of grassroots RIS are the Italian

industrial clusters, which have a long tradition and are very flexible (cf. Iammarino, 2005). At the other end of the spectrum we find planned RIS, which are centrally initiated and maintained by strong and formal ties between policy makers and large companies. One example of a planned innovation system is the Ruhr-area, where closely knitted ties between innovative agents focused the whole system on a few related industries, i.e. coal and steel (Grabher, 1993). An even more extreme example of planned innovation systems were those of the former Socialist countries in East Europe where ties, knowledge flows, research inputs and outputs were completely centrally-planned by the government (cf. Fritsch/Werker, 1999).

	Level	initiated mainly by	Ties	Examples
Grassroots	bottom	SMEs	weak and informal	Italian footwear industry
Network	bottom and top	SMEs, MNCs, policy	Mixed	Machinery sector in Baden-Württemberg, bio-tech in Cambridge (UK)
Planned	top	policy, MNCs	strong and formal	Ruhr area of coal and steel, Rotterdam port

Table 1: Shapes and Functioning of RIS

In-between these two extremes lie the network RIS, which is initiated on various levels by entrepreneurs and policy makers, i.e. bottom-up as well as top-down and contains formal as well as informal ties. An example of a network RIS is Baden-Württemberg where – at least in theory - firms, polytechnic (universities) and political administration closely and flexibly cooperate (cf. Heidenreich/Krauss, 1998). Cooke, 2007, suggests that most RIS nowadays move towards the network RIS type, because it has proofed to be

most flexible and successful in terms of innovative output and technological development. Here, policy, MNCs and SMEs play such an interwoven role.

3. The Bibliometric Analysis on Regional Dynamics

In order to answer the question, which role entrepreneurship and policy play in RIS and how they contribute to regional dynamics in terms of innovation, technological change and growth, we look for empirical findings in recent papers on this topic. As so far empirical findings seem to be ambiguous (see discussion in Section 2) we will in the following use a methodology that will provide consistent empirical results.

In order to do so we collect all empirical studies, which currently exist for regional dynamics and assess all studies that contain the recently discussed hypotheses for causal structures underlying regional dynamics and subsume them with the help of consensus analysis in a set of structural regularities (cf. a detailed description of the method Schwerin and Werker, 2003). Deriving structural regularities means that a set of studies will become available, which contains all recently discussed hypotheses for causal structures underlying regional dynamics. Then, we carry out a consensus analysis. For all hypotheses explored in the empirical studies, the percentage of scientific scholars who agree upon them will be calculated. 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 regional dynamics. Even if there does not exist a consensus on a specific hypothesis its analysis still serves an important function, as it provides hints for economic processes where scientific expertise cannot indicate clear motivation for entrepreneurs and policy makers.

So-called meta-analyses take a similar approach of collecting and condensing scientific published knowledge. This approach is e.g. used for medical analyses in the so-called

evidence based medicine as well as in social sciences (cf. Hunter and Smith, 1990, as well as Campell-Hunt, 2000). However, meta-analysis differs with respect to two important aspects from the analysis carried out here. First of all, up-front very specific hypotheses are 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. Similar meta-studies are carried out in the field of strategic management as well (Campell-Hunt, 2000). 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, because the research designs concerning regional dynamics vary considerably from study to study including case studies, modelling, econometric analysis etc. Therefore, we here assess and condense the results ourselves applying strict rules with respect use of theoretical work, suitable empirical data and a consensus analysis based on variety of approaches.

In order to find all papers relevant for our analysis at hand we broadly searched with the following pairs of keywords in the Social Science Citation Index (SSCI) for the time period 2001 until 2005:

- "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 such as region, regions, regional, etc.

All papers that contain any of the three pairs of words in the title are included in the analysis and 309 papers were found. Papers that do not have one or more clear hypotheses and an (adequate) empirical part are not taken into consideration for the analysis so that we analysed a total of 116 papers 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 eighth 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.

4. Entrepreneurship and Policy in Regional Innovation Systems

In the following, we investigate how entrepreneurship and policy can contribute to the existence and success of RIS. We will present the structural regularities derived by the method discussed in Section 3 and will discuss the role entrepreneurship and policy plays. We concentrate on the five factors emerging from our bibliometric analysis of regional dynamics: systemic effects and infrastructure (Section 4.1), human capital, knowledge spillovers, and trust (Section 4.2). Either policy or entrepreneurship or both influence these factors or are influenced by them (Cooke, 2007 and 2001). The role of entrepreneurship and policy differs concerning the different aspects of RIS discussed above (Section 2.).

The structural regularities presented in the following all hold for the EU as in all cases sufficient studies were carried out for this part of the world. Moreover, most structural regularities hold for Western industrialized countries including the US, the EU and sometimes Japan (structural regularities 1, 2, 4, 6 and 8), whereas just one structural regularity, i.e. 7, holds for the EU only, and two structural regularities, namely 3 and 5 hold for developed and developing countries in general.

4.1 Systemic Effects and Infrastructure

Regional economic activities and regional specialisation emerge from systemic effects and infrastructure. When the result of individual economic activities is bigger than the

sum of these activities we face systemic effects. These stem from dynamic agglomeration processes, which emerge when accumulable production factors, such as human capital (see also Section 4.2), are subject to increasing returns to scale. Moreover, specific localised interactions and learning processes can lead to agglomeration externalities. Most often knowledge spillovers are investigated in this context (see also Section 4.3).

The evidence found here shows that there is substantial support for structural regularity 1. This suggests that positive cumulative and self-reinforcing processes go hand in hand with the agglomeration of economic activities (cf. Bathelt, 2001, Braunerjhelm and Borgman, 2004, Cantwell and Santangelo, 2002, Driffield and Munday, 2001, Fritsch, 2002, Gordon and McCann, 2005, 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 2-8). Bathelt, 2001, Larsson, 2002, and Holmen, 2002, use case studies to come to their conclusions whereas the other studies use different econometric models using various theoretical approaches. 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 1 holds for industrialized countries including the EU.

1.Positive cumulative and self-reinforcing processes usually go hand in hand with agglomeration of economic activities and positive regional development.

The second factor potentially crucial for the existence as well as success or non-success of RIS is infrastructure, which 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 policy provides infrastructure either fully or via public-private intermediaries. Additionally the private sector also contributes 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. The following two structural regularities found show the importance of infrastructure for regional dynamics. Structural regularity 2 deals with university-industry linkages in general, the structural regularity 3 one addresses the impact of knowledge infrastructure in knowledge oriented industries.

2.	*University-industry linkages have a positive impact on the regional innovation performance.*

University-industry linkages, in particular relationships between firms and technical departments are an important part of the regional innovation network. Generally spoken, they positively contribute to the regional innovation performance. This is the finding of Agrarwal and Cockburn (2003), Calderini and Scellato (2005), Van Looy et al (2003), Waters and Lawton-Smith (2002), Gebauer et al. (2005) as well as Hedge (2005). Agrawal and Cockburn (2003) used data on three narrow technology areas in US electrical engineering; Calderini and Scellato (2005) investigated the wireless sector for 15 EU countries and for 33 selected regions in 1992-2001; Van Looy et al. (2003) employed data from German high tech regions, Silicon Valley (US), Cambridge (UK), Leuven (Belgium), and Sophia Antipolis (France); Waters and Lawton-Smith (2002) exploited material from Oxfordshire and Cambridgeshire; Gebauer et al. (2005) made use of data from Landshut (Germany); Hedge (2005) investigated patents granted to US universities between 1975 and 1996. Considering the regions covered by the data we thus conclude that structural regularity 2 hold for Western industrialized countries.

Agrawal and Cockburn (2003), Calderini and Scellato (2005) as well as Hedge (2005) used econometric analysis and Waters and Lawton-Smith as well as Gebauer et al. (2005) carried out a case study. Van Looy et al. (2003) employed both methods. The studies presented here employed a variety of theoretical approaches including regional

innovation system and institutional economics. Thus, the studies building structural regularity 3 are using sufficiently different methods.

In the studies presented here we could detect another interesting result, because the findings by Calderini and Scellato (2005) as well as by Agrawal and Cockburn (2003) suggest that the large innovative firms stimulate spillovers between academic research and industrial applications. Unfortunately, the evidence is not sufficiently broad to support a structural regularity.

3.	*Firms of knowledge-oriented industries need to be embedded into a sophisticated knowledge infrastructure in order to be successful.*

Firms in knowledge-oriented industries, e.g. biotechnology, heavily rely on a sophisticated knowledge infrastructure, namely the proximity of knowledge resources in the form of networking with other innovative agents, in particular other research organizations active in related research and development. All studies investigating this topic come to this conclusion (cf. Asheim and Coenen, 2005, Cooke, 2002, Kaiser, 2003, Niosi et al., 2005, and Schwerin, 2004) and all cover case study material. The four first use different questionnaires and the last uses archive material in the form of letters, reports etc. When analysing their case study material the authors employ a variety of theoretical approaches, i.e. RIS, regional networks, clusters etc. Consequently, we assume that there is sufficient variety in methods. Asheim and Coenen (2005) carried out five case studies in Sweden, Denmark and Norway in the 1990 and 2000s, Cooke (2002) investigated the current regional sectoral innovation systems in Germany, in Cambridge (MA, US) and Cambridge (UK), Kaiser (2003) looked into the Munich biotechnology cluster (Germany), Niosi et al. (2005) investigated 90 Canadian-based publicly-quoted biotechnology firms in 2002, and Schwerin (2004) studied the Clyde shipbuilding industry in the UK in the second half of the 19th century. Therefore, we conclude there is sufficient variety in data and regions and that structural regularity 3 holds for Western industrialized countries.

In the studies presented here we can find two more interesting results: First of all, the investigations by Niosi et al. (2005) and by Schwerin (2004) suggest that industries might undergo a life cycle with respect to the way how the knowledge infrastructure is organized and R&D and production co-evolves thereby supporting the hypotheses of RIS evolving in time in specific ways (see Section 2. and e.g. Brenner, 2005). Second, the results of Karlsen (2005) as well as of Sornn-Friese (???) indicate that there are specific circumstances that encourage or discourage lock-ins of regions. Either the linkages between firms are very strong and bilateral – making lock-ins very likely – or they are weaker and multilateral – leading to a situation where the region can easily absorb and distribute new knowledge and can adapt to a change in the world economy – thereby supporting the view that RIS are organized in various ways depending on a number of factors (see Section 2. and e.g. Cooke, 2007). These two findings are certainly interesting. However, there is no sufficient evidence to suggest that they hold on a broader basis for industries or regions. Consequently, we cannot use the findings to construct another structural regularity.

4.2 Human Capital, Knowledge Spillovers and Trust

There are a number of specific inputs and outputs of innovation processes considered to be crucial for the existence as well as success and non-success of RIS, namely human capital, knowledge spillovers and trust. Human capital is usually subsumed under the heading of accumulable production factors, which are particularly interesting from a dynamic point of view as these kinds of production factors drive innovation, technological change and growth (e.g. Werker/Athreye, 2004). Indeed human capital is very important in this context. However, one should be aware that human capital does not only play a role on the supply side as a production factor but is also relevant on the demand side when choosing products and services as well as within in political administrations when designing policy tools.

4. The presence of human capital positively influences regional development and growth. Particularly the ability and propensity to become an entrepreneur is positive in this context.

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. Audretsch and Keilbach (2005 and 2004), Beugelsdijk and Noorderhaven (2004), Braunerhjelm and Borgman (2004), Ceh (2001), Crescenzi (2005), Gomez et al. (2005), Holmen, (2002), Hussler and Ronde (2005), Johnson (2004), Kim and Lee (2002), Rodriguez-Oreggia, 2005, Salinas Jimenez (2003) as well as Serrano and Gabrer (2004) support the hypothesis that human capital has a positive impact on regional development and growth. Frenkel (2003) as well as Fromhold-Eisebith and Eisebith (2002) find that a lack of human capital hinders industrial and regional development. Audretsch and Keilbach (2005 and 2004), Beugelsdijk and Noorderhaven (2004) as well as Braunerhjelm and Borgman (2004) particularly hint at the positive effect regional entrepreneurial capital has, i.e. the ability and propensity to become an entrepreneur.

Holmen (2002) and Fromhold-Eisebith and Eisebith (2002) use the case study method whereas the other studies employ different statistical and econometric tools. The studies use a variety of theoretical approaches reaching from entrepreneurial capital to regional network theory. Thereby, sufficient variety of methods is achieved. The studies presented here cover sectorally different industries and geographically Indonesia, Israel, Mexico, different European regions and the US. Therefore, we conclude that the structural regularity 4 holds for advanced economies including the EU as well as for developing countries.

Knowledge - like human capital - is mainly regarded as a supply side factor, namely an accumulable production factor. Here we are concerned with knowledge spillovers, i.e. question involving production, storage and in particular transfer of knowledge. In this context the role of demand is obvious, because in particular with respect to high

technology products consumer preferences are mainly developed and transferred via close cooperation between consumers and suppliers (cf. e.g. Lundvall, 1992).

With one exception all studies that analyse the relationship between knowledge spillovers and geographical proximity find that this relationship is positive (cf. Agrawal and Cockburn, 2003, Bottazi and Peri, 2003, Cooke, 2002, Fritsch and Franke, 2004, Greunz, 2003, as well as Zitt et al., 2003). The exceptional study is one on high tech regions in China where knowledge spillover stem from outside rather than from inside the region (Yao, 2005). However, this is a specific situation as the Chinese economy is developing and catching-up to Western standards while at the same time still being organized mostly centrally planned. We conclude that as most studies support the hypothesis that geographical distance matters for knowledge spillovers the Whaples criterion is met.

5.	*In Western industrialized countries geographical distance matters for knowledge spillovers: Knowledge spillovers occur the more frequently the closer the recipient and the sender of the knowledge are located.*

All studies with the exception of Cooke (2002) and Yao (2005) use econometrics. The models employed including the theoretical basis are sufficiently different from each other to meet the criterion of variety of methods. Three of the studies supporting structural regularity 5 make use of European patent data, (cf. Bottazi and Peri, 2003, Greunz, 2003, and Zitt et al., 2003) one of them US patent data (cf. Agrawal and 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 and Fritsch and Franke (2004) use data from three German regions. As the data covers Europe and the US we can conclude that structural regularity 5 holds for Western advanced economies in general and for the EU in particular. As there is only one study testing for geographical distance of knowledge spillovers in a developing country in our sample we cannot come to any conclusive results for this part of the world.

6. *Large firms, in particular multinational companies (MNCs), are a source of vertical knowledge spillovers.*

Large firms, in particular MNCs, contribute to vertical knowledge spillover either by being the knowledge source themselves (cf. Agrawal and Cockburn, 2003, Cumbers and Martin, 2001, Fromhold-Eisebith, 2002, Gebauer et al., 2005, as well as Zhou and Xin, 2003) or by using the local knowledge base (cf. Cantwell and Santangelo, 2002, Gebauer et al. 2005, as well as Santangelo, 2002). As all studies support this hypothesis the Whaples criterion is met. Four of the seven studies are case studies (cf. Cumbers and Martin, 2001, Fromhold-Eisebith, 2002, Gebauer et al., 2005, as well as Zhou and Xin, 2003) and three are econometric analyses (cf. Agrawal and Cockburn, 2003, Cantwell and Santangelo, 2002, as well as Santangelo, 2002) using a variety of theoretical approaches. This suffices for the criterion of variety of methods.

The studies cover regions of the EU, of US, of India and Indonesia as well as of China. Although Cantwell and Santangelo (2002) and Santangelo (2002) 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, namely for small EU countries and for large EU countries. Together with the aforementioned studies we have a strong enough argument to support structural regularity 6 for Western advanced economies including the EU as well as for developing countries.

7. *Firms need trans-territorial knowledge spillovers on top of local knowledge spillovers in order to be innovative.*

Firms do not only rely on local but also on trans-territorial knowledge spillovers to innovate (Doloreux, 2004, Cumbers et al., 2003, Fischer and Varga, 2002, Muller and Zenker, 2001, as well as Gebauer et al., 2005). Structural regularity 7 is confirmed by the analysis carried out in five studies. Madill et al. (2004) comes to a different conclusion

when investigating 423 technology-based businesses and 343 non-technology firms within the Ottawa region in Canada. However, five studies find that trans-territorial knowledge spillovers are crucial for innovation carried out regional case studies so that according to the Whaples criterion there is sufficient consensus to consider this finding as a structural regularity. Doloreux (2004), Cumbers et al. (2003), Fischer and Varga (2002) and Muller and Zenker (2001) used different questionnaires for firms. In contrast, Gebauer et al. (2005) not only interviewed small and large firms but also experts in research institutes and interest groups as well as policy makers. Thus, we conclude that the methods used are sufficiently different.

We find that a large part of the world is covered by the studies included in structural regularity 7: Doloreux (2004) investigated roughly 300 industrial firms in the Ottawa and the Beauce region of Canada, Cumbers et al. (2003) investigated the oil industry in the Aberdeen region in Scotland, Fischer and Varga (2002) investigated manufacturing firms in the Austrian Vienna region, Muller and Zenker (2001) looked into SMES in five different regions in France and Germany, and Gebauer et al. (2005) analysed the Landshut region in Germany. Thus, the findings suggest that structural regularity 7 holds for regions Western industrialized countries.

Trust is considered to be a soft factor in economics. However, it can be defined quite clearly following Coleman (1990): Trust between two agents allows for actions, which are otherwise impossible because of incomplete information and the risk involved. This is particularly the case in innovation processes where the outcome of joint activities is uncertain and cannot be shared in complete contracts signed in advance. Trust is usually developed over time and often includes the joint use of resources.

The soft factor trust turns out to be crucial for the creation and dissemination of knowledge and innovation (cf. Battenberg and Rutten, 2003, Edquist et al, 2002, Fromhold-Eisebith and Eisebith, 2002, as well as Schwerin, 2004). Edquist et al., 2002, use descriptive statistics to come to their results whereas the other three papers are based

on case study findings using a variety of theoretical approaches. Thus, the variety of methods suffices. With respect to the geographical dimension the studies include different industrial sectors as well as different countries, i.e. Indonesia, The Netherlands, Sweden, and the UK. We, thus, conclude that the structural regularity 8 holds for EU countries. As only one developing country is covered the evidence does not suffice to support structural regularity 8 for this part of the world.

5. Conclusions

Our results show that a number of hypotheses developed and used in regional economics hold while at the same time other dearly hold hypotheses do not show up. We could show the importance of publicly funded research infrastructure, human capital, regional and interregional knowledge spillovers as well as positive self-reinforcing processes on the regional level. However, there were no consensual findings on Jacobs and Marshallian externalities or convergence of regions, to name only two examples.

We can show that it depends on the kind of regional environment, i.e. grassroots, network or planned RIS, whether and how entrepreneurs and policy can contribute to regional success. In the context of a grassroots network as well as a network RIS with its (partly) informal and weak ties entrepreneurship is very important, often much more than policy, because entrepreneurs know much more about how to do business, in particular how to turn innovative ideas into marketable products and services than policy makers. In particular, structural regularity 4 on human capital showing the importance of entrepreneurship capital for regional development and growth indicates this. On the other hand side, policy as well as large firms might be crucial in the context of network as well as planned RIS. Structural regularity 3 on knowledge infrastructure as well as structural regularity 6 on knowledge spillovers from large firms indicates this.

Due to our systematic and broad empirical findings from the bibliometric analysis we are able to provide detailed hints at where and when entrepreneurs or policy makers could play a role. Our findings suggest the implementation of policy tools that makes access to human capital easy, i.e. to support the education system. In more general terms, careful attention should be paid to the knowledge infrastructure and the university-industry linkages. This is not necessarily connected with spending more public money but could also include more contribution of private investors. Moreover, it would help to create a positive climate for knowledge spillovers and for relationships based on trust. However, from our results it remains unclear how this can be achieved. The same holds for a way to stimulate agglomeration economies, because they emerge from long-term complex and complicated processes.

An important advantage of our analysis is that we can derive our results from a broad empirical basis and can come up with a number of specific results. However, many interesting results cannot be included in this kind of analysis because the hypotheses are non-consensual. Insofar our analysis is limited. Nevertheless, we strongly suggest that our findings are a first important step to acknowledge that despite the diversity of results with respect to regional dynamics there exists also a substantial area of consensus. Scientific results in economics and related subjects provide us with some rather explicit hints for innovation management and policy recommendations, namely to use and support knowledge infrastructure and university-industry linkages. Second, our results provide us with the possibility to hint at further interesting research questions to be posed and answered, namely to look more carefully into the role of entrepreneurs and policy in grassroots, network and planned RIS. This would give us an even better understanding of how RIS function.

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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	26	12
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
British Journal of Educational Economy	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
Ecological Economics	2	0
Economic Development and Cultural Change	2	0
Economic Development Quarterly	4	2
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	9	7
Environment and Development Economics	1	1
Environment and Planning A	7	3
Environment and Planning C	8	0
Eure-Revista Latinoamericana de Estudios Urbano Regionales	3	0
Europe-Asia Studies	1	0
European Economic Review	1	1
European Planning Studies	42	16
European Urban and Regional Studies	5	0
Gesundheitswesen	1	0
Geoforum	1	0
Geographical Analysis	1	1
Geographical Review	1	0
Geographische Zeitschrift	1	0
Growth and Change	4	2
Habitat International	1	1

Journal	Total number of papers	Number of papers analysed
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 Forecasting	2	0
International. J. of Industrial Organization	1	1
International J. of Manpower	1	0
International J. of Technology Management	6	4
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 Finance and Accounting	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 Economic Geography	2	2
Journal of Industrial Ecology	1	1
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
Organization Science	1	0
Oxford Bulletin of Economics and Statistics	2	0
Papers in Regional Science	3	1
Political Geography	1	0
Post-Communist Economics	1	0
R&D Management	1	1
Regional Science and Urban Economics	5	10
Regional Studies	40	22
Research Evaluation	1	1
Research Policy	11	4
Review of International Political Economy	2	0

Journal	Total number of papers	Number of papers analysed
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 Sozialwissenschaft-liche Forschung und Praxis	1	0
Supply Chain Management	1	1
Sustainable Development	1	0
Technovation	2	1
Technology Analysis and Strategic Managem.	3	2
Telecommunications Policy	1	0
Third World Quarterly	1	0
Tijdschrift voor Econ. en Soc. Geografie	7	5
Total Quality Management	1	0
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	309	116