Confrontation of knowledge transfer models between advanced innovation systems and post-socialist regions in Central Europe

Niclas Rüffer[1]

1. Introduction

This chapter gives a brief overview of the findings of a large research project concerning the effectiveness of knowledge and technology transfer in the regional innovation system of Opole Voivodship in southern Poland.[2] The analysis of successful regional innovation systems in Western Europe and China serves as a backdrop to that project. While vertical and horizontal knowledge sharing is prevalent in high-performing innovation systems and tertius iungens orientation was frequently identified, the relatively low-performing innovation system of Opole Voivodship is characterised by "low collaboration/low trust/low productive" equilibria. Trust between different organisations is rare and knowledge is deliberately held back from partners in other organisations and even within hierarchies, leading to slow knowledge flows and few innovations.

The generation of innovation is undisputed and is regarded as one of the key success factors for the growth of firms, regions and nations in contemporary economic literature. Innovation is viewed as the result of interactive learning processes (Nelson and Winter, 1982) embedded in institutional frameworks of national (Nelson, 1993; Freeman, 1987; Lundvall, 1992) and regional (Cooke *et al*., 2004) innovation systems. The transfer of knowledge and technology between the central actors of the triple helix, the scientific subsystem, firms and the public policy system is essential for the generation of innovation in the innovation system (Etzkowitz, 1993; Etzkowitz und Leydesdorff, 1995). A whole web of knowledge transfer channels such as publications, formal and informal networks, mobility of human capital, formal and informal R&D collaborations, etc. (Bekkers *et al.*, 2008; Brennenraedts *et al.*, 2006) is in use between the scientific and the business system in successful regional innovation systems.

European innovation leaders, such as the German state of Baden-Württemberg base their economic success on dense networks of collaboration and knowledge sharing between business and science, high R&D expenditures and ever-accelerating efforts of policymakers, universities and businesses to improve further collaboration and innovation. Leading European universities and those they work with (policymakers and a range of scientific and business associations) are very active in promoting the transfer of knowledge and technology from science to business and vice versa. The Technical University Eindhoven, located in the world's most innovative city according to the number of patents (Deutsch-Niederländische Handelskammer 2013), the Karlsruhe Institute for Technology or Cambridge University have highly professional technology transfer offices in place and are constantly striving to improve them. Incubators with professional support for academic spin-offs are working to boost the transfer of ideas developed in academia to the business world through entrepreneurship work in each of these universities. The largest technical university in Germany,

[1] Niclas Rüffer, Centre for SME Research and Entrepreneurship – Mannheim University, L9, 1-2, 68161 Mannheim, Germany

[2] This chapter is based on research conducted within the EU's European Social Fund project "Effective knowledge transfer from science to industry in the Opolskie Voivodship" (*Efektywny Transer Wiedzy Z Nauki Do Premyslu W Wojewodztwie Opolskim*). The project and its results are described in detail in Rüffer *et al.* (2015). This chapter summarises some of those results and offers a reinterpretion of them.

RWTH Aachen, is embedded into the "GründerRegion Aachen" (founder region Aachen) and is endeavouring to promote entrepreneurship and technology transfer in collaboration with several partners from the public and private sectors. Dense formal and informal vertical and horizontal networks facilitate knowledge transfer in these highly innovative regions. However, not only do traditionally strong regions in Europe (or in the US) maintain their highly competitive position in the generation of innovation, but newcomers such as certain Chinese regions have become innovative hotspots over the past decade. While the scientific system was literally destroyed in the Cultural Revolution, when Deng Xiaoping came to power in 1978 scientific research and technology began to rank higher on China's political agenda (Vogel, 2011). In an astonishingly short period of time China brought its R&D investment up to a competitive 2% of GDP (OECD, 2015) and leading Chinese universities such as the Tsinghua University in Beijing grew to world class status in the field of technology and knowledge transfer to the business community.

Meanwhile peripheral regions in post-socialist Central Europe lag considerably behind in generating innovation and wealth. Although similar to innovative hotspots such as the Scandinavian countries, Great Britain, the Benelux Countries and Germany in terms of culture and size and closely linked with these European innovation leaders through EU institutions, spillovers seem to be rare with regard to innovativeness. The internal GDP of the Silesian Voivodship Opole in south Poland is approximately €7,700 – only a fraction of regions in the Netherlands, Great Britain or Germany – and can be closely linked to poor R&D and innovation efforts (just 0.3% of the region's internal GDP is dedicated to R&D). According to nearly all measures Opole Voivodship can be regarded as a weak regional innovation system in comparison with European standards (European Commission 2014; Statistisches Landesamt Baden-Württemberg 2015). The Opole Voivodship lags considerably behind, not only in comparisons with European innovation leaders such as the Stuttgart region, but also when compared to strong Polish regions such as the Masovian Voivodship, which includes the capital city of Warsaw (see Rüffer *et al.*, 2015, p. 95).

The central research questions for this chapter can be formulated as the following: What distinguishes a low-performing regional innovation system such as the Opole Voivodship from high-performing innovation systems in Western Europe and quickly accelerating regions in China? What are the main obstacles and bottlenecks for innovation, technology and knowledge transfer in post-socialist Poland? Which key lessons and potential policy measures can unleash the innovation potential of Polish universities and businesses?

2. Research design and methodology

The research project "Effective knowledge transfer from science to industry in the Opolskie Voivodship" simultaneously followed two tiers: (1) the regional innovation, technology and knowledge transfer system of the Voivodship Opole was studied in depth, and (2) international best practice cases in technology transfer and innovation were analysed. The international best practice cases of Baden-Württemberg (with a special emphasis on Karlsruhe and the Rein-Neckar region in the north-west), Eindhoven, Cambridge, Aachen, Shanghai and Beijing were chosen for several reasons. All these regional innovation systems are internationally highly competitive with regard to the generation of innovation while being different in several regards. While some regions, such as Baden-Württemberg, are long-time innovation leaders, other regions such as Shanghai and Beijing only recently grew to frontier status in terms of innovation and technology transfer. Furthermore, the configurations between and the orientation of the actors of the triple helix in the development of the chosen regional innovation systems vary. Central actors of the regional systems, such as universities, have different orientations. For instance, Mannheim University, one of the central actors in the Rein-Neckar region, is one of the leading German universities in the areas of social

science and economics while the RWTH Aachen is specialised in technical fields. While some organisations that were studied (such as Karlsruhe Institute of Technology) focus on larger firms, other transfer organisations (such as the Steinbeis Society) focus mainly on SMEs.

The analysis followed a modified version of the holistic, multi-dimensional six-step policy evaluation protocol introduced by Magro and Wilson (2013). University policy, innovation policy and cluster policy were holistically analysed for the Opole region, while for the best practice cases only selected policy areas were chosen. The analyses followed a mixed method approach. The first stage was an in-depth literature review regarding the regional innovation and technology transfer system of the respective region. For the second stage, multiple actors (university scientists, technology transfer offices, policymakers and businesses) were interviewed on a qualitative base. With regard to the international best practice cases between five and fifteen qualitative interviews were conducted. Regarding the Opole region, interviews with 35 actors were conducted. Finally, the results were discussed during several workshops with university scientists and policymakers from the Opole region. Within these workshops moderated focus group discussions were organised, quantitative questionnaires were distributed among the participants and the results were subsequently analysed.

3. Effective knowledge and technology transfer – high-performing regional systems vs. the Opole Voivodship

Central characteristics that were identified in high-performing regional innovation systems are dense vertical and horizontal networks and intensive collaboration and knowledge sharing between different actors within the triple helix, as predicted by the innovation system approach. A whole web of specialised transfer organisations service special branches and niches (e.g., small- and medium-sized firms) and all actors of the triple helix exchange knowledge and collaborate through different formal or informal councils, associations or clubs. A general tendency for knowledge sharing as well as dense social networks and a tertius iungens orientation is the prevailing tendency of individuals in the high-performing regions analysed (Obstfeld, 2005). Tertius iungens refers to the tendency of individuals in broker positions, i.e., connected with two other unconnected actors, to connect these actors with each other (as opposed to a tertius gaudens orientation, where a broker exploits their position). Obstfeld (2005) is able to show in his seminal work through his multi-method case study of an automotive manufacturer's engineering division, actors with tertius iungens orientation appear to be involved in more innovations. From the qualitative work conducted within this research project, one might hypothesise that this predication also holds true for the analysed high-performing regional innovation systems.

In the low-performing regional innovation system in southern Poland, which was analysed in the research project, generally speaking, actors seem not to trust each other and are unwilling to collaborate. Professional horizontal networks are rare and vertical networks are common, restraining knowledge sharing and efficient decision-making. Knowledge flows – if at all – from the bottom up, from lower levels of organisations to higher levels. However, even vertical knowledge sharing between different levels of the same organisational hierarchy is poor. Critical information is withheld from lower levels, even if this information is vital for the execution of tasks or projects. Actors seem to deliberately withhold knowledge in order to exploit their superior information even in collaboration with their colleagues within an organisation, and especially with their subordinates. Consequently, many subordinates also appear to try to guard their knowledge from their superiors, providing only selected information. Attempts to collaborate with other organisations at lower levels are thwarted by those at higher levels. The regional innovation system is stuck in a "low collaboration/low trust/low productive" equilibrium. Organisations with great potential to generate

surpluses by collaborating with each other due to complementary strengths in fact compete against each other and appear to prefer project failure over profit sharing.

The following subchapters will, following the modified version of the analysis proposed by Magro and Wilson (2013), analyse university policy, innovation policy, and cluster policy, exemplifying the diagnoses. It is not always possible to draw clear borders between these policy fields.

3.1. University policy

In successful regional innovation systems, teaching in universities is oriented towards the regional economy and there is constant knowledge exchange between university staff and businesses to adjust the teaching to the needs of the regional, national and international labour markets. In different forms of interactions, university scientists have the opportunity to identify, describe and document the skills demand in the labour markets and transform this demand into pedagogical content. In projects with businesses, university staff learn to understand the needs of the local business community. There are various exchange platforms, which may either be informal, such as personal ties between business and science, or formally organised through continual research on labour demand by universities or platforms created by industry associations. The long common trajectories of individuals on both sides lead to common values and as such generate higher adoption due to trust (Arthur 1994). The orientation of teaching towards the actual needs of the regional labour market is promoted on an individual level by university professors maintaining steady contact with the business community. Additionally, at an organisational level, entire universities are constantly updating their curricula or developing new degree programmes to meet changing labour demand. Advanced training focused on the needs of regional labour markets (and sometimes for international labour markets as well, e.g., in double degree programmes) is offered at business schools. There are also lifelong learning programmes set up by industry associations or chambers of commerce, for instance, which can help people continually enhance their skills. The regional supply of human capital is constantly developed, thereby leading to stronger innovativeness and a direct transfer of state-of-the-art scientific knowledge into the business community. At the same time, links between business and science not only transfer knowledge on the needs of labour markets (reinforcing universities' role of providing qualified human capital), but also share information about the demand for basic and applied research in the region. Furthermore, the interaction of such partnerships plays a crucial role in the identification and capturing of exogenous innovations, adopting them to local needs and guaranteeing rapid diffusion processes. Many different incentive systems are in place for university researchers to engage in university-industry collaborations (see, for example, the attempt of the Research Excellence Framework in Great Britain to include not only purely scientific research in the evaluation of British universities, but also the impact of scientists on social, cultural and economic issues).

In the regional innovation system of Opole Voivodship, there is little contact between business and staff from the two local universities. Exchanges between businesses and academics about local labour market needs are much less frequent than in successful regional innovation systems. This is true at both the individual level with many scientists having no contact with the business world and at the organisational level with relatively few attempts to orient curricula and the research agenda towards the needs of the local economy. While in successful regional innovation systems, bachelor, master and PhD theses are often of direct practical relevance or directly conducted with – or even within firms – this is very rare in the Opole region. The universities do not participate in lifelong learning programmes and as a result forgo the chance to inject knowledge and technology into the local economy and enhance the innovative capabilities of firms. The academic incentive system is strongly in favour of basic research, with practically no value seen in collaborating with businesses.

3.2. Innovation policy

Successful regional innovation systems constantly strive to improve the networks between the actors of the triple helix. Structures and fulfilment of functions of the regional innovation system are frequently analysed and new vehicles to further improve the system are created jointly by science, business and policymakers. Many broker institutions are in place to mediate between the different sectors of the triple helix as well as between the organisations within each sector (e.g., between different universities). Collaboration between lower levels of different organisations is strongly encouraged and there seem to be high levels of independent decision-making and trust, even at lower levels of organisations. Government plays a crucial role in innovation policy by subsidising innovative projects, often in collaboration with science and businesses, as well as by introducing and reinforcing regulations, (e.g. in the environmental field) which helps create incentives for additional innovations.

In the Opole region's innovation system, a variety of flaws hinder firms and universities from being more innovative and policy measures are insufficient to address these flaws. Innovation policy all too often appears to exclude deliberate consultation processes of all parties involved (i.e., consultation with associations of triple helix members). Management and innovative capabilities of Opole firms are low, and R&D expenditures are, as previously mentioned, only a fraction of the EU average and remain low even when compared against strong regions in Poland. The orientation towards R&D and innovation is not provided in many companies, especially among SMEs. Furthermore, the hierarchical organisational structure and insufficient knowledge sharing within organisations lead to inflexible structures, which hinder innovation activities. Many layers of organisations (e.g., within universities) have to be involved in decision-making processes, consuming time and excessive human resources which cannot be engaged in innovative processes. For the business community especially, working with research organisations on innovative projects demands quick decisions and timely solutions, which are severely hampered by high transaction costs when dealing with university administrations.

3.3. Cluster policy

Research on the regional dimension of innovation has a long tradition in economic research, starting with Marshall's (1890) observations of industrial districts. Since Michael Porter (1998), the term "cluster" has quickly become a part of the scientific and political discussion. Cluster refers to "geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition. They include, for example, suppliers of specialised inputs such as components, machinery, and services, and providers of specialised infrastructure" (Porter, 1998). Policy makers from Europe (see, e.g., Falck *et al.*, 2010) to East Asia (see, e.g., Nishimura and Okamuro, 2011) try to deliberately create clusters to improve the innovativeness of regions. In successful regional innovation systems, cluster initiatives include all relevant actors right from the beginning. Universities, businesses and local policies identify common themes and future technologies, create councils or associations and possibly apply for funding from state or federal governments. By contributing considerable resources, however, commitment from all participating entities is assured. Oftentimes government funding is only supplied if firms and universities agree to contribute substantial own resources. Generally speaking, there are broad attempts to create public-private partnerships (PPP) at regional and national levels. Common idea sharing communities often based on virtual integration rely on well-grounded motives for being in the same flow. Trust is high between individuals and organisations and a tertius iungens attitude is prevalent in several kinds of broker organisations (tangible or virtual) and in profit-oriented firms. This helps to ensure that cluster governance and

strategy serve the target group, i.e., the local economy and research community.

In the Opole region, several cluster projects have been introduced as well. However, a large majority of them have ceased to exist after the initial governmental funding ran out. Of the 15 clusters identified here (Rüffer *et al*., 2015, S. 124), only one was undisputedly identified as a success story during the interviews. Central to the failure of these clusters appears to be a top-down orientation by public policymakers without including any other relevant triple helix parties into decision-making about cluster formation. Clusters were initiated by central authorities, and firms and university researchers are only invited to participate. Because they are set up by central authorities, this leads to passive consumption of the possible benefits of the cluster rather than active participation and co-creation of collaboration surplus.

4. Conclusion

For the Opole Voivodship to catch up with leading regional innovation systems with regard to knowledge and technology transfer and innovation, trust and collaboration in the region must be improved and fundamental reforms must be made in the public and university bureaucracy. However, improving trust in regional systems is not an easy task, if possible at all. Cultural features such as participation in voluntary organisations and trust in non-family members of a society have deep roots in a society's history (Putnam *et al*., 1994; Fukuyama, 1996). Improving such features can only be successful if undertaken as a collective long-term endeavour.

The findings of this research are mainly qualitative and have not been tested quantitatively. Therefore, the results introduced above should be considered hypotheses. Although limiting, this can also offer promise for the road ahead for new research in the field of technology transfer and innovation systems. While there has been much qualitative and quantitative research published in the international literature on highly successful regional innovation systems such as Silicon Valley, or strong regions in Western Europe or Japan, the post-socialist countries in Central and Eastern Europe have been largely neglected. The results discussed in this paper can certainly not be generalised for all of Eastern Europe, or even for all of Poland. However, it highlights a potential way forward for scientific literature and improving public policy to shed light on regional and national innovation systems and knowledge sharing in post-socialist countries. The European Union is investing considerable resources in Eastern Europe to improve the local economy and local innovation systems. However, the fundamental flaws and bottlenecks in these innovation systems are not yet fully understood. More research that takes into account cultural factors could be scientifically useful and have the potential to improve the effectiveness of economic policy programmes.

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