THE TRIPLE HELIX MODEL FOR REGIONAL DEVELOPMENT AND INNOVATION: CONTEXT OF NORDIC COUNTRIES

MARINA Z. SOLESVIK

ABSTRACT

Nordic countries and their capital regions are among the leaders in Europe in terms of innovation development. This paper summarizes the experience of regional innovation in the capitals of Nordic countries (i.e., Norway, Sweden, Denmark, and Finland). Two research questions were explored in this study: What is the difference in innovation policy of Oslo region and innovation policies in capital regions of three other Nordic capitals? Does the regional innovation policy influence on the innovation effectiveness? I have applied benchmarking analysis to explore and compare the innovation policies in the capitals of Nordic countries and to explore the pros and cons of regional innovation policies and cooperation links among key players contributing to innovation development. The findins of this research show that the Triple Helix model implemented in the Scandinavian capitals is an effective model of innovation leading the regions to innovation champions. Notably, the Triple Helix model was implemented early in Stockholm, Helsinki and Copenhagen. This allowed these regions to become "Innovation leaders" and "Innovation leaders +" according to the European Regional Scoreboard. The Triple Helix model was implemented later in Oslo. The adoption of the Triple Helix in this region allowed Oslo to improve its innovation status and become recently an "Innovation leader".

KEY WORDS

Triple Helix model, regional innovation policy, benchmarking analysis, Denmark, Finland, Norway, Sweden.

DOI: 10.23762/FSO_VOL5NO4_17_1

MARINA Z. SOLESVIK

e-mail: maryna.z.solesvik@nord.no

Nord University,
Nord University Business School,
Norway

Introduction

Three of four Nordic countries are traditionally on the top in terms of competitiveness, i.e. Finland is number one, Sweden is number two and Denmark is number four among the European countries (World Economic Forum 2017). The fourth Nordic economy – Norwegian is not on the top ten yet. This question is primarily important for Norwegian policy-makers and practitioners. In this paper, I try to shed the light of why the Norwegian economy is left behind its neighbours' economies in terms of innovation development, though the Norwegian GDP per capita is the highest in Scandina-

Paper received: 22 August 2017 • Paper revised: 16 October 2017 • Paper accepted: 29 October 2017

via and is one of the highest in the world (4th place among the OECD countries (OECD 2017a). One of the possible explanations to this might be the difference in innovation policies and the disparity of expenditure levels for R&D in the country level. The highest level of GDP share spent to R&D in 2014 was in Finland (3.17%) and Sweden (3.16%), Denmark (3.08%) followed by Norway (1.71%) (World Bank 2017).

Academic research advocates merits of decentralization of the innovation policy. Regionalization of the innovation policy allows achieving national innovation targets more effectively (Fritsch, Stephan 2005). Consequently, regional development policies are related to innovation and entrepreneurship policies (Cornett 2009; Solesvik 2016). Nordic countries have a strong social security orientation. Thus, the motivation, which drives entrepreneurship in Nordic countries, is opportunity based. The level of cooperation between Nordic countries is high. The Scandinavian languages (Norwegian, Swedish, and Danish) are rather close. This means that information related to policy measures in one of these countries is easily understandable in other countries as well. This favours a higher degree of knowledge flow and dissemination. The Nordic countries share social, political and cultural values. However, they have significantly different national innovation systems and different productivity growth (Lööf et al. 2001). National innovation system is defined as "a historically grown subsystem of the national economy in which various organizations and institutions interact and influence each other in the carrying out of innovative activity" (Balzat, Hanusch 2004). Some similarities can be anticipated in innovation policies in Nordic countries. However, some differences should be expected as well due to different economic backgrounds of the countries. Sweden, Denmark and Finland are members of the European Union. Norway is not a EU-member but is a member of the European Economic Community (EEC). It is worth noting that the share of new products' sales in entrepreneurial firms is comparable in Scandinavian countries (i.e. 36% for Norway, 34% for Finland, and 33% for Sweden (Lööf et al. 2001)). However, innovativeness of Norwegian firms measured in terms of patents utilization is 40% lower than that of firms in Finland or Sweden (Lööf et al. 2001).

Regions can be considered as systems of innovation (Ronde, Hussler 2005). Thus, knowledge and competence developed in one industry both positively influence on innovation development of other industries in the same region (Ronde, Hussler 2005). From the point of view of innovation development, Tödtling and Trippl (2005) suggested three types of problem regions: peripheral regions, old industrial regions, and fragmented metropolitan areas. This study focuses on metropolitan areas in the Nordic countries. The theory of polarized development which links the city development with the regional development perspective suggests that large cities are more innovative than other areas due to historical and economic development (Friedmann 1972).

Empirical research witnesses that suppliers and customers are major collaborators of firms in their innovative activities (Kaufmann, Tödtling 2000; Solesvik, Gulbrandsen 2014; Sroka, Hittmár 2015). The proximity of the top universities in metropolitan areas has a positive impact factor for innovation development (Ronde, Hussler 2005). Furthermore, the role of policymakers in forming the innovation policy is steadily more important.

"Policy-makers should take the opportunity to learn from experiences made with

innovation policy instruments in other regions and should be open to adopt such policies if they can be assumed to be principally appropriate and have been proven successful elsewhere" (Fritsch, Stephan 2005).

Lessons learnt from the mapping of the regional innovation policies in neighbour countries will be useful for practitioners to promote innovation and policy makers who are occupied with further development of regional innovation programs. The purpose of this paper is to study and compare regional innovation strategies in metropolitan regions in Scandinavian capital regions. The study seeks to answer the following research questions: (1) What is the difference in innovation policy of Oslo region and innovation policies in capital regions of three other Nordic capitals? (2) Does the regional innovation policy influence on the innovation effectiveness? The article is organized as follows: first, the theoretical background is highlighted. Furthermore, the research methodology is explained. In the next section, I analysed regional innovation in the capital areas of Scandinavian countries. The article terminates with conclusions and implications for scholars and policy-makers.

1. Theoretical background

1.1 Regional innovation systems

Innovativeness is named as one of the success factors that allow Nordic countries to compete in the world market with other countries. Innovation systems of Scandinavian countries are widely recognized. Scandinavian regions are at the top in terms of innovation for years according the Regional Innovation Scoreboard (European Union 2012; 2017). Innovation policy is related to "promoting the development, spread and efficient use of new products, services and processes in markets and inside private and public organizations" (Lundvall, Borras 1997: 37). Innovation systems can be divided to the national system of innovation (NSI) and regional innovation systems (RIS) (Nelson 1993).

Regional innovation programs rather than national ones have a closer popularity among scholars and politicians recently. RIS consist of R&D institutions, higher educational institutions, technical centres, and cluster organizations. Thus, capital regions with the high concentration of the above-mentioned institutions are usually in a better situation than remote regions (Asheim et al. 2016; Pekkarinen, Harmaakorpi 2006). Moreover, when innovative firms, universities and other collaborative institutions are closely situated, it is easier for them to share and test novel ideas, and promote innovative products and technologies (Baptista 2000). The regional innovation systems differ in 'periphery', 'old industrial regions', and 'fragmented metropolitan regions' (Tödtling, Trippl 2005).

In Nordic countries, the bottom-up approach to forming the innovation policy is implemented. Brandt (2001: 112) argued that "a top-down approach is called for in e.g. a nation-building context or when setting national standards. Conversely, the bottom-up approach is applicable in an endogenous situation in the context of so-called "learning region"-strategies. The latter has become a leading concept in regional development in the Nordic countries".

1.2 The Triple Helix model

Schumpeter (1934) suggested that innovation is responsible for economic development of regions and countries. The Triple Helix model, developed by Etzkowitz (2008), explains modern trends in innovation development. The Triple Helix innova-

tion model is defined as an innovation cooperation model in which universities, government authorities, and industrial firms cooperate in order to produce innovation (Arnkil et al. 2010). The Triple Helix model suggests four stages in the development of a Triple Helix: (1) Each of the helices start to fulfil new functions beyond their traditional role in society; (2) Helices start to influence on each other; (3) Trilateral alliances and cooperation; (4) Large-scale influence of the Triple Helix on each other and the society Etzkowitz (2003). Etzkowitz (2003) recognized that functions of universities changed dramatically. Earlier, Universities performed a purely educational task, i.e. to provide qualified stuff to firms and organizations. Now, Universities are engaged in R&D, innovation development and implementation. Universities also create incubators to foster venture development and contribute to a development of regions (Lilles, Rõigas 2017). Similar transformations are observed at the governmental level. Governments around the world act more and more entrepreneurially. Industrial firms also fulfil functions that belonged to University some years ago. For example, firms announce industrial PhD and postdoctoral fellow positions (Etzkowitz 2003). So, the borders between governments, firms, and Universities are not as clear-cut as earlier (Strand et al. 2017).

Universities play different roles in innovation development in different regions. In some regions, Universities are active players in innovation production and important cooperation partners of industrial firms, in other regions universities are modest participants in innovation development (Gulbrandsen, Solesvik 2015). The mode of innovation: science, technology, innovation (STI), or doing, using, interaction (DUI) influences on the different roles that universities play in the innovation development cooperation (Isaksen, Karlsen 2010). The role of universities is higher under STI mode (Borch, Solesvik 2016). The development of innovation paradigms is quite dynamic nowadays. Some scholars claim that the active involvement of the final consumers of innovative products into innovation development leads to adding the fourth helix to the Triple Helix model, i.e. users (Arnkil et al. 2010).

2. Research method

The benchmarking analysis was used to explore the research questions of the study. In order to understand the reason of the modest innovation development in the Oslo metropolitan region compared to leading innovative Nordic capitals, I used the benchmarking approach. Benchmarking is defined as "a method of making improvements by making comparisons, and learning the lessons these comparisons generate" (Huggins 2010: 640). Benchmarking analysis is a method used in management field to identify the gaps in firm's performance and studying the best practice in the field. Often exploration of the best practice is made in comparison with foreign competitors. In such way, Japanese and American firms studied best practice of their foreign counterparts and developed own concepts on the basis of analysis and adoption. For example, just-in-time concept was elaborated by Toyota after the visit of its managers to American supermarkets and studies of supply replenishment system there (Ohno 1988). Corporate benchmarking proved to be a viable method of analysis that later was developed to other types of benchmarking. One of them is regional benchmarking (Luque-Martínez, Muñoz-Leiva 2005). Regional benchmarking classified into three groups: i.e. performance benchmarking, process benchmarking, and policy benchmarking (Huggins 2010).

The benchmarking approach allows comparing the firms, organizations and regions according to certain parameters (Ahmed, Rafiq 1998). I have selected the variables of the Triple Helix model as the basis for the benchmarking. Such comparison allows finding gaps between the leaders and outsiders, thus finding ways for improvements becomes easier.

The analysis was made using secondary data sources. Analysis of archival and secondary data is a common method of research in the field of regional innovation (Isaksen, Karlsen 2010). I have collected information on innovation in the Nordic metropolitan areas from reports, Internet, newspapers, magazines, innovation support organizations, Universities, and firms. Using the data collected I, first, analysed innovation policies in each capital region of the four Nordic countries. Then, I made a cross-country analysis of the innovation policies and their impact on innovation development.

3. Evidence from the four Nordic countries

According to the recent EU's Regional Innovation Scoreboard (2017), at the country level Sweden, Denmark, and Finland are named as Innovation leaders (the second, third and fourth places in the total ranking), and Norway is recognized as a "Strong innovator" (11th place in the European Ranking). The GDP share of R&D expenditure is the highest in Sweden and Finland. The GDP share of R&D expenditure is also high in Denmark, above the average in the EU. In Norway, the GDP share of R&D expenditures is the lowest among the Nordic countries, i.e. 1.94% in 2015. Notably, this indicator has increased after the Norwegian conservative government came to power in 2013. However, the indicator is still lower than the average level in the EU, Japan, and the United States (OECD 2017b).

In 2017, the Stockholm region confirmed its status as an "Innovation leader +", followed by Copenhagen (also an "Innovation leader +") (European Union 2017). Helsinki and Oslo are "Innovation leaders". Notably, the Oslo region was an Innovation follower earlier, according to the Regional Innovation Scoreboard (2012).

3.1. Denmark

The population of the Copenhagen metropolitan area is 1,974,542 (2012). Sometimes, the Copenhagen metropolitan area, together with Swedish Malmö, is considered as a larger Copenhagen-Malmö metropolitan area with the total population of 2,591,995 (2011). The educational level of the population in the capital area (66%) is higher than the educational level in other regions and average in Denmark (56%) (Schøtt 2007).

There are about 89 thousand students in the Copenhagen metropolitan area in eight universities and university colleges. The top universities are University of Copenhagen and Technical University of Denmark. There is also a number of research centres in the Danish capital.

The Government in Denmark pays significant attention to the regional development. The accents of political attention changed from the national level to the regional level. This was caused by the influence of the EU regional policy in the 1970s (Cornett 2002). Priority areas of the regional policy change over time. Recently, the regional policy started supporting innovation development in all regions of Denmark. Though, the policy-makers are concerned with an equalization of the regions, the capital area of Copenhagen remains the leading region in terms of the rates of innovation development and entrepreneurship growth

(Cornett 2009). Governmental support of innovation development, as an important part of the business development policy, resulted in the appearing and expansion of science parks, incubators, and technology centres.

Innovation, entrepreneurship, welfare services, and human capital are recognized as the four main drivers of the regional growth and development in Denmark (Ministry of the Interior and Health 2004). In the Danish regional innovation policy, the Triple Helix model is realized (Cornett 2009). Various governmental and non-governmental organizations, regional and local communities and firms are now engaged in the development and implementation of an innovation strategy.

Policy-makers pay much attention to the development of innovative entrepreneurs in the Copenhagen metropolitan area. For these purposes, the International Danish Entrepreneurship Academy was created. The innovation policy in the Copenhagen metropolitan area is claimed to be knowledge-based. Policy-makers are aiming to create an innovative milieu in the capital area. A summary of regional innovation policy in Copenhagen and in other Scandinavian capitals is given in Table 1.

3.2. Finland

The Helsinki metropolitan area includes four cities: Helsinki, Espoo, Vantaa and Kauniainen. The population of the Helsinki metropolitan area is 1,361,508 people (2013). The Helsinki metropolitan area is considered as one of the most dynamic metropolitan areas in Europe (Pekkarinen, Harmaakorpi 2006). The University-government-industry cooperation, functions very well in the Helsinki metropolitan area. Several universities (i.e. Aalto University, Helsinki University, VTT Technical Research Centre of Finland, Laurea University of Applied Sciences and Metropolia University) are active contributors to the innovation development in the region (Markkula, Kune 2015).

Industries play a significant role in innovation promotion in Finland. The Finnish State contributes with the flexible and smart innovation policy but industrial firms pay the biggest share (67%) of R&D costs in 2015 (Official Statistics of Finland 2015). Notably, the amount of R&D expenditures paid by firms dropped from 74% in 2008. The share of GDP invested in R&D, also dropped significantly from 3.8% in 2009 to 2.9% in 2015 (Official Statistics of Finland 2015).

In the Helsinki area, there are nine universities and eight polytechnics. There are several research institutions and agencies promoting innovation. The share of people holding university degrees is higher in Helsinki than the average share of the country, i.e. 32.3% and 24.6% respectively (Culminatum 2005). Globalization in the Helsinki region is one of the goals of the innovation strategy. Interviewees claimed that there are not so many foreign researchers and experts working in Finland comparing to other European countries. The attraction of foreign students and experts to Finnish educational institutions, who later might settle in Finland, is one of the program measures that aim to increase the level of the region's globalization. Business firms are increasingly interested in cooperation with the Universities in Finland (Culminatum 2005). The universities and R&D institutions have good links with firms in certain industries. For example, 56% of new technology based firms reported that they established direct, partial or weak links with the universities (Autio, Yli-Renko 1998).

The innovation policy in Finland is carried out at three levels: national, regional, and local (Cervantes et al. 2010). Like in some other Nordic countries (i.e. Norway),

Finnish policy-makers are concerned with the high degree of centralization around capital metropolitan areas. Thus, much attention is paid to decentralize government institutions all over the country. The attention paid by policy-makers to the Helsinki metropolitan area is minor. Out of the four key regions in Finland, the Helsinki metropolitan region had the modest rates of growth in terms of R&D expenditure and R&D employment. It was below the average Finnish rates. Research and development personnel constitute 2.3 per cent of the working population (Löppönen 2010). Firms interested in innovation development take an initiative and also contribute financially, towards the building of an innovative infrastructure in the capital region.

The innovation policy in Finland is competence-based. The multi-scalar Triple Helix model shapes the background of Finnish innovation policies. Finland has developed innovation strategies at national and regional levels. The national strategy claims "demand and user-driven innovation" (Sotarauta 2011: 20). The innovation strategy for the Helsinki Region was a result of collaborative effort between the National Technology Agency of Finland (Tekes) and the local governments of Helsinki, Espoo and Vantaa. The opinions of 300 specialists and influential people were considered when the strategy was developed (Culminatum 2005). A four-pillar innovation strategy for the Helsinki region was developed. The main directions in the strategy are: "(1) improving the international appeal of research and expertise; (2) reinforcing knowledge-based clusters and creating common development platforms; (3) reform and innovations in public services; (4) support for innovative activities" (Culminatum 2005). This strategy is regularly reconsidered. A lot of efforts and investments were made into the developing of innovation system in the Helsinki region. The region has a reputation of a world-class centre for innovation and entrepreneurship. The common regional marketing program was favoured towards the creation of such a reputation for Helsinki. The Helsinki Region was awarded the European award for creativity and competitiveness. However, in terms of value creation the region is the middle-range one, standing behind other European metropolitan areas.

In the national innovation strategy and the regional innovation strategy for the Helsinki metropolitan area, Centres of Excellences for Science, Technology and Innovation play an important role. Centres for Excellences are funded with 300 million euros annually. The profiles of Centres of Excellences are regularly revised (Sotarauta 2011: 20). Networking and collaboration influence positively on innovation development (Sroka, Gajdzik 2015: 121-134). Thus, collaboration between firms and flexible specialization were encouraged in Finland (Autio, Yli-Renko 1998).

However, several problems challenge the innovation development in the Helsinki metropolitan area. First, the rate of the entrepreneurship growth is still low. Second, the innovation system is still mainly nationally oriented with a lot of efforts needed to make, in order to internationalize innovation development. The level of technical innovation is high; however, in other industries, the level of innovation development is medium (Sotarauta 2011). The avenues for a future innovation development in the Helsinki Metropolitan area are related to further progress of collaboration (both with international and national actors), and social innovation advancement. Though services are highly developed in the Helsinki region (e.g., finance and consultancy), there is a space for improvement in the area of service innovation.

3.3. Norway

The Oslo and Akershus region embraces the capital of Norway and the region around it. The population of Oslo/Akershus is 1,442,318 people (2013). This means that 28.5% of the Norwegian population live in the Oslo metropolitan area. Norwegian policy-makers pay a lot of attention to innovation development at the national and regional level. However, the level of national investment in R&D is lower in Norway than in other Nordic and European countries. In 2014, the R&D expenditure was amounted 1.71% of GDP, and in 2015, this indicator had increased to 1.94% (World Bank 2017).

It has been argued that many people in the Oslo region are employed in low-technology sectors (Braadland 2000) and the innovativeness of enterprises situated in Oslo is not higher than the innovativeness of firms in other regions of Norway. About 90% of the population in Oslo/Akershus is engaged in services (88% in Akershus and 90% in Oslo). The share of industrial employment is the lowest in the country (9%) (Braadland 2000). The industrial structure in Oslo is generally similar to the industrial structure in other Nordic regions. However, the share of the employed in industrial production is lower than in other Nordic capitals (generally, Norway has a lower share of industrial employees compared to other Nordic countries). The share of employment in the financial sector is higher in Oslo than in Copenhagen and Helsinki (Braadland 2000).

There is one large university in the Oslo/Akershus metropolitan area – the University of Oslo, which is the largest in the country. There are also 15 other university colleges in the metropolitan area. Additionally, a number of research institutes are located in Oslo. The Norwegian government attempts to reduce the number of university colleges in the country. A number of merges is observed at the university sector. Though Norway is a high-cost country, the wage of researchers is not high and is comparable to the wage level of researchers in other European countries (Gulbrandsen, Godoe 2008). This fact influences positively on R&D. Industrial PhDs, organized in cooperation between firms and businesses, is a popular measure in Norway supported by the Government, aimed to increase the knowledge base of firms. Industrial PhD programs are developed for firms' employees. The Government pays 50% of the student's salary and a person works with her PhD thesis 50% of time. The rest of the working time, an individual spends on regular tasks in a firm.

There are two innovation leaders in Norway, i.e. the Oslo region and the Trondelag area (with the major Norwegian Technical University and a number of research institutions and firms situated there). Many would expect that the level of innovation in Oslo should be higher but this is not the case in Norway. The results of the Community Innovation Survey (CIS) show that the level of innovation in the Oslo region in 2010 was not higher than in Norway in general (Solesvik, Gulbrandsen 2014). One of the reasons for the moderate level of innovation in Oslo is the service nature of the majority of industries. Traditionally, innovation is associated with the creation of new industrial products. However, service innovation is an investment area in the Oslo region. In some industries in the Oslo region, the level of innovation is higher than average in the country, for example, in transport and communication, industrial services and data processing (Braadland 2000).

The innovativeness of the Norwegian firms and regions is one of the main components leading to a competitive advan-

tage of the Norwegian industries in the world economy. The Norwegian Government had decided to support innovation initiatives in the Norwegian regions and in 2006, introduced a new support program called VRI that is based on the Triple Helix philosophy, which should favour innovation in fifteen regions (Solesvik 2017). Each region is allocated in several priority areas. The priority areas for innovation development reflect traditionally strong clusters in each particular region.

The goal of VRI in Norway is: «to develop knowledge and ability towards interaction and innovation processes in the regions and advance research-based innovation in the Norwegian economy» (VRI Programplan 2010: 5). This should be achieved by closer cooperation among universities and R&D institutions, local governments, firms and organizations. Several stages are determined in the VRI program: VRI I (2007--2010), VRI II (2011-2013), and VRI III (2014--2017). The VRI program in Oslo/Akershus supports key industries in the region. Priority industries for innovation development were not rigid for the whole period of VRI (2007-2017), but was reconsidered during the stage change. The goals of the VRI in the Oslo-Akershus region are to improve interaction across priority innovation networks, to create a learning arena in the region and exchange experience with other regional R&D and innovation projects. Other goals include mobilization and stimulation of R&D-based innovation in the clusters and networks through interaction among firms and among firms and research institutions (VRI 2001: 2). The focus areas of the VRI were Information and Communication Technologies (VRI ICT), the maritime industry (OMN), renewable energy (OREEC), the marine life science (MareLife), the health sector (eHealth) and medical technology (MedTech).

3.4. Sweden

The population of the Stockholm metropolitan area is 2,120,560 (2011) people, which constitutes about 23% of the Swedish population. Stockholm is a part of the larger Stockholm-Mälardals region. In 2009, Stockholm was named number two in Europe in terms of entrepreneurship development.

Representatives from the public sector (i.e. ministries, government, and research funding institutions) and the private sector are involved in the innovation activity in the Stockholm region. In the three leading innovative sectors of Stockholm, i.e. ICT, life sciences, and environment technology, Universities collaborate with the private sector. For example, the three largest universities of Stockholm, i.e., the Karolinska Institute, the KTH Royal Institute of Technology and the University of Stockholm in cooperation with industries and the local government, created the Stockholm Science City Foundation (SSCI) in 1990. Thus, the Triple Helix model is successfully implemented in the Stockholm innovation structure (Danell, Persson 2003). The SSCI is responsible for several innovative programs in the greater Stockholm area. For example, Powerhouse Life Science, the Science for Life Laboratory and the joint marketing program for the region – SULS (Lindqvist et al. 2012). In the ICT sector, large global players (Ericsson, IBM Svenska, and Packetfont), together with the KTH Royal Institute of Technology and the local government, started the Electrum Foundation. The Electrum Foundation aims to improve six strategic areas: innovation, entrepreneurship development, competence development, marketing, research, and education. Two important subsidiaries were created to support the key areas of strategic input, i.e., Kista Science City AB and the incubator STING AB.

In Stockholm, there is a significant concentration of educational and research institutions: the KTH Royal Institute of Technology, the Karolinska Institute, and the Stockholm University, to name a few. These three universities and a number of university colleges are responsible for 23% of university graduates and employ 27% of researchers in the country. Though the level of highly educated people is high, the lack of highly qualified personnel is growing (Lindqvist et al. 2012). In total, the Stockholm knowledge intensive services and the creative sector constitute a significant part of the region's business. 45% of the funding from the European Union, which Sweden gets, goes to the HEIs in Stockholm. In the Stockholm area, the level of cooperation between industries and research institutions is high (Diez 2000). Manufacturers use knowledge accumulated by research institutes in the development of innovative products.

In contrast to other Nordic countries, there is no regional policy and strategy in innovation in Sweden. On the national level, a strategy for competitiveness, entrepreneurship and employment for 2007-2013 was approved (Swedish Government 2007). Stockholm's region's innovative activities are highlighted in a general Regional Development Program. There is also no single body responsible for the coordination of innovation in the Stockholm metropolitan area. On a regional level, the County Council is responsible for the development of the Regional Development Plan for the County of Stockholm. Scholars suggest that the creation of the common regional innovation policy will improve the efficiency of innovation in the Stockholm metropolitan area (Lindqvist et al. 2012). Another important challenge, which will add to innovation development in the region, is the extension of an innovation base. Nowadays, the innovation is concentrated mainly in ICT, environmental technologies and the life science sector. Global actors, such as Astra Zeneca, Pfizer, Ericsson, Telia-Sonera and IBM Svenska are the main providers of innovation activity in the region. There is also a great potential to involve, first, not only large but also smaller firms and second, innovations that should be implemented in other industries, especially in services, the public sector and health care. Notably, the Triple Helix model is more successful in the Stockholm region than in the periphery regions of Sweden (Danell, Persson 2003).

Some innovative programs are developed in the greater Stockholm-Uppsala region (i.e., in life sciences). Sweden spent about 3.6% of GDP to R&D in 2007. In Stockholm, the annual expenditure to R&D is 4.3% (Lindqvist et al. 2012). Not surprisingly, Stockholm was recognized as the top European region in terms of innovation performance in 2009-2017 (European Union 2017). However, there is a potential for growth. Policymakers did not consider innovation in the Stockholm area separately. Instead, it is considered in the context of a broad growth of the region. Local, national, and international actors are involved in collaborative innovative activities.

The innovation performance in the Stockholm region is quite high. Policymakers name public knowledge, technological innovation and innovative entrepreneurship as the main factors of the innovation performance in the Stockholm region. In Sweden, the cluster approach to innovation development has a long tradition. The cluster approach in Sweden was theorized by Erik Dahmen in the middle of the twentieth century (Brandt 2001). As already mentioned before, innovation is considered in a package with other directions aimed to improve growth of the region. One of such priority

areas is stimulation of entrepreneurship development. Several projects are created to foster entrepreneurship, a few of which are, Entrepreneur Stockholm and Entrepreneurial University. The Entrepreneur Stockholm project unites twenty-two consultancy organizations providing advice and help for female entrepreneurs, start-ups, venture development, innovation and internationalization (Lindqvist et al. 2012). The Entrepreneurial University project is a project supported by KTH and is aiming to develop academic entrepreneurship and support academic staff's collaboration with the leading universities and industrial firms.

Conclusions and implications

In this paper, I aimed to explore, analyse and compare the experience of regional innovation in Nordic capital metropolitan areas. Two research questions were explored, i.e. What is the difference in innovation policy of Oslo region and innovation policies in capital regions of three other Nordic capitals? Does the regional innovation policy influence on the innovation effectiveness? In order to answer these research questions, I have considered the development of region innovations in Copenhagen, Helsinki, Oslo and Stockholm areas. The novel contribution of the study is application of the regional benchmarking analysis to explore the effectiveness of the Triple Helix model of innovation implemented in all Nordic capital regions. To our knowledge, this is the first study that compares the implementation of the Triple Helix model in all four Nordic capitals. Previous research explored the Triple Helix model in a single country context (i.e. Billington 2012; Kaukonen, Nieminen 1999; Sörvik, Midtkandal 2016). A number of similarities within the four capitals are observed. First, capital regions have the highest density of educated people. The capital regions host the leading universities and research institutions in the countries. The empirical analysis demonstrated some difference as well. Innovation policies and strategies are developed either separately from innovation at the national and regional level (Denmark, Finland, and Norway) or as a part of global regional programs of development (Sweden). Researchers and policymakers admit that their countries' innovation development programs are successful. But, there is space for further development and improvement. Policy-makers appreciate cooperation among actors in the capital regions, as well as with other national and international partners. However, there is a need to stimulate international cooperation and attraction of foreign experts into R&D.

To answer the second research question, I analysed the results of the introduction of the new innovation strategy in Norway, i.e. VRI program. The Triple Helix model was early realized in Copenhagen, Stockholm, and Helsinki. These metropolitan areas were Innovation leaders for a long time according to Regional European Scoreboard, while Oslo was an Innovation follower some time ago (European Union, 2009; 2012; 2017). Concerns of policy-makers related to the weak innovation position of Norway in general and in the capital region, in particular, lead to the adoption of the Triple Helix model in all of the Norwegian regions in 2006. As a result of such activities, in particular the introduction of the Programme for Regional R&D and Innovation, the positions of the Oslo region improved and the region was recently named as an Innovation leader (European Union 2017). The innovation models are not static and new trends in the modern economy lead to development of new generation of innovation models, like Quadruple Helix model (Arnkil et al. 2010).

The paper has some limitations. First, the regional benchmarking analysis used secondary data from Nordic capitals. Future studies might use primary data to carry out quantitative and qualitative research. For example, subsequent studies might compare intensity of innovation development and innovation collaboration using Community Innovation Survey data collected in all Nordic countries. Scholars might consider also in-depth qualitative studies exploring "How?" and "Why?" research questions.

What are the lessons for policy-makers and scholars from the benchmarking analysis? First, the effective national and regional innovation policies are important for the development of innovations in the metropolitan regions. Second, the Triple Helix model realized in the capital regions of the Nordic countries proved to be effective and lead the capital regions to score high in the innovation ratings. Notably, the in the Nordic capitals where the Triple Helix model was realized earlier (Stockholm and Copenhagen), the success of regional innovation is higher and regions are recognized as innovation leaders long time ago. It is an important implication for policy-makers in countries outside Scandinavia where the Triple Helix model is not implemented yet. This means that the Triple Helix is recommended for innovation outsiders in order to improve the situation with innovation development. Third, the innovation models are not static and modern trends, especially ones related to digitalization, lead to the development of new generation of innovation models.

Acknowledgements

The study was supported by a grant from the Programme for Regional R&D and Innovation in the Oslo-Akershus Region (Akershus County Council, Norway).

References

Ahmed, P.K., Rafiq, M. (1998), Integrated benchmarking: A holistic examination of select techniques for benchmarking analysis, Benchmarking for Quality Management & Technology, 5(3): 225-242.

Arnkil, R., Järvensivu, A., Koski, P., Piirainen, T. (2010), Exploring Quadruple Helix outlining user-oriented innovation models. Working paper, Tampere: University of Tampere.

Asheim, B.T., Grillitsch, M., Trippl, M. (2016), Regional innovation systems: Past-present-future, in: R.Shearmu, Ch. Carrincazeaux, D. Doloreux (Eds.), Handbook on the geographies of innovation (pp. 45-62), Cheltenham: Edward Elgar Publishing.

Autio, E., Yli-Renko, H. (1998), New, technology-based firms in small open economies – An analysis based on the Finnish experience, Research Policy, 26 (9): 973-987.

Balzat, M., Hanusch, H. (2004), Recent trends in the research on national innovation systems, Journal of Evolutionary Economics, 14(2): 197-210.

Baptista, R. (2000), Do innovations diffuse faster within geographical clusters? International Journal of Industrial Organization, 18 (3): 515-535.

Billington, M.G. (2012), Intermediaries - the Norwegian model, ISPIM Conference Proceedings, The International Society for Professional Innovation Management (ISPIM).

Borch, O.J., Solesvik, M. (2016), Partner selection versus partner attraction in R&D strategic alliances: The case of the Norwegian shipping industry, International Journal of Technology Marketing, 11(4): 421-439.

Braadland T.E. (2000), Oslo-regionen som nasjonal nyskapinsnode, Oslo: STEP Group.

Brandt, M. (2001), Nordic clusters and cluster policies, in: Å. Mariussen (Ed.), Cluster policies – cluster development? Stockholm: Nordregio Report 2001: 109-131.

Cervantes, M., Pilat, D., Wilson, K. (2010), The OECD innovation strategy: Findings and implications, paper presented in Stockholm, 11 February 2010.

Cornett, A.P. (2009), Aims and strategies in regional innovation and growth policy: A Danish perspective, Entrepreneurship and Regional Development, 21(4): 399-420.

Cornett, A.P. (2002), The regional system of innovation and regional development, paper prepared for European Regional Science Association 42th European Congress, Dortmund, Germany, 27-30 August 2002, CD-rom proceedings.

Culminatum (2005), Innovation strategy: Helsinki metropolitan area, Helsinki: Helsinki Region Centre of Expertise, Culminatum Ltd.

Danell, R., Persson, O. (2003), Regional R&D activities and interactions in the Swedish Triple Helix, Scientometrics, 58(2): 203-218.

Diez, J.R. (2000), The importance of public research institutes in innovative networks-Empirical results from the Metropolitan innovation systems Barcelona, Stockholm and Vienna, European Planning Studies, 8 (4): 451-463.

Etzkowitz, H. (2003), Innovation in innovation: The Triple helix of university-industry-government relations, Social Science Information, 42 (3): 293-337.

Etzkowitz, H. (2008), The Triple Helix: University-industry-government innovation in action, New York/ London: Routledge.

European Union (2009), Regional European Scoreboard, European Union, Belgium.

European Union (2012), Regional European Scoreboard, European Union, Belgium.

European Union (2017), Regional European Scoreboard, European Union, Belgium.

Friedmann, J. (1972), A general theory of polarized development, in: N.M. Hansen (Ed.), Growth centres in regional economic development (pp. 82-107), New York: Free Press.

Fritsch, M., Stephan, A. (2005), Regionalization of innovation policy – Introduction to the special issue, Research Policy, 34 (8): 1123-1127.

Gulbrandsen, M., Godoe, H. (2008), "We really don't want to move, but...": identity and strategy in the internationalisation of industrial R&D, The Journal of Technology Transfer, 33 (4): 379-392.

Gulbrandsen, M., Solesvik, M. (2015), Comparing university-industry linkages in two industrial clusters in Norway, Academy of Management Proceedings.

Huggins, R. (2010), Regional competitive intelligence: Benchmarking and policy-making, Regional Studies, 44(5): 639--658.

Isaksen, A., Karlsen, J. (2010), Different modes of innovation and the challenge of connecting universities and industry: Case studies of two regional industries in Norway, European Planning Studies, 18(12): 1993-2008.

Kaufmann, A., Tödtling, F. (2000), Systems of innovation in traditional industrial regions: The case of Styria in a comparative perspective, Regional Studies, 34(1): 29-53.

Kaukonen, E., Nieminen, M. (1999), Modeling the triple helix from a small country perspective: The case of Finland, The Journal of Technology Transfer, 24(2): 173-183.

Lilles, A., Rõigas, K. (2017), How higher education institutions contribute to the growth in regions of Europe? Studies in Higher Education, 42(1): 65-78.

Lindqvist, M., Olsen, L.S., Baltzopoulos, A. (2012), Strategies for interaction and the role of higher education institutions in regional development in the Nordic Countries, Nordregio.

Lundvall, B., Borras, S. (1997), The globalizing learning economy: Implications for innovation policy, Commission of the European Communities, Luxembourg.

Lööf, H., Heshmati, A., Asplund, R., Nåås, S.O. (2001), Innovation and performance in manufacturing industries: A compari-

son of the Nordic countries (No. 457), SSE/EFI working paper series in economics and finance.

Löppönen, P. (Ed.). (2010). The State and Quality of Scientific Research in Finland 2009. Academy of Finland.

Luque-Martínez, T., Muñoz-Leiva, F. (2005), City benchmarking: A methodological proposal referring specifically to Granada, Cities, 22(6): 411-423.

Markkula, M., Kune, H. (2015), Making smart regions smarter: Smart specialization and the role of universities in regional innovation ecosystems, Technology Innovation Management Review, 5(10): 7-15.

Ministry of the Interior and Health (2004), Regionalpolitisk redegjørelse 2004.

Nelson, R. (1993), National innovation systems, Oxford: Oxford University Press.

OECD (2017a), Gross Domestic Product (GDP) (indicator), available at: https://data.oecd.org/gdp/gross-domestic-product-gdp.htm (accessed 24 June 2017).

OECD (2017b), Gross Domestic spending on R&D (indicator), (accessed 27 June 2017).

Official Statistics of Finland (2015), Research and Development [e-publication]. Helsinki: Statistics Finland, available at: http://www.stat.fi/til/tkke/2015/tkke_2015_2016-10-27_tie_001_en.html (accessed 18 May 2017).

Ohno, T. (1988), Toyota production system: Beyond large-scale production. Portland: CRC Press.

Pekkarinen, S., Harmaakorpi, V. (2006), Building regional innovation networks: The definition of an age business core process in a regional innovation system, Regional Studies, 40(4): 401-413.

Ronde, P., Hussler, C. (2005), Innovation in regions: What does really matter? Research Policy 34(8): 1150-1172.

Schøtt, T. (2007), Entrepreneurship in the regions in Denmark – Studied via Global Entrepreneurship Monitor, Kolding: University of Southern Denmark, CESFO Centre for Small Business Studies.

Schumpeter, J.A. (1934), The theory of economic development, Cambridge: Harvard University Press.

Solesvik, M. (2016), Entrepreneurship, human capital, and regional development: Labour networks, knowledge flows, and industry growth, International Journal of Entrepreneurial Behaviour & Research, 22(4): 584-586.

Solesvik, M. (2017), Effectuation, causation and firm-level radical innovation in entrepreneurial firms, paper presented at the 4th GSOM Emerging Markets Conference, St. Petersburg, 5-7 October 2017.

Solesvik, M., Gulbrandsen, M. (2014), Interaction for innovation: Comparing Norwegian regions, Journal of Entrepreneurship, Management and Innovation, 10 (3): 7-28.

Sotarauta, M. (2011), Innovation policy in Finland: Trapped by the past or symptoms of policy learning? Tampere: University of Tampere.

Sörvik, J., Midtkandal, I. (2016), Continuous priority setting in the Norwegian VRI programme, Governing Smart Specialisation, London, New York: Routledge, pp. 156-170.

Sroka, W., Gajdzik, B. (2015), Managerial challenges for networks and beyond, in: W. Sroka, Š.Hittmár (Eds.), Management of network organizations. Theoretical problems and the dilemmas in practice (pp. 121-134), Berlin/Heidelberg: Springer Verlag

Sroka, W., Hittmár, Š. (Eds.) (2015), Management of network organizations: Theoretical problems and the dilemmas in practice, Berlin/Heidelberg: Springer Verlag.

Strand, Ø., Ivanova, I., Leydesdorff, L. (2017), Decomposing the Triple-Helix synergy into the regional innovation systems of Norway: Firm data and patent networks, Quality & Quantity, 51(3): 963-988.

Swedish Government (2007), A national strategy for regional competitiveness, entrepreneurship and employment 2007-

2013, available at: http://www.government.se/information-material/2007/02/a-national-strategy-for-regional-competitiveness-entrepreneurship-and-employment-2007-2013/

Tödtling, F., Trippl, M. (2005), One size fits all? Towards a differentiated policy approach with respect to regional innovation systems, Regional Policy, 34(8): 1203-1219.

World Bank (2017), Research and Development expenditure (% of GDP), available at: http://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS (accessed 28 May 2017).

World Economic Forum (2014), Europe's top 10 most competitive economies, available at: https://www.weforum.org/agenda/2014/06/europes-top-ten-competitive-economies/ (accessed 8 June 2017).

Marina Z. Solesvik is Professor and Chair of Maritime Innovation and Management at Nord University in Bodø, Norway. Previously, she was a Professor of Innovation and Management at the Stord/Haugesund University College in Norway. She is a board member at several Norwegian firms and organizations, among others National Riksteatret in Oslo. Marina holds a PhD in Management from the Graduate Business School at the Nord University and a PhD in Entrepreneurship from the Institute of Agrarian Economy in Kiev, Ukraine. Her research interests include regional innovation, open innovation, maritime business, entrepreneurial intentions, female entrepreneurship, strategic alliances, and Arctic research.

Table 1. A summary of regional innovation in the capital areas of the Nordic countries

	Copenhagen	Helsinki	Oslo	Stockholm
Link to HEIs	8 universities	9 universities 8 polytechnics	The University of Oslo & 15 university colleges	19 universities and university colleges, including three leading universities (The Karolinska Institute, KTH, and the University of Stockholm)
Organizations responsible for the innovation policy in the region	Innovation Council Growth Forum Green House	The National Technology Agency of Finland (Tekes) and the local governments of Helsinki, Espoo and Vantaa. The Finnish National Fund for Research and Development – SITRA The Academy of Finland	The Regional administrative entity (Fylkeskommune) Innovation Norway	The County Council of Stockholm The County Administrative Board The Swedish National Agency for Innovation Systems – *Vinnova* The National Agency for Economic and Regional Growth – *NUTEK*
Important industrial innovators	50 largest pharmaceutical companies in the world	Nokia Stora Enso	Det Norske Veritas GL, Norwegian, Schibsted, Snøhetta	Ericsson, IBM Svenska, Telia-Sonera, AstraZeneca, and Pfizer
Innovation centres	Medicon Valley Cleantech Idea lab High Tech foundation	State Technical Research Center VTT The Finnish Foundation of Innovation The Helsinki Virium Forum	The Oslo Innovation Center – Forskningsparken AS The Center for Technology, Innovation and Culture (TIK) at the University of Oslo Nordic Innovation	The Stockholm Environmental Technology Centre (SMTC) The Electrum Foundation The Stockholm Science City Foundation Filmregionen Stockholm-Mälardalen The Karolinska Innovation AB

				The Karolinska Institute Science Park The Unit for Bio-Entrepreneurship (UBE) Innovation Bridge ALMI Business Partners The Stockholm Business Alliance
Innovation activities	Knowledge accounting Innovating milieu Mezzanine capital	*Centres of Expertise for:* - logistics - active materials and microsystems - gene technology and molecular biology - digital media - medical and welfare technologies - software product business Regional Centres Development Program Support for entrepreneurship growth Innovation clinics Growth coaching Open forum events	Centres of Expertise Industrial PhDs	Initiatives to improve innovation culture; "The Entrepreneurial University"; Entrepreneur Sthml; grants & loans Knowledge Navigator (Kunskapslotsen); Innovation Power Stockholm;
Leading clusters in the region	Life sciences Biotechnology ICT Services Shipping	Medical and Welfare Technologies Otaniemi technology cluster Aviapolis Airport city – local technology city owned by Technolpolis Plc. Hitech in Vantaa: logistics, electronics, the environment, welfare and data communications; Biosector technology (est. in Vikki district in 1992); finance and consultancy design industry	Medical technologies eHealth Renewable energy Marine life Maritime cluster	Life sciences ICT Environmental technology sector (including renewable energy) Creative sector (film industry)
Examples of the innovation programs	Copenhagen Innovation and Entrepreneurship Lab (CIEL)	*Living labs* – real life laboratories for research, development and learning; *Helsinki Virtual Village;* *New Media culture centre;* *Manula project* – focuses on local community development; Suurpelto initiative in Espoo; The *Dimes* association – Digital Media Service Innovation;	VRI Maritim21	Innovation Power Stockholm Regional development plan - RUFS 2010 Environmental Technology for Growth (Miljöteknik för tilväxt) MedTech Growth Powerhouse Life Vision 2025

		FinnWell – joint project to improve the quality of health care services; Hitech programme in the city of Vantaa *Smart Specialization* – collaborative project aimed to use modern ICT technology for urban development in order to enhance prestige of the region and economic development.		

Source: Brandt 2001; Cornett 2009; Culminatum 2005; Markkula, Kune 2015.