

Cleantech Innovation and Proximity Dimensions: A Critical Issue for Europe in the Era of the Paris Agreement

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Source: Alternative energy source (2017)

Abstract

This research is an exploratory study on how cognitive and geographical proximity relates to knowledge exchange and innovation in cleantech industries. Being cognitively and geographically close to other actors is important for learning and innovation to take place. This research will focus on cleantech compared to other industries because of the importance of cleantech in tackling climate change. The research aims to compare cognitive proximity, geographic proximity and their combined effects between cleantech and non-cleantech. The research is based on patent data on inventor from Groningen. Variables are computed variables for cognitive proximity, geographic proximity and their combined effect. The distribution of each variable is analysed and compared through statistical tests. In general, cognitive proximity is a more important determinant of knowledge exchange than geographic proximity. The data shows that the effect of cognitive proximity on knowledge exchange in cleantech is generally lower than in other industries. This is not the case for geographic proximity but it is for the combined effect. In order to improve knowledge exchange in cleantech, it is necessary to strengthen cognitive proximity between inventors. This research can help regional policymakers to focus more on the types of technologies rather than the location of the companies.

Introduction

During the past few decades, climate change has received more and more attention. In 2014, 196 countries agreed on a plan to tackle climate change. The goal is to limit the total global warming to a maximum of 2 degrees (United Nations, 2015). Technological innovation and knowledge exchange are one of the key pillars of the agreement. The Technology Executive Committee of the United Nations stresses this importance, stating: 'To achieve the goal of the Paris agreement, there is a pressing need to accelerate and strengthen technological innovation' (TEC, 2017, p.4). All European countries are in the Paris agreement, and this led to the EU forming its own policy on climate change called: The European Green Deal. Throughout the Green Deal, the importance of knowledge exchange is also stressed and especially in the cleantech sector (European Union, 2020). This sector is hugely important in creating the technologies we need to make all parts of society carbon-neutral. To tackle climate change, companies must innovate further. Most innovation requires multiple research teams and companies to come together instead of being developed by one company or research team (Christopherson, Kitson and Michie, 2008). Therefore, companies need to exchange knowledge to stimulate innovation. Since it is important to use the pool of knowledge outside of the research team. All these plans together make it clear that climate change is urgent and research on knowledge exchange can help set up the frameworks for better knowledge exchange between companies, leading to innovation.

Previous research discusses how the location of companies affects their capabilities to exchange knowledge (Boschma, 2005). Geographic proximity can help to understand the interrelations between companies and help to create the framework to understand how companies can improve their capabilities in knowledge exchange. More recent literature has shown that geographic proximity might not be as important as once thought and other dimensions might replace or complement geographic proximity (Teixeira, Santos and Brochado, 2008; de Fuentes and Dutrénit, 2016). In addition to the geographical proximity, there are four other proximities: cognitive, institutional, social and organizational.

This research will focus on cognitive and geographic proximity. Cognitive proximity encompasses the shared knowledge base of actors to enable cooperation. One can imagine that an expert in automotive technologies is not able to work together with an expert on solar panels. Because these two researchers would have low cognitive proximity. Cognitive proximity is particularly important in the cleantech sector; technology is complex and will bring together many researchers with different expertise. Making sure that the entire team understands each other and can work together is a very important point in accelerating innovation in the cleantech sector.

This research will focus on the Groningen region. Groningen is a large city located far from the other major cities in The Netherlands. However, it is still a popular location for innovative companies. It is a university city with a large number of educated residents. Groningen is second in the Netherlands in terms of the relative and absolute number of students per city and is the seventh largest city. (CBS, 2018).

As a human geographer with a special interest in economic geography, I am interested in understanding the spatial patterns of economic activity and the factors that drive economic development. I believe that knowledge exchange, geographic proximity and cognitive proximity play a key role in shaping these patterns. For example, regions with high levels of cognitive proximity and effective knowledge exchange are likely to have stronger innovation systems and more dynamic economies. On the other hand, regions with low levels of cognitive proximity and poor knowledge exchange may struggle to attract and retain talent and investment. I am excited to explore this topic further in order to gain insights into the mechanisms that drive economic development and to identify strategies for promoting innovation and growth in different regions.

Research problem

The research focuses on how cognitive and geographical proximity relates to knowledge exchange. It is important to see how the actors interact with each other along the line of these dimensions. This will ensure that actors can see where improvement can be made. It is an exploratory study to compare cleantech to other technologies.

The main research question is:

How can cognitive and geographical proximity facilitate knowledge exchange in clean technologies?

To look at this, it is first important to find out how each of these proximity dimensions differs between cleantech and other technologies. For each proximity, a comparison will be made between cleantech and non-cleantech. This can show whether each dimension has a stronger influence on knowledge exchange in cleantech than in other technologies. This leads to the following sub questions:

How does geographical proximity facilitate knowledge exchange in cleantech compared to other technologies?

How does cognitive proximity facilitate knowledge exchange in cleantech compared to other technologies?

The association of each proximity with knowledge exchange is now known. However, this does not yet consider cognitive and geographical proximity together. This interaction is important in understanding if cognitive and geographic proximity can complement or substitute for each other. The interaction effect will also be compared between cleantech and random technologies. The final sub-question encompasses this interaction between cognitive and geographical proximity:

Does cognitive and geographical proximity have a combined negative or positive effect on knowledge exchange in cleantech compared to other technologies?

Structure of the research

The research is structured in the following way:

(Theoretical framework and hypothesis) The main concepts are explained and brought together in a theoretical model to relate them to each other. Based on the theoretical framework hypotheses are formed for each research question to try and predict the outcome of the data. (Methodology) The methodology shows why and how the data was selected. The structure of the data and how the analysis is performed. (Results) Here, the main results of the statistical tests on the data are shown along with a short explanation. (Conclusion and discussion) Research questions are answered and reflected upon. Suggestions are made for policymakers and further research.

Theoretical framework

Previous literature states that the colocation of companies can lead to knowledge creation and innovation (Boschma, 2005). However, this so-called geographical proximity is not the only form of proximity economic actors can have. Cognitive proximity focuses on the shared knowledge base between actors. Economic actors need to have this to be able to communicate and work together. Organisational proximity encompasses the structures in which organizations are set up and how alike they are. Institutional proximity focuses on how the norms, values and rule of law are similar between organisations, mainly encompassing the macro level. Finally, there is social proximity which focuses on the relationship between organizations based on shared experiences and social networks (Boschma, 2005).

This research will focus on two kinds of proximity, geographic, and cognitive. Boschma(2005) states geographic proximity cannot be the only form of proximity. In general, there needs to be some cognitive proximity; otherwise, it will be impossible to exchange knowledge. So in theory having geographic and cognitive proximity should be enough to start the knowledge exchange. This is why these two are the most studied proximity dimensions.

Cleantech, Innovation, and Knowledge Exchange

Cleantech is defined as: "Cleantech (clean technology) products and services use technology to compete favourably on price and performance while reducing pollution, waste, and use of natural resource" (Butris et al., 2004, P11). Cleantech companies rely on technological innovation and advancements to bring new products to the market (Marra, Carlei and Baldassari, 2020). This creates a competitive environment where companies are constantly trying to create the most advanced technologies. It is a race between companies to be the first to release new technology.

Innovation occurs when a combination of existing knowledge leads to new technologies. Companies gain access to capabilities and knowledge that might not be available internally and reduce the risk of research by sharing the commitment with different companies (Marra, Carlei and Baldassari, 2020). This is the only way actors can keep up the pace with the growing complexity of technology and the combined demands of innovation (Simensen and Abbasiharofteh, 2022).

Geographical proximity

Boschma (2005) defines geographical proximity clearly as: "The spatial or physical distance between economic actors, both in absolute and relative meaning." (Boschma, 2005, P69) Previous research shows that geographic proximity is a key factor in knowledge exchange however, it is not always necessary and it is never the only form of proximity. Geographical proximity can be seen as an enabler for the other dimension of proximity (Teixeira, Santos and Brochado, 2008; de Fuentes and Dutrénit, 2016). Through geographic proximity clusters and networks emerge in a region. The actors in these networks become closely intertwined. However, learning from the other actors in your network can only go so far until new influences are needed. Without new ideas or knowledge from other actors, a geographic lock-in can happen, where actors are so focused on their region that they neglect outside influences (Boschma, 2005).

Geographic proximity relates to knowledge exchange via the accessibility of the other actors. If actors are located close together face to face contact will be accessible. This is especially important in innovative industries like cleantech. Knowledge in cleantech is generally complex and new. Due to this high complexity, knowledge is less tangible and codified, and direct contact with co-inventors is essential for the exchange of knowledge (Biggiero and Sammarra, 2010).

Historically, economic geography has shown that there is a clear connection between geographical proximity and knowledge exchange. In the literature, companies that are co-located together have a larger degree of cooperation. Companies located near a knowledge source, that is, a university, also tend to benefit more from knowledge exchange between companies and knowledge sources (Boschma, 2005). In cleantech, knowledge is relatively new and complex. Due to the nature of complex knowledge, contact between actors is expected to be more important in cleantech than in other areas. Therefore, the first hypothesis this thesis will investigate is:

H1: In cleantech, geographic proximity facilitates the exchange of knowledge more strongly than in other technologies.

Cognitive proximity

Boschma (2005) defined cognitive proximity as a shared knowledge base between two actors. If different actors want to exchange knowledge, they need to have similar capabilities and values; otherwise, they will not be able to learn from each other. The similarity in practices and work culture are important elements of cognitive proximity (Molina-Morales et al., 2014). It is important to note that Boschma also talks about how having too much cognitive proximity reduces the potential for knowledge exchange because actors will not be able to learn much from each other. Nooteboom et al. (2007) performed research on the optimal level of cognitive proximity. They concluded that cognitive proximity has an inverted U shape. Stating that there is a middle road in which cognitive proximity is at an optimal level. Too little and too much cognitive proximity have a negative effect on knowledge exchange. This effect was later named the proximity paradox (Boschma, Martin and Frenken, 2010).

Cleantech is a knowledge-extensive and innovative sector. In these sectors, cognitive proximity plays a larger role than in established sectors, since new knowledge is harder to codify (Simensen and Abbasiharofteh, 2022).

Previous literature shows a positive relationship between cognitive proximity and knowledge exchange (Lazzeretti and Capone, 2016). Knowledge exchange will be easier if another company has the same cognitive basis. Since cleantech is a highly complex sector, it is expected that cognitive proximity plays a larger role than in other sectors. This leads to the following hypothesis.

H2: In cleantech, cognitive proximity facilitates the exchange of knowledge more strongly than in other technologies

Geographic and Cognitive Proximity

Geographic proximity alone is not sufficient for knowledge exchange since the capabilities and knowledge of the companies also need to align (Boschma, 2005). Previous researchers have shown that cognitive proximity and geographical proximity are related (Molina-Morales et al., 2014). Cognitive proximity is the mediator along which the actors can make use of geographic proximity. Without cognitive proximity, actors may be located together but cannot exchange their knowledge sufficiently (Molina-Morales et al., 2014). However, other research has shown that geographic proximity can also be substituted by cognitive proximity (Hansen, 2014). If companies are located far from each other, cognitive proximity is needed to allow them to exchange knowledge and work together (Capello and Caragliu, 2018).

Although geographic proximity remains a very large factor in knowledge exchange, research has shown that it cannot be the only proximity for knowledge exchange to take place (Boschma, 2005). Other dimensions of proximity are necessary to facilitate the exchange of knowledge. Even though

the actors might be located close together and will be able to work together easily, they still need to be able to understand each other. For this cognitive proximity cannot be low, thus it is expected that cognitive and geographic proximity complement each other. However, other researchers have shown that cognitive proximity can also substitute geographic proximity (Hansen, 2014; Capello and Caragliu, 2018). On the basis of the high level of technology and knowledge in cleantech, it is expected that cognitive proximity and geographic proximity are both needed to facilitate knowledge exchange. Because the knowledge is new, less codified, and there is a high level of technology, clean technologies need more combined effects to exchange knowledge than other technologies. For these reasons, cognitive and geographical proximity are expected to show a complementary effect.

H3: Cognitive and geographical proximity have a combined positive effect on knowledge exchange in cleantech.

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