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# Exploring the spatial reach of co-publication partnerships of multinational enterprises: to what extent does geographical proximity matter?

Utku Ali Rıza Alpaydın 

## ABSTRACT

There is an increasing interest in defining the determinants of university–industry collaborations (UICs). One recent tendency is to embrace the proximity approach while explaining the process of coordination in UICs. Most studies generally take on the role of geographical proximity and try to explain its effects by looking at the universities. These studies try to identify the firms that universities collaborate with and define the determinants of these collaborations in line with the firm characteristics. However, this paper, rather than taking universities as the main unit of analysis, takes a firm-centric approach and examines the co-publication collaborations of a multinational enterprise (MNE) with universities. The paper explores the spatiality of these collaborations and geographical proximity's influence on the collaboration networks of MNEs. Using the case study of a multisite MNEs' co-publications with universities through bibliometric data, it provides some refinements about the influence of geographical proximity. The analysis shows that geographical proximity plays a significant role in UICs for MNEs. The findings also indicate that, despite its overall importance, the effects of geographical proximity differ for the branches of the same firm. The collaboration patterns of different units show divergence regarding the share of collaborations at various geographical scales. This suggests that following a more nuanced perspective in UIC studies, dealing with geographical proximity may be useful in clarifying its effects.

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## INTRODUCTION

Innovation is a key driver of corporate competitiveness in the 21st century. Firms resort to innovation in order to remain viable in the market and grow their businesses, and knowledge emerges as a key asset for those firms that thrive to be innovative (Pezzillo Iacono, Schiuma, Martinez, Mangia, & Galdiero, 2012). However, a single firm, irrespective of how large it is, does not possess all the knowledge resources required to innovate successfully. Therefore, firms embrace several strategies to access external knowledge as a part of their competitiveness strategies. These knowledge-access strategies constitute an important element of firms' competitive strategies

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and generally include the establishment of collaborative linkages with others to obtain access to their knowledge sources. In this regard, the determinants of collaboration, with the aim of obtaining external knowledge, become one of the significant factors of competitiveness for firms (Pezzillo Iacono et al., 2012).

Universities, which play a fundamental role in knowledge generation (Uyarra, 2010), represent important sources of knowledge for innovating firms. In a broader sense, universities represent an important innovation asset for their surrounding territories, particularly when their role in knowledge production and dissemination, in the form of knowledge spillovers, is taken into account. Thus, understanding the drivers and barriers of university–industry collaborations (UICs) is important to understand the overall territorial contributions of universities. In this regard, proximity is generally acknowledged to be important in determining knowledge exchange between partners (Boschma, 2005); therefore, it may be expected that proximity affects a firm's knowledge-access strategies.

Proximity is often used as an explanation of how multinational enterprises (MNEs) access knowledge, locating their sites in areas where it would be easy to tap into local knowledge networks (Broström, McKelvey, & Sandström, 2009). However, this appears too simple because it treats MNE sites as disconnected from corporate hierarchy, where there are knowledge transfers within the firm. The issue of proximity to which site is also a critical question. Therefore, in order to understand better how proximity functions in determining UICs for MNEs, this paper examines whether and how collaboration patterns with universities differ for subunits of MNEs.

Further, MNEs are exemplars of corporate innovation actors. They also play a significant role in the global innovation system through their effects in the internationalization of research and development (R&D) activities. With presence in various countries worldwide, MNEs pose a challenge to testing the influence of proximity in interorganizational knowledge-exchange relationships. Most studies that deal with the location choices of the R&D subsidiaries of MNEs argue that MNEs tend to locate in regions where they can easily tap into local knowledge networks (Broström et al., 2009). However, considering MNEs as unitary actors makes it difficult to explain the local/regional dimension of geographical proximity, since MNEs have an international reach and a global outlook with their presence in various countries. Thus, the arguments in favour of the dominance of local and regional interactions end up being questioned for MNEs that engage in collaborations with universities at various geographical scales. Thus far, studies have failed to provide a comparative examination of collaboration patterns for various branches within a single MNE and the overall impact of geographical proximity in these patterns.

Therefore, this paper seeks to understand whether or not geographical proximity plays a substantive role in determining UICs of MNEs, and asks the following specific research question: 'How does geographical proximity affect the collaboration networks of MNEs with universities?' In order to answer this question, the paper develops a framework based on existing literature on proximity and MNEs (in the second section), and conducts a case study to examine the co-publication collaborations of a Norwegian-origin MNE in the oil and gas sector with universities through a location-based comparison (in the third section). The fourth section presents the co-publication collaboration patterns of the case and the distribution of collaborations across geographical scales. The fifth section discusses the findings of the analysis and questions related to the viability of the influence of geographical proximity across geographical locations. The sixth section concludes by shedding a light on the differentiated effects of geographical proximity for UICs of MNEs.

The novelty of this paper lies in the fact that it adopts a firm-centric approach rather than taking universities as reference actors, while considering co-publications as the proxy for analysis. The traditional division of labour between universities and industry in UICs assumes that publication is the responsibility of academics. In line with this assumption, most of the studies approach UICs from the viewpoint of universities. On the contrary, this paper adopts a reverse attitude with the concept that corporate researchers working in the private sector also publish

either alone or in cooperation with academics. Therefore, this paper examines the publications produced in cooperation with academia.

The main argument of this paper is that geographical proximity is significant for UICs of MNEs, but it is difficult to establish a unified significance of geographical proximity for the various locations of MNEs. There is no persistent pattern in the collaboration networks among the various units of MNEs. With regard to certain bases of the MNE studied in this paper, local collaborations outweigh collaborations with universities located at a distance. However, this is not the case particularly for the bases that are located outside the headquarters country, for which collaborating with national and global universities is the dominant collaboration pattern. Moreover, it is found that there are more international collaborations, specifically collaborations with universities in the same continent as the MNE base, than collaborations at local and national scales. Therefore, attempts to define the spatial scope of UICs only by examining the geographical proximity between partners provide a limited explanation of the phenomenon and they must be supported with a comprehensive perspective that attempts to capture various dimensions of proximity and specific circumstances of the partners.

## THE ISSUE OF PROXIMITY FOR UICs INVOLVING MNEs

### Competitiveness by knowledge through collaboration

The competitiveness of firms, regions and nations is assumed to be directly linked to their innovative capacities (Maskell & Malmberg, 1999). A firm, a region or a nation is believed to become and remain competitive as long as it innovates, and innovation depends on knowledge. Therefore, knowledge processes – creation, diffusion and exchange – are fundamentally important for the innovation performance of firms and ultimately their competitiveness (Pezzillo Iacono et al., 2012). Access to knowledge resources then becomes critical for firms in determining their innovativeness and competitiveness. Firms can obtain knowledge by creating it through internal R&D or by collaborating with external parties. Collaboration may be with other firms (clients, customers, suppliers or competitors) or public sector organizations, research institutes or universities (Fitjar & Gjelsvik, 2018).

Universities are regarded as salient partners and important sources for firms because they provide new knowledge (Bouba-Olga, Ferru, & Pépin, 2012; Kuttim, 2016). Universities and other higher education institutions can provide external knowledge for firms through the former's cutting-edge research activities and specialized research infrastructure facilities. Although the significance of universities for firms in accessing knowledge has been acknowledged, the collaboration levels between universities and industries remain low (Avenyo et al., 2015). Accessing knowledge from universities is potentially useful but practically difficult mainly because of a number of barriers hindering effective collaboration and undermining the success of interactions. For example, Bruneel, D'Este, and Salter (2010) mention two types of barriers, namely 'orientation-related barriers' that originate from different incentive systems and 'transaction-related barriers' related to intellectual property (IP) issues. Ankrah and Al-Tabbaa (2015) combine factors that either facilitate or inhibit UICs under seven categories<sup>1</sup> from their systematic literature review. The barriers are generally regarded as undermining effective collaborations between academic and industrial partners; in order to overcome these barriers, it is argued that partners must be in some sort of proximity (Laursen, Reichstein, & Salter, 2011).

### Proximity in university–industry collaborations

The concept of proximity, which refers to 'closeness of actors and is often assessed by the similarity between the actors' (Fitjar, Huber, & Rodríguez-Pose, 2016, p. 5), constitutes one of the explanations for successful knowledge collaborations. While writing on the influence and role of proximity in collaborations, Boschma (2005, p. 62) provides a widely accepted argument: 'What

unites the different dimensions of proximity is that they reduce uncertainty and solve the problem of coordination, and, thus, facilitate interactive learning and innovation.’

Proximity enables knowledge transfer because partners need a common ground, and different dimensions of proximity could provide this shared platform. There are various kinds of typologies of how proximity may be achieved. Partners could be located geographically close to each other, which makes it more conducive and easier to exchange knowledge. Moreover, several studies on proximity claim that the geographical closeness of actors would be sufficient to be more innovative and, hence, more competitive, mainly due to knowledge spillovers (Fritsch & Franke, 2004). It is argued that the type of knowledge required for innovation – that is, tacit knowledge – is difficult to communicate over long distances, since it ‘can only be produced in practice’ (Maskell & Malmberg, 1999, p. 172). It is possible to transfer this type of knowledge only through demonstration and observation, which requires face-to-face interaction among the actors, and can only be achieved if the actors are co-located (Gertler, 2003). Shaw and Gilly (2000) mention that in addition to geographical proximity, there must be some kind of organized proximity based on the logics of belonging and similarity. According to Torre (2014, p. 98), ‘organized proximity refers to the different ways of being close to other actors, regardless of the degree of geographical proximity between individuals’.

Boschma (2005) introduced a new taxonomy to the proximity literature and his contribution gained prevalence in academic circles. Boschma (2005, p. 62) mentions the inability of geographical proximity in explaining collective learning by stating, ‘geographical proximity per se is neither a necessary nor a sufficient condition for learning to take place’. He proposes a classification based on five forms of proximity, that is, cognitive, organizational, institutional, social and geographical proximity. Cognitive proximity refers to the similarity of knowledge bases and perceptions of the actors. It is closely related to the notion of absorptive capacity. For individuals or firms, in order to absorb new knowledge, there must be some kind of cognitive proximity between the interacting parties. This is essential to understand new knowledge successfully and process it accordingly. Organizational proximity denotes the idea of organizational relationship, such as being part of the same hierarchical structure within a company group (Tijssen, Yegros-Yegros, & Winnink, 2016). It is argued to help in limiting opportunistic behaviour when exchanging knowledge. Institutional proximity is associated with formal (e.g., laws and regulations) and informal (e.g., shared habits, norms) macro-level frameworks (Ponds, Van Oort, & Frenken, 2007). Since institutions set the rules of the game, the actors in institutional proximity are expected to behave similarly and are more likely to interact. On the other hand, social proximity reflects individual-level relationships and carries the idea that the level of trust, friendship and kinship among the actors/firms creates social proximity, which in turn encourages them to easily interact and exchange knowledge (Boschma, 2005).

In addition to these two dominant positions regarding non-geographical dimensions of proximity, there have been other types of proximity that have attempted to account for effective knowledge transfer for innovation purposes. Some of these contributions include cultural proximity (Teixeira, Santos, & Oliveira Brochado, 2008), technological proximity (Cassi & Plunket, 2015) and personal proximity (Werker, Ooms, & Caniels, 2016). It can be claimed that what all these explanations are attempting to capture is that the actors involved in the process of knowledge exchange must be proximate to each other in one way or another either geographically or in terms of other dimensions, such as cognitively or socially.

Despite the numerous accounts on proximity, geographical proximity has emerged as a kind of primate proximity that is considered a key driver for ensuring successful knowledge exchange. The studies combining UICs with proximity literature favour geographical proximity, suggest a regional bias and emphasize the prominence of local and regional collaborations over others. Depending on previous researches, Slavtchev (2013) argues that UICs tend to be realized primarily in the local sphere.

The preference of firms to collaborate with geographically close universities (Garcia, Araujo, Mascarini, Gomes Dos Santos, & Costa, 2018; Steinmo & Rasmussen, 2016) can be attributed to several conditions. The first explanation concerns the interaction costs of collaboration and suggests that knowledge exchange between universities and firms is expensive and that these expenses increase with distance (Fitjar & Gjelsvik, 2018; Laursen et al., 2011). The longer the distance between collaborators, the higher the costs associated with travel expenses, time, cultural differences and language barriers (Muscio, 2013).

The second explanation relates to the difficulties of transferring knowledge mainly due to the tacit aspect of knowledge exchanged. According to this view, tacit knowledge requires close proximity of partners because its transfer necessitates personal contact and direct interaction of partners (Abramo, D'Angelo, & Solazzi, 2012; Laursen et al., 2011). Therefore, the co-location of collaborating partners is more conducive to face-to-face interactions, both intended and unintended, which makes the transfer of tacit knowledge more plausible and smoother. Petruzzelli (2011), echoing Howells (2002), argues that geographical proximity is necessary even for the exchange of codified knowledge, since a certain element of tacitness facilitates the interpretation of codified knowledge.

### Toward a more nuanced model of proximity in UICs from the perspective of MNEs

The accounts that attribute great importance to geographical proximity in knowledge transfer lack a sense of how geography functions from the perspective of actors who are not fixed in space, such as universities and MNEs. It is known that universities create knowledge in global communities and, similarly, MNEs are multisite corporations. Therefore, the question of which units are in proximity to which university becomes critical. It would be rather simplistic to assume that the effect of geographical proximity on UICs is constant or similar for all types of firms (Johnston & Huggins, 2017), and even for different branches of the very same firm, like an MNE. Firms do not decide to collaborate with the nearest university merely by taking advantage of geographical proximity (Fromhold-Eisebith & Werker, 2013).

Related literature provides a number of factors that affect partner search and selection of the MNEs and, therefore, the geographical reach of their collaborations with universities. These factors provide a few refinements on the importance of geographical closeness for UICs and explain the rationale underlying collaboration with universities located at larger geographical distances. By relying on the related literature on these factors, a more nuanced approach for treating the influence of geographical proximity on the MNEs' UIC patterns has been developed. This approach was tested with the help of the following sub-research questions:

- *Sub-research question 1:* Do MNEs collaborate more with universities located at larger geographical distances?
- *Sub-research question 2:* Do the subsidiaries of MNEs in other countries collaborate more with the local universities where they are established than with the universities in the country where they are headquartered?
- *Sub-research question 3:* Do the subsidiaries of MNEs collaborate with universities at various geographical scales in similar patterns?

One of the factors affecting the geographical reach of UICs is the size of the company. MNEs are much larger organizations than small and medium-sized enterprises (SMEs) and have abundant resources that they can invest in R&D activities. Simultaneously, the widespread adoption of the open innovation approach (Chesbrough, 2003) by MNEs has given rise to the emergence of the notion of 'global innovation networks', which refers to the international dispersion of their R&D activities and collaborative relations with international partners (Guimón & Salazar-Elena, 2015).

Studies in this area show that the likelihood of collaborating with universities is two to three times higher for larger firms (Dell'Anno & Del Giudice, 2015). Larger firms such as MNEs do not only have a tendency to collaborate more with universities, but also have the opportunity to interact more with universities located at larger geographical distances since they are less bounded by high interaction costs. Therefore, this paper asks the following sub-research question:

- *Sub-research question 1:* Do MNEs collaborate more with universities located at larger geographical distances?

On the other hand, MNEs opt for those regions to conduct their R&D activities where they can tap into the local knowledge and benefit from localized knowledge flows that are mainly generated by universities in these regions (Siedschlag, Smith, Turcu, & Zhang, 2013). Studies on innovation and R&D activities of MNEs (Belderbos, Van Roy, Leten, & Thijs, 2014) show that MNEs take into account the existence of excellent research universities as the primary reason when choosing where to locate their R&D subunits (Broström et al., 2009). Therefore, the geographical proximity to universities is much more critical for the subunits of MNEs in other countries. From this, another sub-research question is formulated:

- *Sub-research question 2:* Do the subsidiaries of MNEs in other countries collaborate more with the local universities where they are established than with the universities in the country where they are headquartered?

Lastly, the internal configuration and characteristics of MNEs, such as the level of absorptive capacity and the knowledge base of the company, also have an influence on the propensity to collaborate with external actors in their knowledge-access strategies. The level of absorptive capacity, which is defined as 'the ability of an organization to recognize the value of new, external information, assimilate it, and apply it to commercial ends' (Cohen & Levinthal, 1990, p. 128), are expected to be higher for MNEs with rich human capital. However, the level of absorptive capacity does not show much divergence within the branches of MNEs that have highly qualified engineers and researchers.

The knowledge base of firms is argued to exert an influence on firms in their geographical look-out for partners (Asheim, 2007). If the firm operates in an industrial branch that is dominated by an analytical (science-based) knowledge base, such as pharmaceuticals and biotechnology, the collaborations are expected to be less confined to localities mainly due to the codified nature of the knowledge being produced, shared, and exchanged. On the other hand, for firms operating in a synthetic (engineering-based) knowledge base, such as automotive and electronics, for which technical know-how and tacit knowledge is the key, the collaborating partners are located in close vicinity of the firms (Davids & Frenken, 2018). Moreover, the oil and gas sector, also, has a predominantly synthetic knowledge base, since learning-by-doing and engineering-based activities require the acknowledgment of environmental and geographical contexts. However, the knowledge base of the subsidiaries of MNEs remain unchanged if they operate in the same industry.

Combining these two aspects regarding internal similarities of MNEs, with regard to absorptive capacity and knowledge base, this paper raises the following sub-research question:

- *Sub-research question 3:* Do the subsidiaries of MNEs collaborate with universities at various geographical scales in similar patterns?

With the help of these sub-questions, the paper attempts to portray the geographical reach of UICs for MNEs, which is an important aspect in learning which universities MNEs collaborate with for their research and knowledge needs. Since MNEs are multisite actors with their

subsidiaries, if an adequate picture of spatiality of the UICs for MNEs can be depicted along with their subunits, something meaningful can be said about the influence of geographical proximity on UICs. It can be specified how and to what extent the effects of geographical proximity are at play in the choice of collaboration partners for MNEs.

## CASE STUDY AND METHODOLOGY

This paper uses co-publications as a proxy for ‘successful’ UICs in line with a growing interest in using co-publications as an indicator of joint knowledge production (Marek, Titze, Fuhrmeister, & Blum, 2017). Co-publications provide a quantifiable output for UICs (Hoekman, Frenken, & van Oort, 2009). Moreover, since they are registered in journal databases, they constitute an important source for the analysis of UICs. Indeed, as Tijssen et al. (2016, p. 681) argue, they ‘are currently the only available information source for large-scale and systematic quantitative analysis’ to measure university–industry linkages.

In order to answer the research questions, the author created a co-publication architecture for a single MNE using bibliometric data, which enabled to depict how different the co-publication patterns are between the various branches of the MNE. The sub-research questions were analyzed in line with the data, with the expectation that they would enable a reflection on the structures of UICs within an MNE.

A firm-centric approach is preferred in this paper because it is actually the firms that require new knowledge, and/or the potential applications of new knowledge, generated in universities or co-created with them in order to remain competitive. As the active knowledge seekers in UICs, it is assumed that firms initiate interaction with universities and benefit from collaboration. Moreover, the involvement of corporate staff in co-publications reflects the exchange of knowledge and joint knowledge production by university and corporate researchers.

### The case: Equinor

Specifically, this paper conducts a case study on the Norwegian company Equinor and the geographical distribution of its co-publication partnerships with universities. Equinor is a state-owned oil and gas company in Norway. Earlier known as ‘Statoil’, the company changed its name to ‘Equinor’ in 16 May 2018; however, this name change did not affect the study at hand. This particular company has been selected due to its capacity to represent the oil and gas industry, which constitutes the backbone of the Norwegian economy. In addition, Equinor is counted among the largest R&D-conducting companies in the Norwegian economy (Wicken, 2007). According to the statistics of the Norwegian Industrial Property Office, Equinor is one of the most innovative companies in the country, as it is the most active native patent applicant in the last 20 years.

Equinor is a good example of an MNE, as it has numerous offices both within Norway and in other countries globally. Its offices and R&D centres are scattered across Europe, the Middle East, China and the United States, which makes it suitable for cross-regional and cross-national comparison. Table 1 presents the various Equinor bases worldwide and the number of permanent employees by countries. As depicted, approximately 87% of Equinor employees work in Norway. The other large offices of Equinor are located in the United States, the UK, Denmark and Brazil, respectively, in terms of size. In this paper, all the addresses attributed to Equinor and its corresponding operation bases (23 addresses/offices in eight countries) that are used in the database (see below) are examined.

### The data source: Web of Science

Thomson Reuters’ Web of Science (WoS) database was used as the main source for data collection on publications. WoS collects and archives scientific publications electronically. The WoS database contains detailed information on publications, such the addresses of the authors, year



**Table 1.** Number of permanent employees per country for Equinor group, 2017.

Country	Employees	Country	Employees
Algeria	27	Libya	3
Angola	15	Mexico	5
Azerbaijan	11	Netherlands	8
Bahamas	54	Nigeria	12
Belgium	64	Norway	17,632
Brazil	323	Russian Federation	53
Canada	131	Singapore	29
China	6	Tanzania	21
Denmark	330	UK	476
Germany	14	United Arab Emirates	3
Indonesia	19	USA	984
Ireland	2	Venezuela	22
Kazakhstan	1	Total	20,245

Source: Statoil ASA (2018, p. 50).

of publication, related scientific disciplines and funding sources of the articles. This database was used because it contains over 10,000 journals in a wide range of disciplines and it is indicated as being one of the most comprehensive sources of information on scientific research activities by several authors (Lata, Scherngell, & Brenner, 2015; Hoekman et al., 2009). The database enables researchers to find the articles of their interest by conducting searches through certain criteria such as topic, title, language of the article, and journal, author name(s), city, job affiliation, type (article, book, book chapter, etc.), and time of publication.

### The methodological steps

For the purposes of this paper, a search query was conducted in the database for 'Articles' published in 'English' for the '2008–2016' with the search terms '(OG = Statoil)'. The 'OG' (i.e., organization-enhanced) search code (field tag) denotes the name of the organization that published the article and includes all the related usages and variants of the search term, in this case 'Statoil'. The search was limited to 2008–16 because the addresses of authors were compiled in the database only beginning from 2008 onward.

The results of the search were eliminated by checking the co-publication status, thereby implying controlling whether the articles are written only by Equinor employees or in collaboration with others, either other private sector actors or universities. At the end of this process, only the articles published in collaboration with academics and those that contain a university name in the address section were forwarded to the next stage of classification.

The database search yielded 956 articles, out of which 739 were found suitable for examination with UICs. Three articles were excluded from the analysis, since they did not indicate any Equinor address, and 214 articles were excluded because they were published without any university collaboration. Therefore, the analysis was conducted on this reduced dataset of 739 articles and involved 996 collaborations of Equinor with 245 universities in 45 countries.

Thereafter, the articles were classified on the basis of the addresses of Equinor bases. It must be noted here that some addresses provided in the address section of the database point to the same unit of Equinor, specifically for the bases in Norway. For example, the Equinor addresses provided for Rotvoll, Ranheim and Trondheim all respond to the Equinor base in Trondheim. The same issue is also observed for the addresses provided as Sandsli and Bergen, corresponding to the Equinor unit in Bergen. Further, Equinor addresses for Fornebu and Oslo also indicate the Equinor Oslo office, while those for Harstad and Medkila denote the Equinor Harstad.

Moreover, some of the addresses that are located in the same province and close to each other are taken into account together. As such, Equinor addresses in Mongstad and Kollsnes are added to Equinor Bergen, and the Equinor address in Stjørdal is combined with Equinor Trondheim in the analysis. This is done for simplification and agglomeration purposes, under the assumption that the offices located in close proximity are part of the same local/regional innovation system and show similar collaboration patterns. The results of the agglomeration/simplification step can be summarized in the following manner:

Equinor addresses in:

- Bergen, Mongstad, Kollsnes and Sandsli are grouped under *Bergen*.
- Harstad and Medkila are grouped under *Harstad*.
- Trondheim, Ranheim, Rotvoll and Stjørdal are grouped under *Trondheim*.
- Fornebu and Oslo are grouped under *Oslo*.
- Stavanger and Porsgrunn are dealt with independently (Figure 1).

As the next step, all the co-authors from the universities were categorized on the basis of the addresses in the relevant section of the database. The accounts that are published by Equinor authors with university affiliations were also recognized as UICs. For those academic partners who have multiple university affiliations, each of the universities that they are affiliated with were considered as engaging in UICs with Equinor.

In order to detect the prevalence of collaborations realized in geographical proximity, the collaborations were divided into four geographical scales: local, national, continental and global. This division is organized in the following manner: The local scale implies the collaborations of Equinor bases with the closest university. The national scale denotes collaborations with universities realized in the same country of the Equinor subunit, except for the closest university. International collaborations are further divided into two scales, continental and global, with respect to the ease of flight trips between distances. Therefore, the continental scale denotes the collaborations within the same continent, while the global scale encompasses collaborations with universities in other continents. In order to exemplify this classification, the collaboration of Equinor Trondheim is classified as local when it has collaborated with the nearest university – that is, the Norwegian University of Science and Technology (NTNU); as national when it has collaborated with the University of Stavanger (UiS); as continental when it has collaborated with a European university; and finally as global when it has collaborated with a university from the United States.

## GEOGRAPHIES OF CO-PUBLICATION PARTNERSHIPS

Initially, the analysis examines the number of co-publication volumes by Equinor bases in order to detect the productivity of Equinor bases in terms of co-publications (Table 2). The results indicate Equinor bases in Trondheim, Stavanger and Bergen as the top three contributors, constituting approximately 77% of Equinor co-publications. When the offices in other parts of Norway (Porsgrunn, Oslo, Harstad, Mongstad, Medkila and Kollsnes) are included, the share of all Equinor bases in Norway rises to 90.7% of all co-authored papers. This indicates that the bases in Norway generate nine out of 10 co-publications of Equinor. Further, two Equinor offices in the United States (Austin and Houston) account for 6% of Equinor co-publications, while the UK offices (London and Aberdeen) produce 1.8% of Equinor's co-publications. The remainder of the co-publications (1.5%) was co-authored by Equinor employees in Canada (Calgary), China (Beijing), Germany, Sweden and Iran.

The location of university partners are then investigated to determine the geographical reach of Equinor co-publications (Table 3). In total, Equinor bases worldwide have collaborated with



**Figure 1.** Equinor addresses in Norway.

Note: The map indicates the Equinor addresses found in the database and used in the analysis and not all Equinor bases in Norway. Source: Author's own elaboration.

**Table 2.** Co-publication volumes by Equinor bases.

	<i>n</i>	%		<i>n</i>	%		<i>n</i>	%
Trondheim	354	35.5%	Oslo	37	3.7%	Calgary	3	0.3%
Stavanger	236	23.7%	Austin	36	3.6%	Germany	3	0.3%
Bergen	184	18.5%	Houston	24	2.4%	Sweden	3	0.3%
Porsgrunn	54	5.4%	London	17	1.7%	Aberdeen	1	0.1%
Harstad	38	3.8%	Beijing	5	0.5%	Iran	1	0.1%

universities in 45 different countries, which shows that Equinor has a global outreach and is embedded in global innovation networks in order to collect external knowledge. However, the results also signal that Norwegian universities have an overwhelming share in the distribution and their total share in all Equinor co-publications accounts for 41.4% of co-publications (412 collaborations). This is followed by the share of universities located in Europe (38.4% with 382 collaborations) and universities in the rest of the world<sup>2</sup> (20.3% with 202 collaborations).

Table 3 reveals that approximately 70% of the publications of Equinor are produced in collaboration with universities in Norway, the UK and the United States, where Equinor has the largest offices with maximum number of employees. This signals that geographical proximity may have some implications for UICs. Table 3 also indicates that geographical proximity is of significance, but only to a point. This becomes evident in the sense that Equinor has also collaborated with universities from countries where it has very little or no presence in the form of subsidiaries. However, it must be noted that most of these collaborations were realized in the form of co-affiliation of the academic authors with these universities. Another possible explanation for lower co-publication volumes (for most of the 1's in Table 3) is that they are the publications that received funding from the respective countries of the universities.

Further, the share of universities is also examined to determine the gravity centres in terms of Equinor's co-publication partnerships (Table 4). The NTNU is by far the most collaborated with university for Equinor. It alone constitutes 21.5% of the collaborations with Equinor bases. The leading partner at the European continental level for Equinor co-publications is the Imperial College London in the UK, while the leading global partner is the University of Texas, Austin in the United States.

Moreover, the locality of partnerships for all Equinor bases are examined by considering the location of the universities in accordance with the geographical scales. The results are presented in Table 5. Several distinctive features are evident. The first aspect relates to the high share of local university linkage in Trondheim. Equinor bases in Trondheim collaborate extensively with the local university, NTNU. The second striking aspect is the relatively low share of the local university, UiS, in co-publications of Equinor headquarters in Stavanger and higher rate of national collaborations and much higher rate for continental scale collaborations. The third aspect is that the Equinor unit in Bergen poses another picture. For Equinor Bergen, the collaborations at the continental scale – that is, with European universities – constitute the majority, and these collaborations have the highest value among all other Equinor bases. Lastly, the Equinor bases in the capital of Norway, Oslo, have no co-publication collaborations with the local universities in Oslo.

Briefly, this data section reveals the following aspects:

- Equinor bases in Norway produce the majority of co-authored papers with universities (Table 2).
- Equinor collaborates mainly with universities in Norway, the UK and the United States (Table 3).
- The co-publication partnerships of Equinor are concentrated in 13 universities, accounting for over 50% of all co-authored papers (Table 4).
- The shares of different geographical scales fluctuate and do not remain constant (or portray a similar pattern of distribution) for different Equinor bases (Table 5).

It can be inferred from these aspects that geographical proximity is of importance for UICs in the form of co-publications for the Equinor case. Although Equinor is a firm with a global reach, it mainly collaborates with universities in Norway, specifically with universities that are located in the close vicinity of Equinor bases that have a strong presence (with regard to employee numbers). Nevertheless, the share of co-publications with universities in geographical proximity is

**Table 3.** Co-publication volumes by countries of the universities<sup>a</sup>.

Norway	412 (41.4)	China*	19 (1.9)	Iran*	5 (0.5)	Czech Republic	2 (0.2)	Israel*	1 (0.1)
UK	160 (16.1)	Spain	19 (1.9)	Turkey*	5 (0.5)	Ireland	2 (0.2)	Lithuania	1 (0.1)
USA*	112 (11.2)	Belgium	12 (1.2)	Ukraine*	5 (0.5)	Argentina *	1 (0.1)	Mexico*	1 (0.1)
Germany	32 (3.2)	Sweden	9 (0.9)	Oman*	4 (0.4)	Costa Rica*	1 (0.1)	New Zealand*	1 (0.1)
Italy	30 (3.0)	Finland	8 (0.8)	Russia*	4 (0.4)	Croatia	1 (0.1)	Romania	1 (0.1)
France	28 (2.8)	Switzerland	8 (0.8)	Brazil*	3 (0.3)	Estonia	1 (0.1)	Slovakia	1 (0.1)
Canada*	27 (2.7)	Australia*	7 (0.7)	Greece	3 (0.3)	India*	1 (0.1)	Taiwan*	1 (0.1)
Netherlands	25 (2.5)	Poland	6 (0.6)	South Africa*	3 (0.3)	Indonesia*	1 (0.1)	Thailand*	1 (0.1)
Denmark	22 (2.2)	Austria	6 (0.6)	Algeria*	2 (0.2)	Iraq*	1 (0.1)	Venezuela*	1 (0.1)

Notes: <sup>a</sup>Values in parentheses are percentages.

Universities marked with an '\*' are considered to be located in the rest of the world.

**Table 4.** Volumes by leading universities (with over 10 co-publications).

University	Co-publications and shares	University	Co-publications and shares
NTNU	214 (21.5%)	Durham	16 (1.6%)
Bergen	81 (8.1%)	Technical University of Denmark	14 (1.4%)
Stavanger	38 (3.8%)	Texas Austin	12 (1.2%)
Oslo	35 (3.5%)	Delft University of Technology	12 (1.2%)
Imperial College London	31 (3.1%)	Leeds	11 (1.1%)
Manchester	17 (1.7%)	Aberdeen	11 (1.1%)
Tromsø	16 (1.6%)	Total	508 (50.9%)

**Table 5.** Geographical distribution of university partners for Equinor bases.

Equinor bases	Co-publications	Location of university partners (%)			
		Local	National	Continental	Global
Trondheim	354	42.1	12.1	27.4	18.4
Stavanger	236	11.4	29.7	42.8	16.1
Bergen	184	15.8	14.1	53.8	16.3
Porsgrunn	54	13.0	48.1	18.5	20.4
Harstad	38	18.4	31.6	39.5	10.9
Oslo	37	0.0	35.1	37.8	27.0
Austin	36	16.7	44.4	8.3	30.6
Houston	24	0.0	16.7	4.2	79.2
London	17	29.4	47.1	17.6	5.9
Beijing	5	40.0	20.0	0.0	40.0
Germany	3	0.0	0.0	33.3	66.7
Calgary	3	33.3	33.3	0.0	33.3
Sweden	3	0.0	66.7	33.3	0.0
Aberdeen	1	100.0	0.0	0.0	0.0
Iran	1	100.0	0.0	0.0	0.0
Total	996	23.6	22.3	34.6	19.5
Norway	903	24.3	21.0	37.2	17.5
Outside Norway	93	17.2	34.4	9.7	38.7

not evenly distributed for Equinor bases both in Norway and other countries. This aspect leads to the argument that geographical proximity is significant, but holds significance at different levels for different units of MNEs. The fluctuating percentages for geographical scales in Table 5 explicitly indicate the changing influence of geographical proximity from unit to unit.

## GEOGRAPHICAL PROXIMITY, A COMMON DENOMINATOR FOR UICs?

The tendency of MNEs to collaborate with universities in other countries, the expectation of more local university collaboration for subsidiary units established in other countries, and the similarity of collaboration patterns among subsidiary units has been examined with the approach

developed in the second section in order to clarify the impact of geographical proximity in UICs of MNEs.

Our findings indicate that MNEs are more inclined to collaborate internationally. The share of international collaborations (continental and global scales combined) constitute the majority of co-publication collaborations of Equinor. For all subunits of Equinor combined, the majority of university partners are located in other countries, either at the continental scale (34.6%) or at the global scale (19.5%). However, when examined in detail, a few differences also come to the surface. For example, the co-publication collaborations with European universities for Equinor bases located in Norway and other European countries – that is, continental collaborations – have an overwhelming share (36.8%); on the other hand, for Equinor bases in the American continent (in the United States and Canada), collaborations on the global scale are dominant (49.2%).

Second, in partial opposition to the general wisdom that the overseas units of MNEs are expected to collaborate more with the local universities where they are located, our findings illustrate another picture. For all Equinor subsidiary units outside of Norway, the share of local collaborations remains at 17.2%. However, the total number of co-publication collaborations for such countries is very low. The analysis also illustrates another aspect regarding national-level collaborations. The bases across Norway are responsible for 409 collaborations out of 412 collaborations with Norwegian universities. This provides strong support for the argument regarding collaboration networks being confined within national boundaries (Lata et al., 2015; Ponds et al., 2007). Moreover, it shows that Equinor bases worldwide are less dependent on the universities in Norway, where the firm is headquartered. This can be interpreted as a sign that the subsidiaries of Equinor are doing well in terms of obtaining access to knowledge flows in the countries in which they are established, instead of turning back to Norwegian universities for knowledge demands.

Lastly, our findings indicate that geographical proximity does not exert a similar influence on all branches of an MNE. Even though all the bases have more or less the same level of absorptive capacity and rely on the same knowledge base, their propensity to collaborate with local–regional universities shows a significant divergence. Table 5 illustrates this finding and reveals that there is a wide range of fluctuations in the shares of co-publication collaborations with local universities among Equinor bases. The share of local collaborations peaks for Equinor bases in Trondheim with NTNU collaborations. In Stavanger, an opposite trend is brought to light with the lowest share of local collaborations, except for Equinor bases that have no local collaborations at all, such as Oslo.

All these aspects illustrate the differentiated effect of geographical proximity on the collaboration patterns of MNEs. Although geographical proximity plays a role in facilitating the process of knowledge transfer between firms and universities, it does not have the same influence in every case. It is difficult to discuss geographical proximity as a common denominator for UICs of MNEs. MNEs enjoy the advantages of geographical proximity while they also shoulder the burdens of distant relationships if, and when, they need to access specific new knowledge. If the required new knowledge is to be found in universities in other regions or countries, MNEs attempt to establish collaborative linkages with them in order to sustain their innovativeness and competitiveness.

## CONCLUSIONS

The arguments in favour of the significance of geographical proximity for easing the process of collaborations between universities and industry are well established. However, does geographical proximity equally influence the collaboration networks of MNEs with universities? This study suggests that geographical proximity exerts an influence, but a differentiated one, on the

collaboration patterns of MNEs. There is no 'one-size-fits-all' type influence of geographical proximity on UIC patterns of multisite actors. It is shown that among the geographically dispersed branches of a single MNE, geographical proximity has different effects. While a few subsidiary units collaborate more intensively with local universities, some of them are more commonly engaged in collaborations with international partners.

We find that the effect of geographical proximity appear to be lower for MNEs that, in principle, have richer resource bases for establishing and maintaining long-distance collaborations. This is illustrated by our case of Equinor, for which the share of international collaborations constitutes the majority of all co-publication partnerships.

In addition, we also find that the subunits of the examined MNE in other countries are not more likely to collaborate with local universities in the countries where they are established. This aspect challenges the arguments that MNEs locate their R&D activities in other countries in order to obtain access to local knowledge sources retained mostly in local/regional universities. Nevertheless, our findings also suggest that despite the low levels of collaboration with local/regional universities, the presence of MNEs subunits in a country increases the likelihood of national-scale collaborations. The share of national collaborations for subsidiaries in other countries are much higher than the national collaborations realized in the country where the case firm has its headquarters. In other words, the mere existence of MNE subsidiaries in a particular region of a country provides a gateway to reach other universities at the national layer in that country. While the main rationale for MNEs in establishing subsidiary units in other countries is to tap into local knowledge networks, the existence of these units has a spillover effect and also paves the way toward reaching national networks. Therefore, establishing subsidiaries in other countries appears to be a viable strategic choice for MNEs that are willing to broaden their knowledge acquisition efforts globally.

The findings of the paper also strengthen the most significant aspect of proximity literature – 'geographical proximity between organizations is neither a sufficient nor a necessary condition for learning and interactive innovation to take place' (Boschma, 2005, p. 62). Geographical proximity is a potential determinant of UICs, but its influence changes and does not remain constant for the collaborations of a single multisite firm. However, our data, its analysis, and findings do not reveal anything about why this is the case. The questions of why the geographical pattern of UICs differs among various bases of an MNE and why these subunits prefer to collaborate with universities located at longer distances require a broader research that takes into account several other factors, and from the perspective of proximity, the inclusion of non-geographical proximity dimensions. Therefore, in explaining the determinants of UICs, other dimensions of proximity must be included in examining the partner choice of MNEs.

Researches trying to combine proximity approach and UICs in the context of MNEs should take into account that both universities and MNEs are multisite actors and have presence in various locations as campuses or subsidiaries. UIC studies about MNEs taking the academic and industrial partners as unitary actors would result in flawed conclusions stemming from attributing, or aggregating, connections of different units to one central body, which may provide an unbalanced, and therefore inaccurate, representation of the existing partnership patterns. For more elaborate and accurate studies on the influence of geographical proximity in defining the scope of UICs for MNEs, the issue of which unit's proximity to which university must be approached with caution.

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## NOTES

1. These categories are indicated as: (1) Capacity and resources; (2) Legal issues, institutional policies and contractual mechanisms; (3) Management and organizational issues; (4) Issues relating to the technology; (5) Political issues; (6) Social issues; and (7) Other issues (Ankrah & Al-Tabbaa, 2015, p. 395).
2. Universities marked with \* are considered in this category.

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