

HEC MONTRÉAL

**The Contribution of Foreign Subsidiaries to the Innovative
Performance of Industrial Clusters**

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Mémoire présenté en vue de l'obtention du grade
de maîtrise ès sciences
(M. Sc.)

Avril 2017

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Résumé

Cette recherche a pour but d'explorer le rôle des filiales étrangères dans la performance en innovation des grappes industrielles en Amérique du Nord. La recherche est basée sur les théories en économie de la connaissance, des agglomérations régionales et en affaires internationales. Plus concrètement, la base de l'argumentation réside dans le fait que la connaissance tacite, dans une économie à la fois mondialisée et concentrée dans des régions spécialisées, sert de moteur au développement économique des firmes et des régions géographiques. La première partie de ce mémoire consiste donc à explorer comment certaines régions se spécialisent et en quoi elles se distinguent dans leur dynamisme de créativité et d'innovation.

L'intégration et la spécialisation grandissante des régions les ont toutefois menées vers certains défis. Par des phénomènes d'isomorphisme et d'enfermements technologiques, certaines régions géographiques (observées ici par des dimensions économiques) ont tendances à se refermer sur elle-même dans leur acquisition de connaissance, ce qui nuit à leurs capacités à développer des solutions nouvelles. Il est donc de plus en plus discuté que les régions, et les firmes qui en font partie, doivent s'approvisionner constamment en connaissances provenant de l'externe afin d'être exposées de façon continue à des formes de idées nouvelles, qui vont de surcroît les mener à développer eux-mêmes des idées originales.

Dans cette optique, le rôle de la filiale étrangère devient intéressant. Via l'attraction de firmes multinationales dans une grappe industrielle, cette dernière importe du coup une entité qui possède potentiellement un large éventail de connaissances puisées dans des régions variées à travers le monde. En effet, la multinational qui ouvre une filiale dans une nouvelle région possède à priori un réseau déjà existant de ces filiales qui, à travers leurs activités, contribuent à la construction d'une base de connaissances élargie pour la multinationale.

Alors, lorsque ces firmes mondialisées entrent en contact avec l'environnement local et tous les acteurs qu'il comporte, elles échangent une partie de leur connaissance et savoir-faire avec ces acteurs. Cela est spécialement prometteur dans un contexte dynamique comme celui dans les grappes industrielles, où les interactions sont fréquentes et où il y a

un grand potentiel d'échanges de savoir continues. Donc le fait d'une part d'attirer ces firmes étrangères et ensuite de tisser des liens étroits avec celle-ci peut donner un accès permanent à des bases de connaissances externes pour les firmes locales.

Le processus de transferts de connaissances ne se fait évidemment pas automatiquement. Plusieurs facteurs sous-jacents peuvent influencer leur réalisation. Parmi les différents facteurs identifiés par la littérature, la distance culturelle peut particulièrement affectée la relation d'échange et ce, sous plusieurs angles. D'un côté, les firmes locales et les filiales étrangères doivent être en mesure de partager une certaine proximité culturelle afin d'établir des liens de communication efficaces. En revanche, une trop grande proximité nuit à la diversité de connaissances qui sera impliquée dans l'échange et donc, les firmes doivent aussi avoir une certaine distance culturelle entre elles pour que la relation soit bénéfique. Il est donc envisagé que la distance culturelle va modérée la relation positive entre la présence de filiales étrangères et la performance en innovation.

C'est donc cette dynamique potentielle qui sera plus longuement discutée dans cette recherche. Le propos sera appuyé par une analyse quantitative impliquant près de 9000 filiales distribuées dans les différents états américains. L'analyse porte sur l'effet d'une plus grande proportion de filiale dans une grappe sur ses performances en innovation, telles que mesurées par les brevets. Une variable sur la distance culturelle permet aussi d'explorer si le fait que la maison-mère évolue dans un contexte institutionnel distant peut nuire au transfert de connaissances efficient entre les firmes étrangères et la grappe.

En somme, les résultats démontrent que les grappes industrielles dans lesquelles il y a une plus grande proportion de firmes étrangères tendent à avoir de meilleures performances en innovation. La distance culturelle montre quant à elle qu'à la fois l'homogénéité et l'hétérogénéité soutiennent ce dynamisme innovant, tandis qu'une distance modérée nuit.

Mots clefs : Grappes industrielles, Investissements directs étrangers, innovation, transferts de connaissances, compétitivité, Économie de la connaissance, brevets, empirique

Abstract

In the literature on economic geography, it is now well established that along with benefiting from local synergies, firms within clusters also rely on external linkages to acquire diversified forms of knowledge and enhance their performance. This research follows this assertion by arguing that the physical and permanent presence of MNEs brings better innovative capabilities to the cluster given that local firms get access to new forms of knowledge through the corporate network.

This paper uses a dataset composed of data on local clusters from the *US Cluster Mapping Project*, data at the firm level from *Orbis* and data on the cultural distance from GLOBE. Three main hypotheses are explored: (i) The highly innovative environment of industrial clusters attract FDI through the establishment of foreign subsidiaries than other locations; (ii) Given the importance of diversified knowledge for innovation, clusters that have a higher proportion of foreign subsidiaries will show a higher innovative performance. (iii) However, it is expected that this relationship will be moderated by the relative cultural distance between the host country and the country of origin of the subsidiaries. Therefore, it is postulated that this last relationship will take the form of an inverted u-shape, i.e. both too much proximity and too much distance will attenuate the positive effects of a higher proportion of foreign subsidiaries for innovation.

First, the results show that industrial clusters do in average encompass more foreign subsidiaries than other locations. Second, clusters with a higher proportion of foreign-owned subsidiaries are more likely to show a stronger innovative performance. Concerning the cultural distance, the results suggest that both homogeneity and heterogeneity are beneficial for innovation, whereas a moderate cultural distance is detrimental. This result contradicts the theoretical intuitions behind the concept of optimal cultural distance which stipulates that firms both need to share norms and language while having enough distance to bring new forms of knowledge in the partnership.

Keywords: industrial clusters, foreign direct investments, innovation, knowledge transfers, competitiveness, knowledge economy, patents, empirical

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Introduction

This research explores the contribution of foreign subsidiaries to the innovative performance of industrial clusters. The research design lies mostly on the literatures in economic geography and international business to understand how the presence of subsidiaries can lead to knowledge transfers between local and foreign firms and how these can contribute to enhance innovation in the cluster. This research therefore seeks to empirically assess of this relationship along with measuring the impact of the cultural distance between firms. It contributes to the conceptual understanding of the relationship between MNEs and locations along with providing empirical evidence of their interplay.

On the one side, the discussion will focus on the agglomeration of firms and how specific locations develop specialization over time. While globalization has brought many activities of the modern economy to be internationalized, some other economic activities have rather followed an opposite path through the agglomeration of some sectors of activities around specific regions (Porter, 1990). The literature in economic geography has broadly highlighted the dynamic and highly innovative environment of those specialized regions (Maskell and Malmberg, 1999; Porter, 2003; Morgan, 2004; Delgado et al. 2015). Many authors assessed of their distinctive features, from their favourable environment for entrepreneurship, the extensive knowledge sharing, the frequent contacts and their higher innovative output (Delgado et al. 2010; Bathelt et al. 2004; Fosfuri and Ronde, 2004; Ibrahim et al. 2009; Maskell and Malmberg, 1999; Morrison and Rabellotti, 2009).

These localized factors have brought those locations to become attraction poles for companies that wish to build or maintain their competitive advantages based on advanced knowledge, relatively to their sector of activity. This knowledge, especially in its tacit nature, is found to be geographically bounded, stressing the importance of being physically present in these locations (Maskell and Malmberg, 1999; Storper and Venables; Trippel et al. 2009). Firms consequently benefit from those regions *inter alia* by monitoring the activities of competitors and collaborators (Garcia et al. 2013), by acquiring knowledge or contributing to its creation process (Bathelt, 2005).

Accordingly, the literature in international business has extensively explored the motivations of multinational enterprises (MNE) to seek for a particular location (Porter, 1990; Cantwell, 2009; Mudambi et al. 2014). Dunning (1998) highlighted that advances in technology and globalization have brought MNEs to move their location motivations from production-related factors to strategic assets seeking. The access to intangible forms of productive factors has become key for MNEs to compete internationally. In that matter, MNEs increasingly need to be able to diversify their knowledge sources if they want to bring novelty to the market. Their ability to access, integrate and market diversified knowledge has become a strong source of competitive advantage (Mudambi et al. 2014). In that optic, MNEs are rather dependent on the regional environments in which they operate, consisting of the set of resources, capabilities, technologies and knowledge (Dunning, 1998). Thus, MNEs increasingly take into consideration multiple factors prior to the extension of their network of activities. In that context, industrial clusters have become key locations for those MNEs wishing to get access and participate to the creation of advanced knowledge and innovation.

It will be argued in this research that this reliance on locations to develop competitive advantages is reciprocal, i.e. locations too rely on MNEs to acquire and develop advanced knowledge. The literature in economic geography largely exposed that locations, and in that case clusters more specifically, need to acquire distant forms of knowledge to stay dynamic. In fact, as firms strengthen their local linkages and tap repetitively into the same knowledge pool, they face the risk of limiting their innovative capabilities (Bathelt, 2005; Nooteboom et al. 2007; Maskell and Malmberg, 2007). Over time, local networks create rigid institutions, norms, routines and over time face the risk to rely too much on the local sources of knowledge to pursue their innovative activities (Sotarauta, 2011; Boshma, 2004). The lack of novel knowledge circulating in the cluster leads to complacency and convergence in organizational practices, a phenomenon called isomorphism (DiMaggio and Powell, 1983), which can hamper the ability of local firms to generate creative problem-solving solutions, leading to a decline in their innovative performance. To circumvent these potential declines, it has been argued that local firms and clusters should develop external linkages (Bathelt et al. 2004; Owen-Smith and Powell, 2004) that allow economic actors to acquire diverse sources of knowledge and broaden their knowledge

base, which is a prerequisite to further develop innovative capabilities (Cohen and Levinthal, 1990).

There exists a broad literature on the nature, the impacts or the types of actors involved in those linkages (Tracey and Clark, 2003; Boschma, 2004; Owen-Smith and Powell, 2004; Sotarauta, 2011; Grillitsch et al. 2015). One type of linkage recently discussed by Bathelt and Li (2014) is the presence of foreign subsidiary as a permanent connection to external pools of knowledge.

This conceptualization of foreign subsidiaries has, however, not yet been deeply explored in the literature. Studies on FDI have rather mostly focused on one-way spillovers either from the foreign firm to the local economy (Aitken and Harrison, 1999; Birkinshaw and Hood, 2000; Thomson, 2002; Fosfuri and Ronde, 2004; Kosova, 2010, Higon and Vasilakos) or on how local economies impact the performance of MNEs (Dunning, 1998; Cantwell, 2009; Meyer et al. 2011; Dellestrand and Kappen, 2012; Poon et al. 2013; Mudambi et al. 2014), and seldom on the mutual benefits the situation can generate. Moreover, a large proportion of studies tend to address these relationships in terms of productivity spillovers as captured by economic indicators (Garcia et al. 2013; Aitken and Harrison, 1999; Kosova, 2010) or on sporadic knowledge spillovers (Thomson, 2002; Branstetter, 2006; Higon and Vasilakos, 2011), while the lasting impacts of the interactions between foreign and local firms on the innovation performance of the whole cluster is still to be explored (Wang and Wu, 2016).

This research will focus both in conceptual and empirical terms on this role of the subsidiary as a permanent bridge between the corporation and the cluster knowledge pools. The question that will be explored in detail is whether clusters are more attractive for MNEs than other locations and whether clusters can benefit from the presence of foreign subsidiaries for innovation, leading to a mutually beneficial relationship between clusters and MNEs.

Albeit this interrelation can prove to be highly beneficial, being physically present in a cluster does not guarantee that the subsidiary will be able to create strong linkages with local actors. The concept of cultural distance will therefore be explored. While geographical proximity is often identified as an important enabling factor for knowledge

exchange, some authors rather argued that other types of proximity are needed. One of those types identified by Boschma (2004) is the institutional proximity, which includes as an important dimension the cultural proximity (Boshma, 2005). Cultural proximity is believed to particularly affect knowledge transfers and collaboration between foreign and local firms for two broad reasons. Too much distance can be detrimental because of the communicational and relational barriers, while too much proximity between two partners could bring only limited benefits because of the lack of knowledge novelty that is transferred in the exchange (Boschma, 2005).

Therefore, the contribution of this research is manifold. First, it will build on Bathelt and Li (2014) to deepen the conceptualization of foreign subsidiaries by an integrated approach that explore the mutual relationship between MNEs and industrial clusters. This research will partly deviate from their approach which consists of conceptualizing the subsidiary as a link between related clusters to rather explore the role of the foreign subsidiary as a permanent connection for clusters to the corporation knowledge base. It will be further argued that both regions and companies actually rely on each other to gather new and diversified knowledge, highlighting the important role of the subsidiary as a bridge between the two and hence moving away from the general approach that tends to observe both phenomena separately.

Second, the role of cultural distance as a moderating factor for beneficial knowledge exchange between foreign subsidiaries and the cluster as a whole will be addressed. Although it is often conceptually acknowledged as a potential barrier or enabler to effective communication and knowledge transfers between organizations from two different contexts, few studies actually conceptually and empirically integrated a cultural perspective in studies on FDI, clusters, and innovation.

Finally, few large-scale empirical studies have focused on the relationship between MNEs, clusters, and cultural distance. In that sense, this research contributes to better understand and assess whether FDI and clusters impact each other in terms of innovation and whether culture is an important determinant in the process.

To pursue these objectives, data from three different sources was combined. Data on over 7800 foreign subsidiaries were gathered from *Orbis* (Bureau Van Dijk) and further

aggregated in 9 types of innovative clusters distributed across counties in the US. These data were merged with data on industrial clusters coming from the US Cluster Mapping Project, which provided data on the performance of the cluster (utility patents) and served as the basis to regroup data at the cluster level. The grouping of these two datasets allowed to create a measure of the proportion of foreign subsidiaries over the total number of firms in the cluster, consisting of our independent variable. Data on cultural distance was collected from the *Global Leadership & Organization Behaviour Effectiveness* (GLOBE) dataset on cultural indicators and consist of a multidimensional aggregate measure. Cultural distance was measured by the difference between the score of the country of origin of the parent company and the US.

Using multinomial regression that categorizes clusters according to their level of innovative activity, this research shows that clusters with higher proportions of foreign subsidiaries have a stronger innovative performance. Cultural distance also shows a significant impact, suggesting that moderate distance is detrimental to knowledge transfers within the cluster, whereas great cultural proximity and large cultural distance are beneficial, which contradicted the initial insights.

2. Theoretical background

The literature review will focus on four main themes that are closely interlinked and necessary to understand to interplay between clusters and foreign subsidiaries. The table in **Appendix 1** categorize reviewed articles in accordance with their relevant theme and their contribution is shortly summarized. The conceptual background lies on a mix of seminal and more recent papers. Since only a few works have focused on this particular topic however, the review focuses on important concepts related to the research question and less to recent empirical works, since it is yet a research problematic that needs to be further explored.

The first theme that will be discussed in the theoretical background section is knowledge. In this section will be explored the definition of knowledge and the distinction between explicit and tacit knowledge, based mainly on the works of Nonaka, Polanyi and Kogut. It will be argued that tacit knowledge constitutes in the modern economy the base upon which firms, and region, develop their competitive advantage. It is from the conception of the importance of knowledge in the economy that the ideas concerning knowledge spillovers between foreign and local firms will be based. The hypotheses will be based on the assumption that firms seek to accumulate and gather knowledge in order to increase their innovative performance, and that knowledge is similarly accumulated and developed within geographical locations.

The second broad theme that will be addressed is the geography of innovation and the different perspectives and concepts developed to understand the concentration of economic activities. The first sub-section presents the different approaches in economic geography to explain agglomerations before explaining the choice of focusing on industrial clusters particularly. The subsequent subsections seek to explore further the concept of industrial clusters and its different dimensions, including the positive externalities emerging from clustering and the different types of linkages that are established between the actors.

The following subsection focuses on specific characteristics of those clusters in order to understand how the innovative environment is created, evolve and seek for external sources of knowledge to stay dynamic. Thus, the third section of this literature review focuses on the role of physical proximity, face-to-face contacts and trust. Those elements in

combination lead to the creation of a local buzz which facilitates knowledge transfers and cooperation.

Then, the subsequent paragraphs will focus on regional lock-in and external pipelines. It will be argued that regions face the risk to suffer from a potential decline in their innovative activities over time due to over-specialization and institutional isomorphism. The discussion on lock-in and external pipelines as channels to acquire diversified knowledge will lead to the development of the idea that the presence of foreign subsidiaries in clusters allow to permanently have access to external knowledge and potentially avoid or overcome lock-in situations.

This discussion leads to the section on the relationship between MNEs and clusters per se. The review of the literature on this theme highlights that the presence of foreign subsidiaries can be beneficial both for the MNEs that seek to augment their knowledge base and for the cluster that diversify its knowledge base and improve its innovative ecosystem. A special attention will be given to the specific role of the subsidiary given it is the unit of analysis of this study.

The last of the four sections explore the different types of proximity (including geographical), which plays the role of moderator between foreign subsidiaries and clusters in the model. The discussion will mostly focus on the role of cultural proximity. It will be argued that firms need a certain level of proximity to be able to share knowledge but enough distance for the knowledge to be new for the firms. This section will lead to hypothesis 3 and conclude the literature review.

2.1 Knowledge

First of all, to understand the phenomena of knowledge flows in a context of regional agglomerations and industrial clusters, it is important to understand how knowledge is understood in the literature and, furthermore, its importance in the modern economy. Thus, this first section will address the conceptualization of knowledge before addressing the nature and the functions of knowledge in the modern economy with regards to its impacts on innovation in firms and regional economic development. This discussion will provide underlying understandings for the subsequent discussions on knowledge transfers and

acquisition in a cluster context. It will be mainly argued that although knowledge is technically embedded in individuals, it can also be accumulated within groups of people, organizations, regions and industrial clusters, becoming a source of competitive advantage.

2.1.1 What is knowledge?

To begin, it is important to define what is fundamentally understood by knowledge. In that matter, the works of Michael Polanyi and Ikujiro Nonaka provide interesting avenues for reflection, whereas the literature in economic geography has long developed how distinguishing between different natures of knowledge help explaining the behaviour and agglomeration of firms.

The discussion will start by addressing knowledge in its subjective form. Although all the authors that will be presented agree that there exists distinctive forms of knowledge (codified and tacit), its tacit nature represents the foundation of any knowledge, stressing the idea that its subjectivity has to be understood before addressing any categorization.

Hence, Nonaka et al. (1996) define knowledge as “*a meaningful set of information that constitutes a justified true belief and/or an embodied technical skill...*” (p. 205) and further argue that “*knowledge creation [is] a dynamic human process of justifying a personal belief toward the truth and/or embodying a technical skill through practice*” (p. 205). This definition addresses many aspects of the concept of knowledge.

First, the information that is possessed by the individual must encompass a meaning and constitute a belief, emphasizing the intangible dimension of knowledge. Polanyi (1966) had discussed this idea by arguing that the acquisition of knowledge meant grasping a part of reality by revealing its truth for the mind, whether that process of transforming an existing but non-perceptible object into reality was conscious or not (this idea of consciousness will be further developed as the distinction between explicit and tacit knowledge will be discussed). Making sense of an object implies according to Polanyi an aggregation of elements captured by the mind that together form an entity. This entity becomes an object that does not just exist by itself, but that rather refers to a meaning and purpose. Polanyi uses the example of words to explain the transition between objects and entities of meanings and purpose. Taken in its raw form, the word is just one or a sequence

of sounds exteriorized by a living being. The process of making sense to those sounds signifies the translation of those sounds into meanings that can influence our thoughts and actions constitute the notion of knowledge. In other words, knowledge is the process of forging a sense of something. However, some nuances will be brought below as both Polanyi and Nonaka discuss the idea that this process can be more or less (tacit) conscious.

Furthermore, Nonaka's definition implies that if knowledge is a justified belief, it means that knowledge can be influenced by the perceptions, experience and the interactions between individuals, both those who develop and integrate the knowledge and those who will be involved in the justification of the belief of the knowledge holder. There is thus a process of confronting the beliefs with others' beliefs to integrate knowledge as truth or not. The construction of knowledge consequently involves many participants and can be defined as a collective process. This refers to the second part of Nonaka's definition, affirming that knowledge creation is a dynamic human process in which different individuals with different beliefs will come together and exchange parts of knowledge to form new knowledge.

The intangibility of the knowledge, constructed through perceptions and related meanings, can bring individuals to have a different understanding of a same object or concrete piece of information. This adds a considerable obstacle in the communication of knowledge, so people sharing knowledge need to be able to support communication with other mediums allowed by physical co-presence.

Finally, Nonaka makes the distinction between justified beliefs and technical skills or embodied knowledge, suggesting two distinct forms of knowledge that will show distinctive features related to the ease to communicate and exchange them.

A dual categorization was prior developed by Polanyi, who argued that we must distinguish between two different forms of knowledge, the tacit and the explicit forms. Expressed in a tautological way, tacit knowledge is "indeterminate, in the sense that its content cannot be explicitly stated" (Polanyi, 1966: 4). Their distinctive features will be explored more deeply in the next few lines.

2.1.2 Tacit vs explicit knowledge

The categorization can be made through a spectrum on the level of consciousness. The discussion above implied that knowledge is rather intangible and is built through subjective processes. However, there is knowledge that is or become more conscious for individuals and can be more readily explainable and transferable.

The latter form refers to its explicit form. It has a stable meaning and can be communicated with concrete symbols that carry specific meanings for those in contact with the knowledge (Storper and Venables, 2004). Those concrete symbols can take the forms of words (written or orally spoken), mathematical formulas or any type of codes, as long as it can be interpreted in a clear and precise way (Maskell and Malmberg, 1999). Thus, given its nature, this type of knowledge is more easily transferable, especially in a modern context in which communication costs have become significantly lower (Grant, 1996; Bathelt et al. 2004). Explicit (or codified) knowledge therefore implies a lower level of subjectivity of interpretation so it can generally meet shared meanings between individuals, enabling its transfer. This form thereby involves a higher level of consciousness, as the knowledge holder knows its nature and specificities and can easily translate it into transferable information.

However, not all knowledge can be functionally codified (Maskell and Malmberg, 1999; Bathelt, 2005). Polanyi (1966) discusses the idea that some knowledge an individual possesses is rather unconscious and learnt through experience and observation, so it can't be clearly expressed through other mediums than through actions related to the knowledge. Put in other words, Polanyi (1966) exemplifies the nature of tacit knowledge as following: "We can see this best in the way we possess a skill. If I know how to ride a bicycle or how to swim, this does not mean that I can tell how I manage to keep my balance on a bicycle, or keep afloat when swimming. I may not have the slightest idea of how I do this, or even an entirely wrong or grossly imperfect idea of it, and yet go on cycling or swimming merrily" (p. 4).

This kind of knowledge is thus embedded in one's skills and actions, or simple routine activities. Although these tasks might be simple to execute, the nature of knowledge one

individual possesses to carry them out is highly tacit in nature and hard to precisely describe via standard communication channels. This relates to the notion of unconsciousness of the knowledge: the individual possesses the knowledge but cannot explain it clearly. The level of tacitness (or unconsciousness) thus correlates the difficulty to communicate its existence and the bigger difficulty to understand the composition of this knowledge without any direct connection to the knowledge holder. In psychological terms, it is the human's limited cognitive capacities that forge communicational barriers to effectively verbalize abstract objects and further interfere when agents try to effectively share knowledge embodied in psychological heuristics (Gertler, 2003).

In spite of the insights the dual categorization of knowledge between tacit and explicit provide, Polanyi (1966) and Nonaka and von Krogh (2009) however argue that knowledge should not be seen in a hermetic categorization, but rather through a continuum. On the first hand, Nonaka and von Krogh (2009) argue that there is a gradual distinction between more explicit and more tacit knowledge and all types of knowledge incorporate a relative mix of consciousness and unconsciousness. Polanyi (1966), on the other hand, claim that all explicit knowledge must rely on tacit knowledge for understanding and application. Indeed, the categorization will facilitate the conceptual development in this research, but these reflections stress the capital role of tacit knowledge as the basis of all knowledge development and as a great potential source of uniqueness for individuals and organizations.

2.2 Knowledge-based theory of the firm

Knowledge has been discussed so far in general terms and mostly applicable to individuals. Many authors, however, assert that it can be accumulated at the organizational level (Grant, 1996, Nonaka and von Krogh, 2009). Indeed, knowledge is fundamentally found in individuals (Nonaka, 1991). Nonetheless, from a knowledge-based viewpoint, the constitution of the organization consists of coordinating and bringing in common such knowledge that is developed by its members, leading knowledge to circulate within the firm and to become embedded in the organization instead of solely in individuals' activities (Grant, 1996; Nonaka and von Krogh, 2009).

Nonaka (1991) argues that individuals within the organization exchange ideas, information and technical skills through observation and imitation, which leads to the circulation of personal knowledge throughout the group. However, given the subjectivity of the interpretation of knowledge, internal knowledge creation and transfers is not a simple process and involve a large set of relational, cognitive and cultural aspects. Grant (1996) states in that line that members of an organization must possess some common knowledge in order to effectively share the knowledge they create. The author therefore identifies the language, symbolic communication, the commonality of specialized knowledge, a shared meaning and a recognition of individual knowledge domains as factors that will affect positively or negatively the ability for the organization to set up a collaborative environment or not. Nevertheless, knowledge that is accumulated by individuals and further by the set of individuals that constitute the organization can become an important source of value.

According to Grant (1996) and the knowledge-based view of the firm, coordinating the production and diffusion of knowledge within the firm is a fundamental reason of its existence. This deviates from the theories of Coase and Williamson on the existence of the firm, with some insights used, however, to distinguish the efficiency of the firm *versus* the market in the organization of certain activities. Grant affirms that given the nature of tacit knowledge and the difficulty to communicate it, markets are inefficient to coordinate its circulation. Thus, one of the major advantages of the firm over the market is its ability to ensure the conditions under which individuals can exploit their specialized knowledge and further collaborate for the integration of pieces of knowledge produced separately within the firm. Then, the role of the firm is to find profitable applications for the integrated knowledge accumulated in the organization. This process of knowledge creation within the firm and the capacity of the firm to convert it into concrete applications represents the *raison d'être* and the source of the competitive advantage of the firm.

2.2.1 Tacit knowledge in the organization

As the knowledge-based view of the firm argues that knowledge represents that basis for the construction of competitive advantages, its tacit forms in particular can prove to be a more sustainable asset to keep a competitive edge. Unlike codified knowledge, which is

readily and increasingly available, tacit knowledge is hardly acquired and transferable, therefore harder to copy for competing firms (Amin and Cohendet, 1999). Thus, it represents a vital dimension of competitiveness with consequences on the behaviour of MNEs and the distribution of economic activities across the globe.

At the organizational level, tacit knowledge is found in the firm's routines and processes (Maskell and Malmberg, 1999). Winter (1986) defines organizational routines as "a relatively complex pattern of behaviour[...] triggered by a relatively small number of initiating signals or choices and functioning as recognizable units in a relatively automatic fashion" (cited in Grant, 1996:115). Routines therefore refer to practices, habits and behaviours that are deeply integrated in the organization's internal functioning.

In the same vein, Boschma (2004) discusses the idea that tacit knowledge represented the fixed capital of the firm, embedded in the human capital of the organization. In that respect, tacit knowledge can represent good practices, specializations in certain contexts, specific problem-solving mechanisms, all affected both by the immediate environment and the regional culture and practices. Such skills and competences can therefore be hardly described by formalized forms of communication and can, moreover, be irrelevant for different contexts (Nooteboom, 1999).

2.2.2 The creation of tacit knowledge in the organization

While it has been discussed above what tacit knowledge represented for organizations, the next paragraphs will focus on its creation process by exploring Nonaka's theory. Based on the principle of a continuum of interpretation of codified and tacit knowledge mentioned above, Nonaka (1991) identifies four mechanisms of knowledge creation in organizations that include the processing of different forms of knowledge:

1. From tacit to tacit (socialization): This process of knowledge creation implies that individuals share tacit knowledge with each other. Given the nature of tacit knowledge, this mechanism necessitates collaboration, observation, imitation and practice, which means that the learning of such knowledge is done through interactions with the knowledge holder. This mechanism will further highlight the

importance of co-location for firms that wish to acquire such knowledge from a specialized environment.

2. From explicit to explicit (articulation): This mechanism refers to the (re)combination of codified knowledge by individuals, which according to Nonaka does not truly extend the knowledge base of the firm.
3. From tacit to explicit (combination). Nonaka argues that the third and fourth categories represent powerful patterns of knowledge creation. Tacit to explicit knowledge means that the knowledge holders have been able to translate their knowledge into transferable forms so it can be shared more easily with the rest of the organization. This allows every other individual to integrate knowledge that was produced by other units within the firm.
4. From explicit to tacit (internalization): Following the third mechanism, explicit knowledge that is shared within the organization is further internalized by the different members. This allows all the members to accumulate knowledge alongside the process, and therefore to build on this to extend their own tacit knowledge from the application and mastering of explicit knowledge.

These processes highlight the importance of developing holistically various forms of knowledge within the organization. The ability for the firm to constantly develop new knowledge and then to convert it into technologies and products can represent an important source of competitive edge (Nonaka, 1991) and will explain the motivations of MNEs to try to get access to specialized sources of knowledge.

In the same vein, Cohen and Levinthal (1990) argued that the development of the knowledge base of the firms represented a crucial activity to build up innovative capabilities. In fact, the authors found that firms that invest more in fundamental forms of research were more prone to pursue effective innovative activities than firms rather focusing on applied sciences. Thus, as many authors concurrently affirmed, firms must dedicate important resources to the development of their knowledge base to create and

maintain competitive advantages in technology-led sectors (Amin and Cohendet, 1999, Maskell and Malmberg, 1999; Maskell, 2001; Bathelt, 2004).

In sum, this conception of knowledge is important in many aspects for theories of agglomeration and clustering in economic geography. The intangible and embodied nature of knowledge mean two major things for organizations. The uniqueness of knowledge that is developed by individuals within the organization leads to a *savoir-faire* that is hardly replicable for other actors, leading to the creation of a competitive advantage. This uniqueness and personal understanding of this knowledge creates, on the other hand, problems in its efficient communication and transfer between individuals and organizations. A large body of the literature has therefore argued that physical proximity was necessary for individuals and firms seeking to acquire tacit knowledge and integrate it and their own activities, providing a strong explanation of the agglomeration of firms.

2.2.3 Tacit knowledge and agglomerations

Following the knowledge-based theory of the firm, some authors stressed that embedded knowledge was also of great importance for the economic development of regions and clusters. Maskell (2001) argues in this direction by highlighting the importance of the region and geographical co-location for the development of tacit knowledge. Likewise Grant explained the existence of the firm by its enhanced ability to coordinate knowledge circulation; Maskell further claims that clusters could owe their existence and sustainability to the presence of enhanced knowledge-creation capabilities found within specific geographical boundaries. In fact, interactions with other firms expand innovation capabilities more than by developing them individually.

As discussed above, different members of an organization will develop diversified but still compatible knowledge, due *inter alia* to the coordination efforts of the firm and the common knowledge that is internally developed over time. Consequently, knowledge that is created at the level of the organization follows some isomorphic paths. The diversity of knowledge developed within the single firm is thus limited and can become path-dependent. Consequently, the ability of the single firm to develop independently new forms of knowledge does not correlate with the variety of knowledge that is developed by an

amalgam of economic actors interacting in a cluster, in which various competitors and collaborators develop and share knowledge (Antonelli, 2000).

Maskell thus proposes that firms alone cannot be as innovative as firms in interactions in a cluster. Firms that are able to gather different pieces of knowledge in their surrounding environment and combine and recombine them can benefit from greater innovative capabilities (Cohen and Levinthal, 1990). Considering once more the tacit nature knowledge that is gathered within the firm, this collective process has been argued to be embedded in relations of proximity and spatially bounded (Breschi and Lissoni, 2001; Storper and Venables 2004; Boschma, 2004 Ibrahim et al. 2009). Tacit knowledge will flow in the cluster as firms increasingly build partnerships and frequently meet in face-to-face. Members of such relationships thus benefit from spillovers not accessible from outside the cluster environment (Maskell and Malmberg 1999; Amin and Wilkinson, 1999). As those actors tied by close relationships undertake collective knowledge creation processes, none of the firms have the exclusive property over the use of this knowledge, which leads it to be accumulated within networks, institutional contexts or geographical locations that encompass the collaborating firms (Amin and Cohendet, 1999; Rigby, 2000), reinforcing the spatial agglomeration economic activities (Morgan, 2004). As it will be developed further, this is a strong argument in favour of the physical presence of foreign subsidiaries in clusters for MNEs, since knowledge that is accumulated within the cluster is not necessarily accessible from outside.

2.3 Agglomerations

While tacit knowledge is argued to foster the agglomeration of firms and related economic agents, an important number of other features distinguishes those agglomerations from other industrial/regional settings. The next paragraphs will explore the different dimensions of the clusters by analyzing different perspectives on agglomerations and highlight the relevance of the perspective adopted in this research.

As already discussed, the literature in economic geography has long been interested in localized knowledge production (Hervas-Oliver et al. 2015). The benefits of being co-

located, including the facilitation of knowledge sharing, have been argued to foster the agglomeration of economic agents in highly specialized regions.

Many authors underlined the paradox behind this phenomenon of agglomeration. There is, on the one hand, a propensity for the globalization of the value chains based on the needs of cost efficiency. The internationalization of such activities has been made possible *inter alia* by technological advancements and the reduction of barriers to trade. In contrast, authors interested in regional economics and related fields, starting with Marshall (1919), have observed that in front of the fiercest competition between firms that globalization has brought, they tend to concentrate their activities in specific geographic areas. From this common ground, different perspectives have been developed to explain this regionalization process, from its inception to what constitutes its core attributes. In light of major contributions to popularize these research questions, including the works of Porter (1990) and Krugman (1991), there has been a growing interest in the study of regional concentrations of economic activities since the early 1990s, leading to various conceptualizations (Hervas Oliver et al. 2015).

For instance, Krugman (1991) identified industrial districts as agglomerations of manufacturing firms in concentrated geographic areas led by economies of scale and diminution of costs due to the relative proximity to customers and suppliers. This conception mainly lies on productivity considerations and rather neglect the importance of knowledge. Markusen (1996) further proposed a typology of such districts by identifying four different types, namely: (1) Marshallian New Industrial Districts (2) The Hub and Spoke model (3) The Satellite Industrial Platform and (4) the State-Centered District. This categorization highlights the different configurations agglomerations can take according to the spatial distribution of economic actors and their hierarchy in the network.

Another approach conceptualizes agglomerations as *systems of innovation*. This perspective emphasizes the role of regional institutions in fostering innovation rather than cost efficiency. Nelson (1993) defines the system of innovation (SI) framework in broad terms as a “set of institutions whose interaction determine the innovative performance [...] of national firms” (p. 4). The notion of “institution” is understood in its broad sense, which includes on one side formal public and private institutions, but also common habits, culture

and established practices (Lundvall 2010). Those institutions can be studied at a transnational, national or regional level, but their nature will differ the more distant they are to the innovative ecosystem (Nelson, 1993). Common to many of the approaches in economic geography, the *system of innovation* framework highlights the interactions and linkages between a set of actors located in a delimited geographical area. Those actors share norms and a common culture which facilitates the strengthening of those linkages (Lundvall 2010). In that context, the central role of the government and supportive institutions is put forward. They have an active role to play by adopting favourable policies that foster collaboration between innovative actors and by creating good and well-adapted institutions, such as a good education system, public research institutes and oriented training programs (Furman et al., 2002). The outcome expected to emerge from those interactions is a localized knowledge accumulation that will enhance the overall industrial innovation capabilities (Narula, 2002).

2.4 Industrial clusters

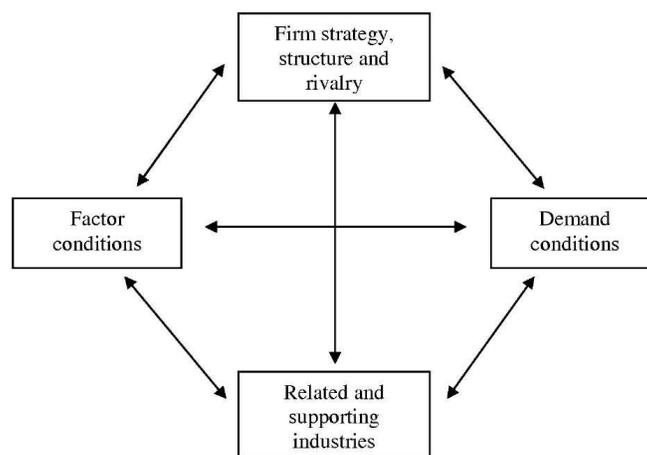
Despite the enlightening insights these parts of the literature provide, this research will mostly rely on insights developed in the literature on industrial clusters. As the other perspectives focused on cost efficiency and the role of regional institutions in economic agglomeration, the cluster perspective concentrates on the dynamism of private firms to explain how some regions specialize in some sectors and are more competitive than others. Although at the core of this approach is the role of competition and private firms, they are seen as strongly dependent on their environment, which is considered a strong determinant for the development of the firms' capabilities to innovate and to perform. Firms in that context cannot be analyzed in isolation from their direct environment. Therefore, this framework provides a good conceptual basis to assess the role of foreign firms in regional innovation, through inter-firm linkages, knowledge spillovers and co-operation/competition environment.

The next few paragraphs will thereby explore further the industrial cluster theory for purposes of setting the foundations before focusing more specifically on the connected literature on path-dependency and external linkages.

2.4.1 Diamond

The formalization of the industrial cluster approach to study regional agglomerations was brought by Porter (1990) in *The Competitive Advantage of Nations*. In this work, Porter develops four aspects of the environment in which a firm evolves that will favour the creation of competitive advantages. This is what is conceptualized as the diamond, in which each point will have an influence on the firm's behaviour.

Figure 1. Porter's Diamond



Michael Porter (1990) *The Competitive Advantage of Nations*

Therein, the first point consists of the firm's strategy along with the structure of the market and the intensity of the rivalry. A strong competitive environment is believed to fuel innovation because the fear to lose pushes the company to increase its effort to become more efficient and creative. At the demand level, the sophistication of the local buyers constitutes another point of the diamond. If the local buyers are highly demanding, it puts pressure on the company to innovate faster and respond quickly to a change in their needs. The third aspect concerns the presence of related and supporting industries which can lead to significant knowledge spillovers that will benefit firms engaged in close relationships with those partners. Finally, the last determinant for a location to be highly competitive is

the presence of productive factors of great quality, such as a pool of skilled labour and good infrastructure.

The points of the diamond are likely to become interdependent and to become a “system” in a context of geographical concentration. Physical proximity amplifies the effects of each aspect of the diamond, leading to the creation of “clusters of competitive industries” (1990: 83). The cluster thus refers to the interaction between those dimensions and firms. More precisely, industrial clusters are defined as “geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions, in a particular field that compete but also cooperate.” (Porter, 2000: p. 15). Therefore, clusters encompass firms in similar sectors and in which there is a highly productive and innovative dynamism (Porter, 1990; Saxenian, 1994; Morgan, 2004). This highly dynamic environment fosters innovative activities and enhance firms’ performance.

The dynamism of a cluster can consequently bring many potential positive externalities for the firms. Ibrahim et al. (2009) identify three categories of externalities that can occur. First, the dense presence of a qualified pool of workers that work in similar industries acts as channels of transmission of knowledge through their mobility within and outside the cluster. Second, there is the development of a broad and readily available mass of related materials and inputs for the companies, thus lowering their costs and enhancing their performance. Finally, there is an iteration of knowledge transfers occurring between firms and other organizations both within and outside the cluster.

2.4.2 Horizontal and vertical dimensions

Maskell (2001) argues that relationships leading to those externalities can take two major forms, which consist of the horizontal and vertical dimensions. First the horizontal dimension represents the competition among firms of a same industry due to the similar kinds of activities they undertake. As similarly put forward by Porter (1990), the presence of direct competitors in the cluster that share “common conditions, opportunities and threats” (Maskell, 2001:929) pushes firms to innovate further as they are constantly aware of the competitors’ moves and performance.

Second, the vertical dimension refers to the relationships between the firm and its suppliers and buyers that lead to knowledge sharing and the constant accessibility of specialized inputs. Both the suppliers and buyers have frequent interactions with the firm so they are able to adapt their activities quickly to its changing needs. Moreover, the frequent interactions lead to repeated knowledge transfers, either through the requirement of some specificities from the demand side or the implementation of joint projects, leading to knowledge accumulation for all partners.

Maskell also argues that in an industrial cluster context, a gap in the supply chain is more rapidly fulfilled. Actors in the cluster are more able to quickly identify those gaps and thus establish new companies, either through spin-offs or entrepreneurship, dedicated to provide firms with the lacking resources.

2.4.3 Cluster-based development

From these ideas, the concept of cluster has been extensively developed in the literature. In parallel, it has been increasingly considered as a framework to study the development of regional and national economies, as well as a policy tool to favour innovation and economic development (Altenburg and Meyer-Stamer, 1999; Porter, 2000 Felbinger and Robey, 2001, Ketels and Memedovic, 2008). In fact, an increasing number of regional organizations have used the cluster theory to elaborate policies either to promote a deeper integration of regional actors or else to promote the region as highly dynamic and attract MNEs¹, which is empirically tested in this study.

Porter (2000) argues that governments and public institutions have a great role to play in the construction of a regional competitive advantage and the development of clusters, especially in a context where there is a fiercer competition between nations to develop, attract and maintain economic activities on their territory (Porter, 1990). Therefore, in such a strategic regional development perspective, the theory says that local authorities should focus primarily on the implementation of favourable policies that will foster competition and innovation (Porter, 2000; Ketels and Memedovic, 2008). Moreover, the cluster theory prescribes that regional authorities have the responsibility to ensure the quality of the

¹ See for example organizations such as Ecotech Quebec, Montreal International, Grappes Montréal

labour force, for which the training must be well oriented and highly flexible (Felbinger and Robey, 2001). The theoreticians of the cluster-based development perspective therefore believe that by setting up these types of policies, public authorities will foster the development of a highly dynamic environment that will serve as the basis for the construction of regional specialization. In this research, this vision is partially endorsed as it will be argued that clusters have a great attraction power toward MNEs not solely because of their competitive environment, but also because the cluster represents an important source of localized knowledge that MNEs will seek to exploit to create, maintain and strengthen their competitive advantage.

2.4.4 Criticisms

Although the cluster framework has been widely studied and used by public authorities, it is sometimes criticized for its vagueness regarding certain aspects. In that vein Martin and Sunley (2003) provide an extensive criticism of the concept, addressing its flaws and avenues for further reflection. They argue that the definition of clusters is so broad that it has allowed researchers to use it in every which way to suit their own purposes, thus reinforcing the ambiguity around the concept. Still according to the authors, one of the greatest flaws of the theory is the lack of clarity of the spatial scope of a cluster and what the diverging characteristics between clusters of different scopes are.

A second broad criticism brought by Martin and Sunley concerns the difficulty to operationalize such concept. Since the theory is rather general and hard to account for in empirical studies, academics have to turn to indirect measures such as input/output patterns, labour turnover or wages. There is no guarantee, however, that these measures truly assess of the presence of an industrial cluster, in which economic actors are supposed to share tight relationships and formally or informally transfer knowledge. So far, many different ways of empirically defining and identifying clusters have as a matter of fact been developed and used in the literature (Porter, 2003; Bathelt, 2005; De Propriis and Driffield, 2006; Trippel et al., 2009; Bathelt and Li, 2014), supporting the argument of Martin and Sunley (2003) on the lack of consensus on how to clearly define clusters in empirical terms.

On the other hand, data on innovation, knowledge transfers and data organized reflecting clusters' activities are lacking. Thus, it is unsurprising to see the challenges for the literature on clusters to demonstrate empirically what has been developed conceptually or described through case studies and general observations. However, the recent popularity of the concept has brought many researchers to refine the theory and to elaborate methodologies to assess of the clusters' behaviour and evolution. As Hervás Oliver et al. (2015) showed, the literature on clusters has truly expanded in the early 2000s and increasingly, data started to be collected on industrial clusters².

Albeit these criticisms around the cluster concept, it presents interesting insights for the study of localized economic structures. As stated above, the increasingly important literature around this concept brought many complementary perspectives and dimensions to explain the phenomenon of agglomerations and knowledge transfers. For this study more specifically, it allows to analyze the related activities in a specific region as an integrated element, and therefore analyzing how the presence of a foreign firm affects the whole group's knowledge base and ability to innovate. Thus, the foreign and local firms are not viewed as separate elements that affect the behaviour of each other, but rather as different elements integrated in the same structure, in which there are specificities and where knowledge circulates.

2.5 Physical proximity

To summarize what has been discussed so far, it was argued that the nature of knowledge is at the core of the explanation for the agglomeration of economies, in which we find a set of actors and elements that favour specialization and the creation of competitive advantages. These insights all point out to the importance of geographical proximity and linkages (in their various dimensions) between the actors. This next section will consequently address this question of proximity more specifically by digging further the underlying processes that take place in a context of co-location leading to the development

² See Us Cluster Mapping Project, the EU cluster Observatory, The Canadian Institute of Competitiveness and Prosperity

of a cluster. It will be contended that those underlying factors supporting co-location are capital for the cluster.

As seen earlier, it has been argued that co-location facilitated the transfer of tacit forms of knowledge, which is an important factor for the agglomeration of firms. Co-location has also been said to benefit firms in terms of productivity spillovers and access to specialized inputs. However, as Martin and Sunley (2003) state, the mere co-location of alike and related businesses does not necessarily mean that they are closely integrated as a unified network of firms. The formation of linkages is rather fostered by multiple factors, including communication, a particular atmosphere, face-to-face contacts and trust relationships.

2.5.1 Five types of communication channels

To first explore the supporting and underlying processes of agglomerations and clustering, the idea of communication channels discussed by Antonelli (2000) will be developed. In this first step, the complexity of knowledge circulation in a cluster is addressed by slightly moving away from the horizontal/vertical conceptualization of partnerships to different channels through which knowledge can be transferred.

Antonelli (2000) points at five different communication channels that need to accompany co-location to foster knowledge flows. First, as labour turnover is likely to generate knowledge spillovers between firms, the quality of the *factors* market is an important technological communication channel. The second channel is the features of the local industry structures. The author asserts that firms must be able to bank on reliable technological and knowledge-related inputs outsourcing, for instance through partnerships with knowledge-intensive business services. Third, the knowledge infrastructure must allow firms to access knowledge relatively easily within the network. The presence of universities and other research institutes along with their connectivity with the firms can represent important flows of novel knowledge. The fourth channel is the quality of communication infrastructure in the location. The use of information and communication technologies can indeed ameliorate the speed at which information will be transferred and its quality. Finally, the author stresses the importance of the integration within the location,

in which the connectivity and the receptivity of the firms facilitate communication and allow firms to align their strategies in light of the competitors' moves.

Those communication channels can represent important supportive factors for knowledge flows in the cluster. Besides, co-location needs to be supported by elements that link firms together, such as the creation of a shared language and norms that help overcome cognitive barriers and facilitate co-operation and knowledge transfers (Lawson and Lorenz, 1999; Bathelt and Turi, 2011).

2.5.2 Local buzz

The first of such elements that will be highlighted is the concept of the local buzz (Storper and Venables, 2004). This concept builds on the notion of industrial atmosphere developed by Marshall (1919). Bathelt et al. (2004) define it as the “information and communication ecology created by face-to-face contacts, co-presence and co-location of people and firms within the same industry and place or region” (p. 38). In other words, this environment is developed through the synergies created by co-location and the frequent face-to-face contacts in a cluster that eventually lead to cultural, normative isomorphism and ultimately innovation (Storper and Venables, 2004).

This environment is very dynamic as linkages are constantly forged and reinforced. People and firms that share information are constantly aware of the competitors' moves and the activities of the suppliers and buyers, which is a catalyst to perform and innovate (Storper and Venables, 2004). Bathelt (2005) emphasizes how information is more easily acquired when an individual or an organization is part of the local buzz: “receipt of information, news, rumours, gossip, and trade folklore about other cluster firms and their actions is virtually automatic (p. 109)”. In fact, those information exchanges can take place even in routine activities, such as through negotiations with the suppliers, the buyers, during business lunches or at conferences. Moreover, as economic actors frequently meet, those frequent interactions decrease opportunism and strengthen mutuality, facilitating co-operation (Amin and Cohendet 1999).

Although no particular investment has to be made in order to be simply part of the local buzz, it is not guaranteed that every firm will benefit from it equally (Bathelt, 2005). The

benefits of the local buzz for a firm will depend on its ability to acquire and assimilate external knowledge. To benefit fully from the local buzz, firms need to invest in the development of strong absorptive capacities in order to assimilate information about external technological processes or any other types of complex information (Cohen and Levinthal, 1990).

In sum, by being part of the local buzz, both constituted of formal and informal ties, firms can gain access to the local pool of knowledge and benefit from spillovers that are bounded by the location (Owen-Smith and Powell, 2004). In this environment, firms, institutions and related actors will be able to gradually create informal institutions which enable collective knowledge creation and transfers. Those informal institutions, such as the development of trust, are supported by face-to-face contacts.

2.5.3 Face-to-face contacts

The nature of the local buzz, along with the elements of tacit knowledge discussed in the first section, emphasize the important of face-to-face contacts (F2F) to exchange knowledge. Since tacit knowledge is hard to communicate between agents, the physical presence of the partner holds multiple functions to attenuate the complexity of the exchange (Ibrahim et al. 2009; Bathelt and Turi, 2014). First of all, the physical presence of the partners helps the creation of a relation of trust between participants. Storper and Venables (2004) argue that being present physically with a person brings “visual contact and emotional closeness” (p. 354), which in turn are prerequisites to the development of interpersonal ties and further a sentiment of trust toward the other person.

Trust is in turn a very important informal institution actors need to establish within a cluster to facilitate exchanges of information and efficient partnerships (Granovetter, 1985). Nonaka and Takeuchi (1995) identifies the role of trust in a network as “mutually understandable, explicit language and often prolonged socialization or two-way, face-to-face dialogue that provides reassurance about points of doubt and leads to willingness to respect the other party’s sincerity” (cited in Morgan, 2004:8).

Murphy (2006) recognizes three different levels of trust. At the micro-level, the establishment of a relationship of trust is a subjective process based on shared experiences

and the perception of the other person's set of competences. At the meso-level, trust is based on social ascriptions, i.e. with what behaviours and emotional characteristics the individual associates trust. Trust can also be influenced by *a priori* judgments, such as the partner's group membership. Finally, the macro-level of trust refers to "institutionalized attitudes about the trustworthiness of people", and is thus based on broad cultural, philosophical or religious beliefs and on the quality of institutions that regulate mutual contracts if trust relationships formalized by contracts are violated. This suggests that the building of trust between actors can be influenced at different levels in the cluster, from the firm's culture to the quality of institutions. Those aspects are taken into consideration in this research, as the role of cultural proximity, which indirectly encompasses notions of trust building, will be developed.

Thus, once trust is established, co-operation is more likely to take place as the willingness of the participants and the quality of information that is shared is enhanced (Nooteboom, 1999; Maskell and Malmberg, 1999; Morgan, 2004).

Along with encouraging the establishment of a relation of trust, F2F, through the body and facial expressions, act as supports and complements of information, for example by demonstrating understanding or incomprehension toward the interlocutor's speech (Morgan, 2004; Bathelt and Turi, 2014). Nonaka et al. (1996) asserts accordingly that "only face-to-face interaction can capture the full range of physical sense and psychoemotional relations (e.g. ease or discomfort) [...] no other communication medium is better in transmitting tacit information" (p.217). In other words, physical presence allows to better understand implicit elements, such as people's intentions and purposes and is therefore most important for understanding and integration the more complex the nature of the information transmitted.

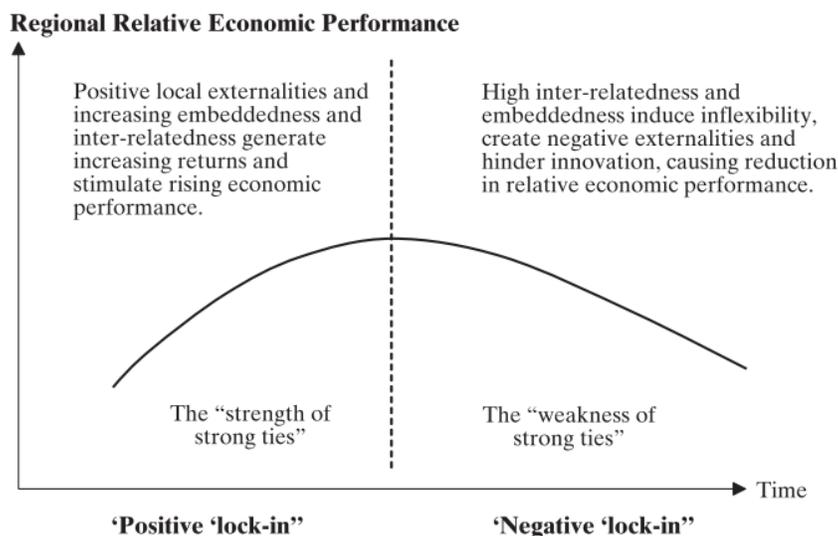
All those dimensions of F2F contacts strengthen the fact that co-location is an important aspect of collective knowledge creation and represent a strong argument for the need for MNEs to physically access industrial clusters through the establishment of foreign subsidiaries to benefit from localized and specialized knowledge. In that sense, many studies empirically explored the importance of co-location for firms and confirmed that they benefited from localized knowledge for the development of their competitive

advantages (Sonn and Storper, 2008) and innovative capabilities (Trippel et al. 2009; Todtling et al. 2012; Grillitsch et al. 2015).

2.6 Lock-in

The path-dependency literature highlights nonetheless that while geographical proximity and tighter social and economic integration through frequent interactions, trust and linkages can be beneficial for firms in a cluster, it can become detrimental to the region's overall ability to innovate in the long run. Martin and Sunley (2006) propose that depending on the maturity of the cluster, positive externalities generated by embeddedness can actually become negative. **Figure 2** below summarizes their argument by showing that up to a certain point in time, regional embeddedness will produce increasing returns and better economic performance, while passed a turning point firms might negatively get stuck in the same patterns of activities. This situation lowers their ability to both create and assimilate new knowledge. Martin and Sunley identified in their study different approaches in the literature to explain how regional embeddedness can lead to a decline in the regional dynamism. Those perspectives will be explored in the next paragraphs. The first approach is based on the regional technology adoption. Secondly, the network-based approach developed by Kogut will be explored before concluding with the socio-institutional perspective of regional lock-in.

Figure 2. Lock-in



2.6.1 Technological approach

Analyzing the works of Paul David on technological path dependency, Martin and Sunley identify three main factors in his approach that potentially lead to technological lock-in situations. First, firms increasingly develop interrelatedness in the type of technology they produce and exchange. As argued by Porter (1990), regional agglomerations are supported by the presence of related suppliers and buyers. In the case where a product or a service is not locally provided, there are strong incentives for entrepreneurs to fill this empty space in the supply chain (Delgado et al. 2010). Consequently, as the cluster matures, specialized inputs can increasingly be found locally, so regional embeddedness brings firms in clusters to rely growingly on proximate suppliers and buyers. That proximity with the suppliers leads in turn regional economic agents to produce, use and share technologies that will be similar, compatible or complementary to the activities of other local firms (suppliers, buyers or competitors), causing technological isomorphism.

Secondly, the complementarity and compatibility of the technology that is produced in a cluster is reinforced by the presence of economies of scale. The firms that produce a technology will gradually become more efficient and the product more standardized, thus reducing the cost and the price. The costs of using those technologies will also decline over time, as firms gain experience in using them and collaboration is easier because of the bigger community of users. Those trends reinforce the large adoption of a few selected technologies in the cluster.

Thirdly, the investments made in these technologies are quasi-irreversible. Major investments are made both in the physical and human capital to propagate or adopt specific types of technologies. There are consequently little incentives for suppliers to start producing new technologies and for the buyers to seek out for technologies that are not mastered within the organization.

Those three arguments relayed by Martin and Sunley give ground to explaining how regional clusters fall into technological lock-in situations. Similar inputs are increasingly adopted by firms which benefit from decreasing costs in the acquisition and the use of such

technologies. Moreover, the development and adoption of new technologies necessitate such investments that technological changes are rendered more difficult in the cluster, which can cause in the medium and long term a gap between the technology that is well established in the cluster and the technologies developed and adopted elsewhere. These phenomena can hence represent important explaining factors of the relative decline clusters can bear over time.

2.6.2 Network-based approach

The literature on path dependency also pointed at other more intangible mechanisms that lead to isomorphism and lock-in situations. Kogut (2000) rather explains regional lock-in through a network-based approach. The author first defines an economic network as a knowledge depository. In that sense, the competitive capabilities of firms do not lie solely on their internal knowledge, but also dependent on the external knowledge that is embedded in the network. Thus, one of the main skills one firm must possess is the ability to coordinate both the knowledge coming from within and from outside its walls. Firms that are able to develop this ability to exploit those two sources of knowledge put themselves in a favourable position to gain a competitive edge over other firms.

The strong ties that are formed within integrated economic networks are translated in frequent interactions and the gradual construction of a mutual technological, social and institutional framework. Kogut et al. (1993) conceptualize these economic networks as “group of blocks” (p. 71) in which close partnerships are established and information about the members flows freely. Over time, firms base their interaction patterns on their experiences in the network, therefore influencing the type of relations they further establish. Similarly to what has been previously discussed, the intensity of interactions following alike patterns in the network can freeze its structure which is increasingly replicated over time, leading to a decrease in the variety of knowledge absorbed and innovation developed by the firms (Kogut, 2000). Kogut et al. (1993) therefore argue that external pressure must be brought to the network in order to bring new sources of knowledge and technology, for instance by promoting competition and by attracting foreign direct investments.

2.6.3 Socio-institutionalist approach

Martin and Sunley (2006) finally identify the “*Porter-type*” approach to explain the occurrence of lock-in situations. This approach rather focuses on the socio-institutional mechanisms that bring local networks to isomorphism. This perspective provides, according to Hassink (2005), a powerful explanation of the decline of some industrial areas. It emphasizes firstly that the knowledge-creation process is at the source of innovative activities. Those processes are in turn influenced and ultimately determined by the economic socialization that occurs in networks. By being part of a same community, firms of a cluster develop a mutual cognitive framework which shapes their set of possibilities they consider feasible in their innovation processes. In the first stages of the regional integration process, this mutual framework can benefit the local actors as communication and collaboration is facilitated by a common language and common norms (Martin and Sunley, 2006). However, as firms in the cluster build strong ties with each other and exchange intensively different forms of knowledge, they repetitively tap into the same pool of knowledge, thus lowering the potential to find novel solutions and new problem-solving processes (Bathelt, 2005; Nooteboom et al. 2007; Maskell and Malmberg, 2007).

This approach further suggests that the routines firms establish, which are influenced by the socio-institutional environment in which they operate, become deterministic of the routines they subsequently establish. As firms are increasingly engaged in deterministic avenues, it can hamper their propensity to develop groundbreaking innovations. Routines then become increasingly rigid over time and restrict the ability of firms kept in that situation to develop or acquire distant (new) forms of knowledge (Maskell and Malmberg, 2007; Sotarauta, 2011).

In parallel, some authors develop the concept of *myopia* to address the inward-looking focus of clusters. Similar to the arguments presented above, a cluster myopia refers to the evolution of a common cognitive framework which constrains the set of actions firms undertake (Maskell and Malmberg, 2007). The deterministic nature of prior activities restrict the organizations’ capacities to envision radically new processes. This relates to Cohen and Levinthal’s (1990) argument which states that prior knowledge is essential for

the absorption of new knowledge and the more diversified the knowledge base is, the easier the absorption of distant forms of knowledge.

In sum, whether it be for external reasons (tapping repetitively into the same external pool of knowledge) or for internal reasons (rigidity of routines), the socio-institutionalist approach exposes isomorphic paths clusters can fall in, causing declining innovative performance. Although the three approaches presented above bring interesting avenues for explaining regional declines, the ensuing discussion on external pipelines is mostly grounded in this approach to explain lock-in situations, by focusing on the need to bring new and diversified knowledge to the cluster in order to stay dynamic.

2.7 External pipelines

Therefore, to overcome or prevent such technological lock-in situations, authors following a socio-institutionalist perspective argued that firms of a cluster need to create and maintain various linkages with external actors in order to acquire diversified knowledge and maintain their ability to come up with novel problem-solving solutions in the medium and long term (Tracey and Clark, 2003; Boschma, 2004; Bathelt, 2005).

Owen-Smith and Powell (2004) use the analogy of the *pipeline* to characterize linkages that are created between organizations. They can have two broad natures. On the first hand, *pipelines* can be hermetic, i.e. the pipeline is a formal channel of transmission between two actors to transfer knowledge and information. In that form, the organizations at both ends of the pipeline are the sole beneficiaries of the knowledge that is transmitted. Secondly, pipelines can be more informal and diffuse in nature. They do not only benefit the two nodes at each end, but also other organizations through what the authors call the sprinkler effect. It refers to the diffuse knowledge spillovers that occur when the pipelines are leaky, so other firms benefit from spillovers although they are not directly involved in the relationship (Owen-Smith and Powell, 2004). Pipelines also vary in reach: some are geographically close whereas some are established with firms in distant locations (Bathelt et al, 2004; Bathelt and Henn, 2014). They can be formed with a variety of actors, from suppliers, buyers, firms in the same or another industry or non-private organizations. Moreover, Tracey and Clark (2003) argue that while networks have become increasingly globalized, local actors incrementally started to seek for partners abroad, either to source

knowledge, to align strategies or to develop new markets, broadening the geographical scope of external pipelines. Through the acquisition of various forms of knowledge coming from diversified partners in different locations, firms that establish and maintain effective external pipelines can therefore enhance their innovative capabilities, and at the same time, benefit the whole cluster through formal or informal knowledge spillovers (Sotarauta, 2011; Todtling 2012; Grillitsch et al. 2015).

The regional consequences of establishing pipelines have been empirically explored by the literature. For instance, Bathelt (2005) identifies the lack of external linkages as a factor of the decline of the media industry in Leipzig. Giuliani and Bell (2005), through a case study on the wine industry in Chile, highlighted the connections with external partners as a source of dynamism for the cluster. In the same vein, Todtling (2012) empirically show that the use of external pipelines had a positive impact on the innovative performance of firms in Austria, although the use of external sources varied according to the regional structure in which the firms operate. Grillitsch et al. (2015) find similar results. They argue that not only international sourcing enhanced innovative performance, but the effect is accentuated when the sources are varied. The authors well explained how sourcing knowledge at the international level could foster firms' performance: "International sources allow firms to access knowledge not available regionally, observe changes in the global environment, react to global trends, and reduce the risk of being locked in outdated production systems, markets and technologies" (p. 37).

On the other hand, some authors proposed that the establishment of such pipelines is not automatically beneficial. Morrison et al. (2011), in a modelling of the effects of external linkages, find that external pipelines are beneficial only when two prerequisite conditions are met. The first one is that the prior level of knowledge must not be above a certain threshold, over which there exists available local substitutes, so external linkages become less relevant. The second condition is that the cluster must *a priori* benefit from a "high-quality buzz" (p. 79). The buzz facilitates the circulation of new knowledge in the cluster and firms not directly involved in the pipelines can still benefit through sparse spillovers. Boschma (2004) similarly underlines two conditions for regions to respect in order to fully benefit from external linkages. First, firms need a certain level of absorptive capacity to

integrate and use this external knowledge in a beneficial way. Secondly, there need to be a certain level of common values and expectations between the local and external partners.

Alongside the potential conditions under which external pipelines can be beneficial, there are as well some important costs the firm must bear to create and maintain them. First, firms must beforehand do a screening of potential partners by different means, for example through the participation in international trade fairs or by the development of international networks (Bathelt, 2005). Then, establishing and maintaining relationships with distant partners bring relative costs due to cultural differences. That can be explained by the fact that the organizational development of the firm is believed to be greatly dependent on the institutional environment in which they operate (Wuyts et al. 2005). This leads to differences in languages, practices and references that can become barriers when it comes to communication and knowledge transfers (Bathelt, 2005). Thus, those barriers can reap supplementary costs to overcome them.

In sum, although it involves some costs, establishing external pipelines allows firms to acquire new knowledge and avoid potential lock-in situations. It has been shown that clusters that fail to establish those external linkages might experience a relative decline in the long run (Bathelt, 2005). In contrast, other clusters that have relied on those linkages over the years to diversify their sources of knowledge have been able to keep or improve their innovative capabilities (Trippel et al. 2009, Sotarauta et al. 2011).

2.8 MNEs and industrial clusters: The presence of a subsidiary as an external pipeline

It has been argued above that external pipelines can bring positive externalities to firms and clusters. There is, however, a multitude of forms of linkage firms and regions can create. A form that is yet to be more deeply explored is the attraction of foreign-owned subsidiaries. As it will be developed in this section, the establishment of a subsidiary in a cluster can represent a permanent point of access to the parent corporation's pool of diversified knowledge. Martin and Sunley (2006) point out that lock-in situations can in effect be tackled through inward FDI, as they bring novelty to the region in terms of technology, management practices, organizational forms and skills and competences.

Thus, as linkages with the subsidiary are created and strengthened in the cluster, the subsidiary will contribute to the collective-knowledge creation process.

So far, a large part of the literature has focused on the effect of FDI on local economies either in terms of firm-level productivity or general economic performance. In a cluster context, however, the role of subsidiaries goes beyond mere isolated technological transfers, increased competition and increased pressure on the demand for inputs. Rather, the subsidiary can be seen as an extension of the MNE to gather knowledge at the local level and a permanent point of access to the diversified knowledge base of the parent corporation for local firms (Mudambi, 2002). As linkages in the cluster are abundant and tight, F2F are frequent and co-operation is commonplace, the subsidiary becomes an integrated contributor to the collective effort to produce innovation and competitive advantages in the cluster.

The next sections will thereby address the relationship between FDI and industrial clusters. First, this relationship will be developed from the MNE perspective, which increasingly relies on location-specific intangible assets to build their competitive advantages. In that case, industrial clusters represent important attraction poles. Second, it will be asserted that clusters can benefit as well from the presence of MNEs through the establishment of a subsidiary to acquire distant forms of knowledge.

2.8.1 Location determinants

Dunning (1998) highlights that the advent of the modern economy has led MNEs to change their strategies toward their location decisions. This is due to major changes new technologies, liberalized trade, and transportation advances have brought. First, the production of goods and services is increasingly globalized, so MNEs now have to manage a diversified portfolio of locations in which they have activities. There is also a more important number of MNEs evolving in knowledge-intensive sectors which rely on intangible forms of capital to compete (Meyer et al. 2011). In both cases, intellectual and human capital has become a key asset for modern companies. The MNE needs strong human competences to manage the diversity of organizations in the corporate network, the

internationalization strategies or to manage knowledge sharing within the organization. Human knowledge and skills have consequently become major inputs to production for many organizations.

This changing economic landscape and the evolving nature of the MNE have hence brought a large set of MNEs to shift their location decisions based on market or natural resources seeking to knowledge (strategic asset) seeking. Those assets can represent “technical knowledge, learning experiences, management expertise and organizational competence” (Dunning, 1998:50), which are mostly found according to Dunning in advanced economies. These strategic assets now represent a very important source of competitive advantage, even for sectors in low-tech industries. As stated by Dunning (2001), locations are no longer solely means to exploit MNE’s competitive advantages, but rather they are “vehicle for augmenting these advantages” (p. 182).

In light of these observations, Dunning stresses the paradox globalization brought to the FDI worldwide distribution. Although globalization and technological advances have minimized transportation and communication costs, the scarcity of advanced human and intellectual capital necessary to compete worldwide in advanced sectors have fostered the regionalization of economic activities around some geographical locations that show high specializations (see also: Porter, 1990, 1998; Krugman, 1991; Saxenian, 1994). In that context, industrial clusters have become very attractive for MNEs seeking to access locations with high levels of knowledge and competences in order to enhance their own capabilities (Dunning, 1998; Cantwell, 2009). As discussed previously, clusters encompass particular dynamism in which there is a high level of innovative capabilities, specialized knowledge and frequent interactions that lead to constant knowledge transfers (Delgado et al. 2010; Bathelt et al. 2004; Fosfuri and Ronde, 2004; Ibrahim et al. 2009; Maskell and Malmberg, 1999; Morrison and Rabellotti, 2009). These factors are important sources of competitiveness for firms, and cannot be accessed easily from the outside, leading clusters to be attractive locations for MNEs. The attractiveness of industrial clusters has been empirically explored by a few studies in the literature. Guimaraes et al. (2000), through an empirical study on foreign-owned plants establishments in Portugal, show that foreign investors considered the presence of agglomeration economies as a determinant factor in

their location decision. In the same vein, Bathelt and Li (2014), in a study on FDI flows between Canada and China, show that firms located within clusters (relying on knowledge and innovation for their competitive advantage) tended to target their FDI toward other clusters based upon the level of knowledge present in the host region.

2.8.2 The role of the subsidiary

Given that MNEs in advanced sectors of the economy increasingly seek to get access to localized knowledge bases, the role of subsidiaries takes a major role in the construction of the corporation's competitive assets (Dellestrand and Kappen, 2012). Indeed, there is more than one mechanism through which MNEs can acquire and share knowledge. The corporation can either try to acquire knowledge through the market, or else internally through FDI, mergers or acquisitions. For MNEs relying more on tacit knowledge in their activities, relying on market mechanisms can bring heavy transaction costs.

Dunning (2001) identified three main reasons that can push a firm to internalize activities in general. The first reason "arises from risk and uncertainty" (P.3), which bring high transaction costs given the extra monitoring efforts that have to be put in to guarantee the quality of the exchange. The second is the ability of firms "to exploit the economies of large-scale production" (P.3), so the costs of producing a good decrease under the market price over time, leading to a gain for the firm. The third main reason to internalize occurs "where the transaction of a particular good or service yields costs and benefits external to that transaction, but that are not reflected in the terms agreed by the transacting parties" (P.3).

Applied to the case of transactions of tacit forms of knowledge, the reasons to internalize relate more strongly with the first and third arguments of Dunning. Due to its specific nature, tacit knowledge is hard to communicate, to transfer, and to absorb. Thus, sharing tacit knowledge through contractual agreements or other market mechanisms can prove to be too costly and inefficient. There are great uncertainties prior to the transaction about whether knowledge or competences that are exchanged are of great quality or truly suit the needs of the recipient. In addition, there are costs external to the transaction, for instance whether the firm will have the internal capabilities to absorb and use the content of the

transaction in an efficient way. Those factors can bring many costs to the firm that uses market mechanisms to try to acquire tacit forms of knowledge. As stated earlier, it necessitates lasting interactions with the knowledge holder along with F2F meetings, whether it be for communication or for learning by imitation and experience. In that case, market mechanisms cannot efficiently be used for the transfer of tacit knowledge, leading the MNE to rely on internal mechanisms to benefit from external knowledge (Song Et al. 2011; Meyer et al. 2011).

In that context, the establishment of a subsidiary can represent an interesting mechanism to acquire tacit and localized knowledge. It allows both a permanent access to those pools of knowledge and to create long-lasting and effective channels of transmission of tacit knowledge within the corporation.

Within the corporation network, the subsidiary can accordingly fulfil different but related roles with regards to knowledge acquisition. As stated by Morgan (1997), subsidiaries can in the first instance simply act as listening posts. Their role is then to monitor and to permanently assess knowledge and technological advancements to further channel this information to the headquarters. This role can, however, evolve into a more creative one (Meyer et al. 2011). In this last scenario, the subsidiary becomes more embedded in the local network and pursue innovative activities by itself. In that vein, Poon et al. (2013) empirically show that being located in a local cluster did increase the subsidiary's innovative capabilities. The authors show that subsidiaries located in industrial clusters were generally granted more autonomy *vis-à-vis* the headquarters than in non-cluster regions, suggesting that MNEs strategically let the subsidiaries in such dynamic regions develop stronger linkages with their local environment and pursue more spontaneous innovative activities. Furthermore, the autonomy and the dynamic environment of those subsidiaries were factors that enhanced their innovative capabilities. In such case, subsidiaries are able to acquire knowledge and create new competences that can further be disseminated to the whole corporation through reverse knowledge transfers (Mudambi et al. 2014). Reverse knowledge transfers refer more specifically to knowledge that is generated, developed or acquired by the subsidiary that represent a source of value for the MNE as a whole. When such transfers occur, the corporation can hence augment its global

knowledge base and develop new competences through the activities of its network of subsidiaries.

So the subsidiary fulfils a role which is crucial to MNEs in this globalized economy. They allow the corporation to tap into diversified pools of knowledge allowing it to build and maintain strong competitive advantages (Birkinshaw and Hood, 2000; Frost, 2001; Almeida and Phene, 2004; Un and Cuervo-Cazurra, 2008; Andersson et al. 2002; Mudambi et al. 2014).

However, those MNEs need to have the competences to benefit from and effectively manage such a diversified portfolio of knowledge sources and further to spread the knowledge acquired by the subsidiaries to the whole network (Meyer et al. 2011; Mudambi et al. 2014). This process involves many challenges for the headquarters. First, as stated above, the tacit nature of knowledge makes it harder to communicate and to share. The MNE must be able to create long-lasting and efficient channels to disseminate this tacit knowledge along with the underlying competences to use it accordingly. This difficulty is supplemented by the embedded nature of technical and technological skills the subsidiary has developed over time. Indeed, subsidiaries are more likely to benefit from knowledge spillovers and enhance their innovative capabilities if they are in a dynamic environment and able to create important ties with local partners (Cantwell, 2009; Almeida and Phene, 2004; Andersson et al. 2005). Their active and long-lasting participation in the cluster facilitates the creation of multiple linkages with surrounding actors and thus facilitate knowledge and technological transfers (Frost, 2001). This is in line with what was discussed previously about the increasing embeddedness of regional agglomerations.

The increasing embeddedness of the subsidiaries in the regional economy can, however, become detrimental over time. Over-embeddedness can eventually hamper the ability of the parent and the subsidiary to effectively convey reverse knowledge transfers. In fact, through the frequent interactions with its local milieu, the subsidiary is susceptible to develop context-specific competences that can hardly be applied elsewhere (Andersson et al. 2002). Other nodes in the corporation's network can simply lack the underlying skills, knowledge or specialized partners to appropriately benefit from this specific knowledge that is transferred from a subsidiary operating in another context.

Additionally, the fact that the subsidiary is increasingly relying on its partnerships with local actors to innovate, and thus becoming more independent, might trigger an unwillingness to cooperate closely with the other members of the corporation and can also lead the subsidiary to use its possession of specialized knowledge as leverage for negotiating resource allocation from headquarters. This represents an extra challenge for the parent that must eventually deal with internal power struggles and temptations for the subsidiary to seek for more resources and autonomy (Mudambi et al. 2014; Meyer et al. 2011).

This situation creates a dilemma between the subsidiary's local integration and corporation's internal consistency (Dellestrand and Kappen, 2012). Therefore, a big challenge for the MNEs is to adapt its management practices to this globalized context in which they must exploit the specialized knowledge present in different locations and further integrate their portfolio of knowledge pools into a comprehensive strategy that will allow the whole corporation to augment its knowledge base (Meyer et al. 2011).

To summarize the last sections, MNEs can benefit from a portfolio of specialized locations, especially when management difficulties are overcome. It has been argued that the increasing reliance of MNEs on intangible assets has brought industrial clusters to be attractive locations, given their localized and specialized (tacit) knowledge that can benefit the MNEs in the construction of their competitive advantage. MNEs benefit in effect from being located within an industrial cluster through the development of close relationships with local partners and the access to knowledge not readily and easily available from the outside.

It is therefore hypothesized that: (1) clusters will show a higher proportion of foreign subsidiaries than non-cluster locations.

2.8.3 Impacts on the cluster

In the last section, it was discussed how industrial clusters could represent attractive locations for MNEs that seek to enhance their knowledge base. More is to be said from the reverse perspective on the impact the establishment of MNEs has on innovation in industrial clusters. Although there is a large literature on the impact of FDI on local

economies but a few studies on FDI in the particular context of a cluster, the understanding and empirical exploration of the relationship between foreign and local firms on the innovation performance of clusters is still to be deepened (Wang and Wu, 2016). The particular dynamism and embeddedness of the cluster, along with the specific motivations of MNEs in advanced sectors to target those locations, suggest a new role for FDI and most particularly the subsidiary. This role can be better assessed by following a knowledge-based approach and through the investigation of its role with regards to innovation, since FDI and the attraction of FDI in clusters are based on the needs to acquire diversified knowledge.

In this section, the contrast between the market-based and the knowledge-based approaches to apprehend the impact of FDI on clusters will be developed and explored through a review of studies on the topic. It will be further argued that locations can benefit from the establishment of foreign subsidiaries not solely through sporadic spillovers and increased competition (market-based), but rather through the permanent channelling of distant forms of knowledge (knowledge-based).

2.8.3.1 Market-based approach

A large part of the literature on FDI and industrial clusters has focused on the economic outcome of foreign ownership in terms of productivity and performance. In that vein, Porter (2000) mentions that foreign subsidiaries can be potential contributors to employment and investment, increasing the productivity of the whole cluster. Thomson 2002 also shows that MNEs investing in industrial clusters push local firms to be more efficient due to competitive pressures. The major argument is that co-location between local and foreign-owned subsidiaries lead to a closer monitoring in addition to a fiercer competition for suppliers and customers (Porter, 1990; Garcia et al. 2013). Monitoring leads on the first hand to increased pressure for local firms, since they are aware of any move or improvement from the foreign firm, so it pushes them to adapt quickly and to be more efficient, especially in a context of a limited demand. On the other hand, the increased competition for suppliers brings the price of inputs to rise, due a stronger demand from the supplier perspective. This also puts pressure on the local firms to make more efficient their production.

As for Birkinshaw and Hood (2000), they propose three possible consequences to expect from the presence of foreign subsidiary in industrial clusters. Their study was based on a sample of 229 subsidiaries in 12 clusters. The first scenario they hypothesized is that foreign ownership in a cluster has no effect on the dynamism of the cluster; it is rather the quality of inter-agent linkages that matter the most, no matter the origin of the firms.

Secondly, the authors suggest that foreign ownership could be positive for two main reasons. First, MNEs not only benefit from the local environment to enhance their own performance, but they can also contribute positively to the dynamism of the location. Second, the fact that foreign companies are attracted toward a particular location sends a favourable signal to foreign investors and qualified labour that having activities in this location is favourable and profitable.

Finally, and as it will be discussed further, Birkinshaw and Hood argue and actually find through their empirical results that the presence of foreign companies can be detrimental to a cluster because they may not necessarily develop strong relationships with local actors (lack of embeddedness), which make those foreign firms more prone to leave at any moment. Markusen (1996) states accordingly that economic production has become increasingly “slippery” as capital is significantly easier to move in the modern economy. Consequently, MNEs might not engage intensively in linkage creation with their local counterparts, hampering the potential for the local ecosystem to benefit from spillovers coming from the foreign-owned establishment.

Moreover, foreign ownership can also lead to a crowding out of local firms. The *crowding out* or *market-stealing* effect refers to the situation where the activities of a foreign establishment overlap too much with the activities of certain local firms, therefore potentially pushing them out of the market or in other more niche markets (Garcia et al. 2013). Aitken and Harrison (1999) observe that this phenomenon is stronger in the short term and in the case where competitors share similar fixed costs of production. In that scenario, a foreign-owned firm with lower marginal costs will be able to increase production and “steal” the demand from the local firms by offering lower prices.

Kosova (2010) corroborates these results by showing that this effect is effectively short-term. As foreign sales grow, the demand increase for local inputs, offsetting in part or

totally the prior decrease in local production. A potential negative outcome from this situation is, however, that the establishment of foreign-owned firms relegate local ownership to sectors with lower value-added activities, as foreign establishments now occupy certain high-level sectors of the value chain.

In sum, the market-based approach to assess the impact of FDI on industrial clusters suggests a set of potential consequences foreign-ownership can have on the local economy. The competition the establishment of foreign subsidiaries brings can have positive outcomes, such as an increased productivity and reduced costs of production, or negative outcomes, such as the crowding out of local firms or their relegation to lower value-added activities.

2.8.3.2 Knowledge-based approach

Another approach to address the relationship between foreign investments and industrial clusters is to assess the potential knowledge spillovers that can occur between foreign and local firms, and vice versa. As foreign and local firms generate innovation and exchange information in a context of an industrial cluster, the knowledge that is produced by a firm is not necessarily bounded within organization. On the contrary, the innovative firm may informally transfer soft technologies, skills and competences, through the process, which is further spread to other firms by different means (Thomson, 2002). Aitken and Harrison (1994) argue that firms can even benefit from the production of these “soft” technologies by simply observing other firms, or, in other words, by being in the local buzz. In more formal ways, the transfer of tacit knowledge can be done for instance by the labour turnover, i.e. when a former employee of a competitor, a supplier or a buyer integrate the organization and use its knowledge and competences accumulated in prior experiences.

Through those mechanisms, the establishment of foreign subsidiaries in industrial clusters has a great potential to generate knowledge spillovers that will benefit the innovative performance of the whole cluster. For instance, Branstetter (2006) finds that Japanese FDI to the United States both benefited the Japanese and the American firms because of mutual knowledge transfers. In addition to the factors of imitation and labour turnover, foreign firms will establish strong connections to a broad network of actors that will in turn learn

new processes, management practices and technological applications through the collaboration.

Some authors have accordingly argued that knowledge spillovers might actually be greater in a specific context of clusters, where firms and organizations are more integrated and more prompt to benefit from spillovers (Wang and Wu, 2016). Geographical proximity and strong ties enable local firms to benefit more directly from spillovers, given their localized nature (Higon and Vasilakos, 2011; De Propris and Driffield, 2006; Ibrahim et al. 2009). In that vein, Fosfuri and Ronde (2004) show a significant link between formal and informal knowledge spillovers and productivity for local firms, but the intensity of the correlation diminishes with a greater distance between the firms.

These approaches to assess the impact of FDI on local economies and industrial clusters have in sum addressed many forms of relationships between the actors and different types of externalities that can occur. However, the role of FDI and more precisely subsidiaries is not limited to sporadic transfers and increased competition. Studies that focused on knowledge spillovers from the subsidiary to the local cluster mostly see knowledge spillovers as isolated acts of transfers.

Following the arguments of Bathelt and Li (2014), the role of foreign subsidiaries in a cluster and local buzz context should rather be seen as a permanent channel of external knowledge acquisition for the local firms. But at the difference of their approach, the subsidiary is not solely seen as a connection between related clusters, but rather as a permanent connection to the corporation knowledge base develop through the corporation's portfolio of subsidiaries and partnerships in multiple locations. This conception is more in line with the relationship between clusters and MNEs Mudambi (2002) highlights, which is that through knowledge flows between locations, subsidiaries and parents, the MNE acts as a carrier of knowledge between different locations. As it was discussed in the previous section, MNEs multiply their activities in various dynamic locations around the globe and develop strong abilities to gather and transfer knowledge within their extended network. In that matter, Mudambi et al. (2014) argued that: "the MNE's ability to undertake explorative R&D and mobilize the knowledge resources that exist within its network of subsidiaries is one of its key sources of value creation" (p. 49).

So as knowledge is propagated by the parent to the whole network (Ghoshal and Bartlett, 1988), internal knowledge transfers occur and the subsidiaries become both creators and recipients of the accumulated knowledge of the corporation (Almeida and Phene, 2004; UN and Cuervo-Cazzura, 2008).

Thus, the contribution of the foreign establishment is two-fold. On the one hand, it contributes to the collective knowledge-creation process with its own embedded knowledge and competences which are based on the corporation accumulated experience. Additionally, it serves as a permanent channel for local firms to obtain distant forms of knowledge through its corporation network. As the parent corporation spread knowledge within its network, the subsidiaries have constant inflows of such knowledge developed elsewhere.

This whole discussion on local clusters, the local buzz and frequent interactions, shows that the dynamic environment of industrial clusters accentuates local interactions and knowledge transfers. It can therefore be postulated that the new knowledge that is frequently acquired by the subsidiary will eventually spill over to the rest of the cluster, both through bilateral and multilateral relationships, in formal or informal ways. Consequently, the diversified knowledge the subsidiary assimilates from its parent does spread to the cluster and has the potential to enhance its global innovative capabilities.

The relationship between industrial clusters and foreign subsidiaries is altogether mutually beneficial. On one side, the dynamism of the cluster will act as a magnet for MNEs that seek to benefit from specialized sources of knowledge (Porter, 2000; Maskell, 2001). At the same time, the establishment of foreign subsidiaries in a cluster can revitalize and fuel its innovative activities through the new forms of knowledge it brings to the network.

The presence of foreign subsidiaries within a cluster can therefore become a durable source of diversified knowledge for the cluster and have thus the potential to concur with a better innovative performance.

It is consequently hypothesized that (H2): higher proportions of foreign subsidiaries in a cluster will be positively associated with higher levels of innovation.

2.9 Cultural proximity

Yet it is argued that foreign subsidiaries and clusters have a mutually beneficial contribution, there are some other factors to take into consideration. So far, most of the argument was based on the principle that geographical proximity engendered the underlying processes that fostered the creation of linkages. Many authors have argued, on the other hand, that geographical proximity alone cannot explain the development of a cluster. Rather, the creation of linkages could be seen as the result of other types of proximities that are necessary for the firms to cooperate more closely. Following this perspective, geographical proximity would be considered as an enabler for the formation of those more intangible forms of proximity (Antonelli, 2000; Breschi and Lissoni, 2001; Torre and Rallet, 2005; Morrison and Rabellotti, 2009). In the next section, those types of proximity will be explored with a particular focus on cultural distance, which is included as a moderating variable in the model.

Boschma (2005) proposes to distinguish between 5 types of proximity. First, he defines *geographical proximity* as the simple physical distance between economic actors and thus excludes the notion of networks and social ties from this concept. He argues on the contrary the social networks are not necessarily bounded by space, underlining the importance to separate the different dimensions of proximity.

Secondly, Boschma describes the *cognitive proximity* as to which extent knowledge embedded in the other firm is close to the existing knowledge base. The cognitive distance will not vary solely depending on the partner's forms of knowledge it possesses, but also depending on the firm's absorptive capacities. In fact, the more the firm will be able to develop strong absorptive capacities, the more it will be able to acquire more distant forms of knowledge, therefore reducing the cognitive distance with their partners.

The third type is the *organizational proximity*. It refers, on the one hand, to the management skills an organization possesses in order to exchange complementary knowledge both within and outside of the organization. In the case of inter-organizational proximity, it refers to “vehicles that enable the transfer and exchange of information and knowledge in a world full of uncertainty”, referring to “spaces of relations... in which actors are

connected” (p. 65). In other words, the connectedness between organizations can go from no relationship at all, to contractual relationships, joint research, etc. The exchange of information between organizations will therefore be influenced by their degree of integration.

Social proximity corresponds to the economic relationships embedded in social contexts. Boschma argues that economic relationships go beyond mere formal interactions and evolve in a social context, in which individuals share experience and emotional connections. Therefore, closer social proximity favours the establishment of long-lasting relationships and thus facilitates diverse forms of partnerships between the individuals’ respective organizations. This type of proximity relates strongly to what was developed earlier in this research on the fact that frequent face-to-face contacts engender trust and closer partnerships.

Finally, Boschma distinguishes the *institutional proximity* from the other forms. The general macro-environment influences the behaviour of economic actors. Individuals and organizations evolving in specific contexts share common general practices, values and references, and those are different depending in which institutional context the organization is. Thus, different institutional contexts can create barriers between two firms trying to establish a collaboration, for instance because of the different legal and contractual obligations, the difference in the language or in the business culture.

This research focus on the role of institutional proximity by addressing more particularly the cultural proximity. Parent corporations, and by extension the subsidiaries, come from various regions of the world and therefore operate in different institutional contexts. In that matter, institutional distance between the parent corporation and the host country can become problematic. The institutional attributes of a region can be regrouped in two major dimensions: the formal institutions, such as the legal system and the public administration, and the informal institutions, composed of social norms, habits and other cultural traits. Culture represents in that matter a major aspect of the institutional environment as studied by economic geographers. As Boschma states, culture refers globally to the “people[’s] share[d] set of values, such as ethnic and religious values” (p. 66). Culture affects business relationships by influencing aspects such as the development of trust between the actors.

As stated earlier, the development of trust depends greatly on the sharing of similar values as well as a common language (Maskell and Malmberg, 1999), which are two important dimensions of cultural proximity. The architecture of those different cultural dimensions therefore form a major part of the general institutional setting. Moreover, Boschma (2004) underlines that cultural proximity is an important enabling factor for the creation of external linkages. Firms need to share a certain cultural basis with their partners if they want their partnership to be conclusive (p. 1006). There is accordingly a great relevance to include the cultural dimension in a study on the impact of foreign subsidiaries in industrial clusters. Since the subsidiary belongs to a corporation coming from and evolving in different cultural contexts, this can have an impact on its ability to rapidly and efficiently create linkages with local firms. On the other hand, the subsidiary will be influenced by the culture of the cluster, leading to a certain isomorphism with the local environment. Hence, cultural proximity is an important dimension to take into consideration while studying this relationship.

At the empirical level, some studies have highlighted the role of those different dimensions of proximity for innovation. For instance, Eriksson (2011) shows that geographical proximity played in fact the role of an enabler for the reduction of cognitive distance which thereby favoured knowledge sharing and fostered innovation. Sotarauta (2011) puts forward concurring results, concluding that geographical proximity has a positive effect on innovation through the formation of cognitive and institutional proximity between the organizations that are co-located. Those studies highlight the interacting nature of the different types of proximity and their importance in knowledge exchange.

On the other side, the purpose of establishing external linkages is to broaden the knowledge base to enhance innovative capabilities (Nooteboom, 1999; Cohen and Levinthal, 1990). In that case, MNEs may rather seek cultural contexts that are qualitatively different from their home base (Frost, 2001) to get access to knowledge produced in a different institutional context and consequently increase their chances to retrieve information and knowledge of a different nature (Wuyts et al. 2005). Thus, there is a dual need for MNEs to both share a common culture to facilitate communication and trust while being different enough for the knowledge that is transmitted to be qualitatively dissimilar.

From the local perspective, the presence of foreign subsidiaries can represent a major advantage vis-à-vis other types of external linkages, since it can present a right mix of cultural proximity through physical co-location and distant forms of knowledge through the origin of the parent. On the one hand, being part of the same cluster allows the local and foreign firms, through a collective learning process, to develop and share common norms and cultural practices. Sharing the same values and language further foster the development of trust between the foreign subsidiary and the local firms and facilitate exchanges (Boschma and Frenken 2011). At the same time, the subsidiary acquires and integrate knowledge coming from the parent company, which has the potential to develop and possess an eclectic knowledge base due to a diversified network of subsidiaries and partners in different locations (Wuyts et al. 2005). Ultimately, by tightening the relationships with the subsidiary, local firms will benefit from the corporation knowledge through diffuse knowledge spillovers coming from the subsidiary, allowing the cluster to get access to a diversified source of knowledge with an access point incorporated in the foreign establishment.

Therefore, a variable on cultural proximity is added to the model in order to test whether or not cultural distance that exists between clusters (US) and the parent companies' countries of origin affect the relationship between the proportion of foreign-owned subsidiaries and the innovative performance of the cluster. In that sense, we argue that too much cultural proximity does not bring enough novelty in the kind of knowledge that is exchanged, while too much distance creates barriers in the effective transfer of diversified knowledge.

Thus: (H3) Cultural distance will moderate the relationship between the proportion of foreign subsidiaries and the innovative performance of clusters.

3. Data and empirical approach

To explore further the relationship between foreign subsidiaries, the innovative performance of clusters and cultural distance, a large-scale empirical approach was followed. As subsequently specified, data from three different sources was gathered and

further aggregated to explore the relationships at the cluster level. The study focuses on the United States. The first reason is the availability of data, both for subsidiaries and for the clusters (US Cluster Mapping). Moreover, there is a great number of diversified clusters in different areas in the US, allowing to avoid an over-homogeneous sample. In brief, this large-scale approach allows to assess whether clusters that encompass a higher proportion of foreign subsidiaries, with different levels of cultural distance between local and foreign firms, are correlated with higher levels of innovation.

3.1 Sectors selection

A total of nine sectors are comprised in this study. The sectors are namely: (1) Aerospace and Defence; (2) Biopharmaceutical; (3) Upstream Metal Manufacturing; (4) Downstream Chemical Products; (5) Downstream Metal Products; (6) Food Processing; (7) IT and Analytical Instruments; (8) Medical Devices; (9) Upstream Chemical Products. The sectors were identified in accordance to their technological level to avoid differences explained by the specific characteristics of different types of industries, such as low-tech, high-tech and services. Secondly, sectors were chosen for their relevance for the economy in a North-American context. These sectors have had important growth rates in recent years and have been targeted by many regional organizations as sectors of high interests³.

This study combines three sets of data. On the first hand, the data on subsidiaries were collected at the firm level from the *Orbis Database*. Collecting data at the firm level was necessary given the scarce availability of data on subsidiaries according to specific criteria. There were actually two major conditions needed for the data to fit in the architecture of the research question, which made in turn the use of national or international statistics on FDI irrelevant. First, the data needed to be disaggregated by specific locations. Secondly, the specific sector of activity was needed to match FDI (or foreign subsidiaries) with the data on clusters. Those two conditions could not be met by using national or international statistics. Consequently, the best solution was to identify subsidiaries at the firm-level by using the *Orbis* dataset. Orbis allowed to target firms that were owned by more than 50%

³ See for instance *Grappes Montréal*, *Montréal international*, *Compete Prosper*, and *Communauté Métropolitaine de Montréal*.

by a single foreign company, which consisted of the definition used to characterize a firm as a foreign subsidiary (Liu and Zou, 2008; Barrios et al. 2005; Guadalupe et al., 2012). In addition, *Orbis* gives specific information on the sector of activity (NAICS) and the specific location (ZIP-Code). All the information about foreign-owned subsidiaries were gathered and allocated to each cluster based on both the location and the sector of activity using the classification of Delgado et al. (2015).

The sample from orbis comprises close to 8000 subsidiaries in the United States from 9 types of industrial clusters. In this research, the county is the geographical scope that is considered for the activities of the cluster. Yet the geographical scope of clusters can vary (Porter, 2000; Delgado et al. 2010, 2015), defining them in rather small administrative regions concur with its conceptual nature and allow to draw further distinctions in the data. Actually, clusters spread their activities beyond a single city and often include the suburbs or other cities close to the urban areas (Guimaraes et al. 2000; Porter, 2003). Counties hence represent a good geographical scope to empirically assess of the characteristics of clusters and allowed to precisely match the data on foreign subsidiaries (of which the location was categorized by counties) with the data on clusters.

3.2 Data on clusters

The second dataset comes from the *US Cluster Mapping*. It offers a wide range of data on industrial clusters across the United States with indicators of their performance and composition. Close to 3000 county clusters (cluster with a location quotient > 1 delimited by the county) were identified from the 9 sectors of activities. From these, information on the location quotient and the level of innovative activities were collected for each county, along with more general information such as the level of economic activity and governmental support. A location quotient of 1 is further used as a threshold to discriminate between clustered and non-clustered locations (Delgado et al. 2015; Bathelt and Li, 2014).

3.3 Data on cultural distance

Finally, the data on cultural distance were gathered from the Global Leadership and Organizational Behavior Effectiveness (GLOBE) dataset on business culture differences

between countries. Data comes from survey-based study carried out in 2004 targeted at middle managers in close to 1000 organizations in 62 countries. GLOBE study is based on distinguishing different societal cultures and exploring their impact on the behaviour of organizations. GLOBE differentiates between cultural practices and values that define organizational behaviour in a country. Javidan et al (2005) define cultural practices in GLOBE as “measured with survey items assessing "what is" or "what are" common behaviors and institutional practices in society. They represented the way things were currently done in a culture” (p. 61). Cultural practices thus affect the way organizations actually interact and are therefore deemed relevant to be included in studies on FDI (MacDermott and Mornah, 2015). The indicator of cultural distance used in this study is based on the aggregation of the 9 indicators of societal practices: (1) Uncertainty avoidance; (2) Future orientation; (3) Power distance; (4) Collectivism I; (5) Humane orientation; (6) Performance Orientation; (7) Collectivism II; (8) Gender egalitarianism; (9) Assertiveness⁴.

3.4 Combination of data

Combining firm-level data with aggregated statistics to assess of foreign activities within a given geographical scope is common in the literature, although not specifically used for studies on the same topic as the research presented here. A non-exhaustive examination of how different authors operationalized foreign direct investments (FDI) and measured the number of foreign subsidiaries on a given territory effectively shows that many of them use statistics at the firm-level.

As it can be observed in **Table 1**, a small sample of 17 papers were specifically examined due to their relevance for the operationalization of FDI. From these, the majority of authors used national statistics on the activities of the firms, most of which used those statistics, however, to assess of FDI spillovers in terms of firm productivity. The criteria to determine the status of ownership are usually based on the foreign shares owned by foreign interests, whether it be 10% or 50% depending on the nature of the study. Although the majority of those studies presented in the table use national statistics, it is not well suited to account of

⁴ See Globe’s website for full details on the data: http://globeproject.com/study_2004_2007

FDI impacts in specific geographical settings nor to target specific sectors of activities following the industrial cluster typology.

The last row of **Table 1** is, on the other hand, of particular interest for the methodology used in this present study. Those studies similarly use a mix of public and private databases. For instance, Girma (2005) uses micro-level data to study the relationship between FDI and absorptive capacities. The author in fact considers the use of firm-level data as “best suited” (p. 290) to study interactions between local and foreign firms. Girma uses firm-level data from the private database *OneSource* (now *Avention*) to construct his indicator of FDI and cross those data with other sources for the complete model. In the case of Liu and Zou (2008), they merged data on mergers and acquisitions from the database *Thomson One* to account for foreign activities with national statistics on high-tech industry in China. Finally, Burger et al. (2015) use a similar method by combining data from the *Financial Times FDI Markets* database with data retrieved both from a survey and the European Cluster Observatory to study the attractiveness of European clusters vis-à-vis Greenfield investments.

In sum, the methodology used to construct the database is similar to what was done in the last studies presented above. Yet some specificities may diverge, it is a common and well-recognized methodology to merge firm-level data with aggregate measures when it comes to studying the impact of the presence of foreign companies in geographical settings.

Table 1. FDI Operationalization⁵

Surveys	Thomson 2002
National Statistics (Firm-level)	De Propris and Driffield (2006); Blalock and Gertler (2007); Girma and Wakelin (2007); Higon and Vasilakos (2011); Girma, Gong and Gorg (2008); Aitken and Harrison (1999); Konings (2001); Barrios Gorg and Strobl (2005); Sanfilippo and Seric (2016); Girma, Gong, Gorg and Lancheros (2015); Javorcik (2004)
Macro-Level Data	Garcia, Jin and Salomon (2013); Cheung and Lin (2004)
Private Datasets	Liu and Zou (2008); Girma (2005); Burger, Karreman and Eenennaam (2015)

3.5 Methodological challenges

Although the use of this kind of data is deemed to be relevant and well suited for such study, the combination of three datasets represented some methodological challenges. First, the data on foreign subsidiaries included some duplicates in *Orbis* due notably to a change in the name of the company over time or to a regrouping of different services of the same company in the same location. In accordance with the definition of an *establishment* in the US cluster mapping dataset and by the US Census Bureau⁶, the duplicates had to be removed or merged into a single establishment. The identification of the duplicates were made using the zip+4 digit codes⁷ available for each line in the dataset.

⁵ Most of these studies were not included in the literature review and focused on research questions mainly concerned with FDI. Their relevance lies on the methodology they used and were not directly in line with the specific research question discussed. Table 1 was therefore added to give a snapshot of empirical studies that followed similar designs or to make comparisons with the method used in this research. Empirical studies directly focusing on the research question of this study were presented in the literature review.

⁶ “An establishment is a single physical location at which business is conducted or services or industrial operations are performed. It is not necessarily identical with a company or enterprise, which may consist of one or more establishments. When two or more activities are carried on at a single location under a single ownership, all activities generally are grouped together as a single establishment” (<https://www.census.gov>)

⁷ ZIP + 4 has four extra digits that identify a specific segment of the five-digit delivery area -- like a city block, office building or individual high-volume mail receiver” (http://www.zipboundary.com/zipcode_faqs.html).

When it was not possible to clearly state the presence of a duplicate by looking directly at the data, a more refined research on the company was made.

Secondly, there is a time lapse between the data coming from the *US Cluster Mapping* (patent count and control variables) and the data on foreign subsidiaries. On one side, the last year available for the data in the US cluster mapping project is 2013, whereas the data on subsidiaries were collected in 2015. Consequently, the database contains subsidiaries that were established after the final year of patents count for the clusters. Some tests and verification were executed to ensure this situation did not cause problems for further statistical tests. A closer verification of the data confirmed that the mismatch is very minimal so it should not interfere in the results. First, slightly above 1% of the subsidiaries comprised in our database and of which the year of establishment was available (1686) were created after 2013.

Table 2. Year of Establishment

Year of Establishment	Freq.	Percentage
1700-1849	11	0.65
1850-1899	31	1.84
1900-1949	111	6.58
1950-1999	1053	62.46
2000-2012	460	27.28
2013-2015	20	1.19
Total	1686	100

Furthermore, in order to ensure that the data on subsidiaries was truly consistent with those coming for the USCMP, a correlation test was run between the number of subsidiaries (Orbis 2015) and the employment created by FDI in 2012 (the last year available on the USCMP). The results displayed in *Table 3* show strong and significant correlations between the two variables, therefore confirming that the distribution of FDI in the US did

not significantly change between 2012 and 2015. A Spearman’s correlation test was further run between those same variables.

Table 3. Correlation Matrix for FDI

	FDI per State	FDI employment creation 2012	Number of establishments
FDI per State	1.0000 2908		
FDI employment creation 2012	0.9301*** 2812	1.0000 2812	
Number of establishments (State cluster)	0.6272*** 2812	0.5733*** 2812	1.0000 2812
<i>Spearman's rho</i> (<i>FDI per state –</i> <i>FDI 2012</i>)	0.9662 ***		

The Spearman’s rho confirms that the relationship between those two items is nearly perfectly correlated, therefore rejecting the null hypothesis that the variables are independent. The ratio of foreign over local firms of each cluster can thus be assumed to have stayed strongly similar in this time lapse.

3.6 Dependent variable

The dependent variable consists of the innovative performance of the cluster. The total number of utility patents in each cluster as provided by the US Cluster Mapping Project will be used to assess the overall performance of the cluster. As stated by Jaffe et al. (1993), patents represent an official embodiment for novelty and contribution of new knowledge

created. Garcia et al. (2013) argue concurrently that patents count is an excellent indicator to evaluate the performance of organizations.

However, some criticisms toward the use of this proxy have been formulated over the years. Criticisms are mostly targeted to the reflectivity of this proxy to measure innovation. For instance, it has been argued that it fails to capture some dimensions like the development of new managerial practices or different kinds of innovations that are not patented because of strategic motives. Innovation also comprises novelty in the processes, in the marketing or in the organization of the company, all dimensions that are generally not formalized into utility patents (Thomson, 2002; Almeida and Phene, 2004). Although quantifying such a concept may prove to be imperfect, using patents as a proxy still gives a standard base for quantitative comparisons across different regions given their uniformity and their use by various types of innovative companies. The use of patents as of proxy for innovative performance has been acknowledged as accessible, reliable and well suited for cross-sectional studies with a geographical perspective (Porter, 2003; Cheung and Lin, 2004).

3.7 Independent variables

The first explanatory variable consists of the *proportion of foreign subsidiaries over the total number of firms in a cluster*. The variable reflects the presence of permanent connections to external pools of knowledge. To make sure that foreign parent companies are effectively linked to the subsidiaries, only those that are majority-owned (\Rightarrow 50%) by a singly foreign company other than private holdings are considered. Private holdings were excluded from the data given the tenuous links they may maintain with the subsidiary.

For cultural distance, the indicator used in this study represents the means of the 9 variables on cultural practices for each country from the Globe dataset. The distance is measured by the difference between the average score of cultural practices of the US and the average score of the country of origin of the subsidiaries' parent corporation (MacDermott and Mornah, 2015; Mornah and MacDermott, 2016; Tang, 2012)

3.8 Control variables

To control for the firm-level characteristics, the variable *Size of the corporation* was added. The fact that subsidiaries belong to a larger group can give it access to a broader international knowledge base through the corporation network. Corporations that maintain a large portfolio of locations have more opportunities to tap into diversified knowledge bases and hence increasing their own stock of knowledge (Mudambi 2002; Mudambi et al. 2014; Miller et al. 2007; Markides and Williamson, 1994). Subsidiaries belonging to large groups thus enhance the probability of bringing knowledge that is new to the cluster and thus size should affect positively the innovative performance of clusters.

Secondly, a set of other variables control for the general environment of the cluster both at the county and the state level. First of all, a control variable for the size of the cluster is comprised in the model. Indeed, the number of patents produced in a cluster should be directly related to the number of establishments in this cluster.

Controls about the external innovation dynamism are added both through the RD expenditure per capita and the federal funding per capita at the State level. RD expenditure reports of the innovative dynamism of other organizations in the same or other counties within the state. RD expenditure has accordingly been identified as a measure of innovation, acting as a considerable input for the introduction of new products (Baptista and Swann, 1998). Delgado et al. (2014) argued that the presence of other clusters in the same region can impact the performance of a single cluster, *inter alia* through inter-regional spillovers. So it is expected that a high level of innovative dynamism in the State will positively impact the innovative performance of the cluster.

The federal funding per capita at the state level refers to the institutional support given to innovation-related activities, thus acting as a proxy for public support in the state. In their study on innovation in clusters, Baptista and Swann (1998) argued that industrial innovation was relying heavily on scientific knowledge coming from government-funded R&D, which can represent important common knowledge pools when targeted at public institutes (Isaksen and Karlsen, 2012). This public support through R&D funding can thus positively impact the ability of firms in the cluster to innovate.

3.9 Final sample

The final sample is composed of 7840 subsidiaries from 9 types industrial clusters in the United States. At the aggregate level, a total of 2908 county clusters included 1 or more subsidiaries on their territory. Clusters without any subsidiary were not considered given the methodology used to create the aggregate measure for the ratio of foreign firms. As considered elsewhere (Delgado et al. 2015; Bathelt, 2014), a threshold of 1 of the location quotient is used as a minimum to discriminate between simple co-location and the presence of a cluster.

3.9.1 Size of the corporations

Most of the subsidiaries included in the dataset belong to rather large corporate groups (**Table 4**). Over 50% of them are part of corporate groups with over 100 companies and 11% with over 1000 companies. This suggests that those selected clusters in the US tend to attract more large corporate groups. This could potentially be explained by the fact that it might require large investments to first integrate and then benefit from those specialized environments.

Table 4. Size of the Corporate Group

Number of other companies in the corporate group	Frequency	Percentage
1-9	895	11.65
10-49	1145	14.90
50-99	599	7.80
100-199	1143	14.88
200-499	1576	20.51
500-999	1449	18.86
>1000	877	11.41
Total	7684	100

3.9.2 Spatial distribution

Table 5 below shows statistics on the location of the subsidiaries. By looking at a few key and diversified regions, we can see that the distribution by region is rather representative of the population density in the US. The largest difference is found in California, where the distribution of foreign subsidiaries is significantly larger than the proportion of the population. That may be due to the attractiveness California and in particular the Silicon Valley has had toward MNEs in high-tech sectors, due to its highly dynamic environment (Saxenian, 1994; Almeida, 1996). In line with what was previously discussed on the attraction power of dynamic clusters toward multinational companies, the fact that there is an “overrepresentation” of foreign subsidiaries in California is not surprising.

Table 5. Location in the US (sample)

Data on US population comes from the US Census Bureau, 2017

State	Number of Subsidiaries	Percentage	Population in the US 2015	Percentage
California	1379	17.59	38 993 940	12,15
Florida	451	5.75	20 244 914	6,30
Iowa	45	0.57	3 121 997	0,97
Maine	14	0.18	1 329 453	0,41
Massachusetts	270	3.44	6 784 240	2,11
New York	436	5.56	19 747 183	6,15
New Jersey	467	5.66	8 935 421	2,78
Texas	662	8.44	27 429 639	8,55
Wyoming	8	0.10	586 555	0,18
Total	7840		320 896 618	

Figure 3 and **Figure 4** below give a visual presentation of the distribution of those foreign subsidiaries in North America. Although this study focuses on United States clusters, data on subsidiaries in Canada was also available in the dataset and included in the visual presentations to show how the clustering of activities does not occur solely in the United States, but in Canada as well and potentially in many other countries.

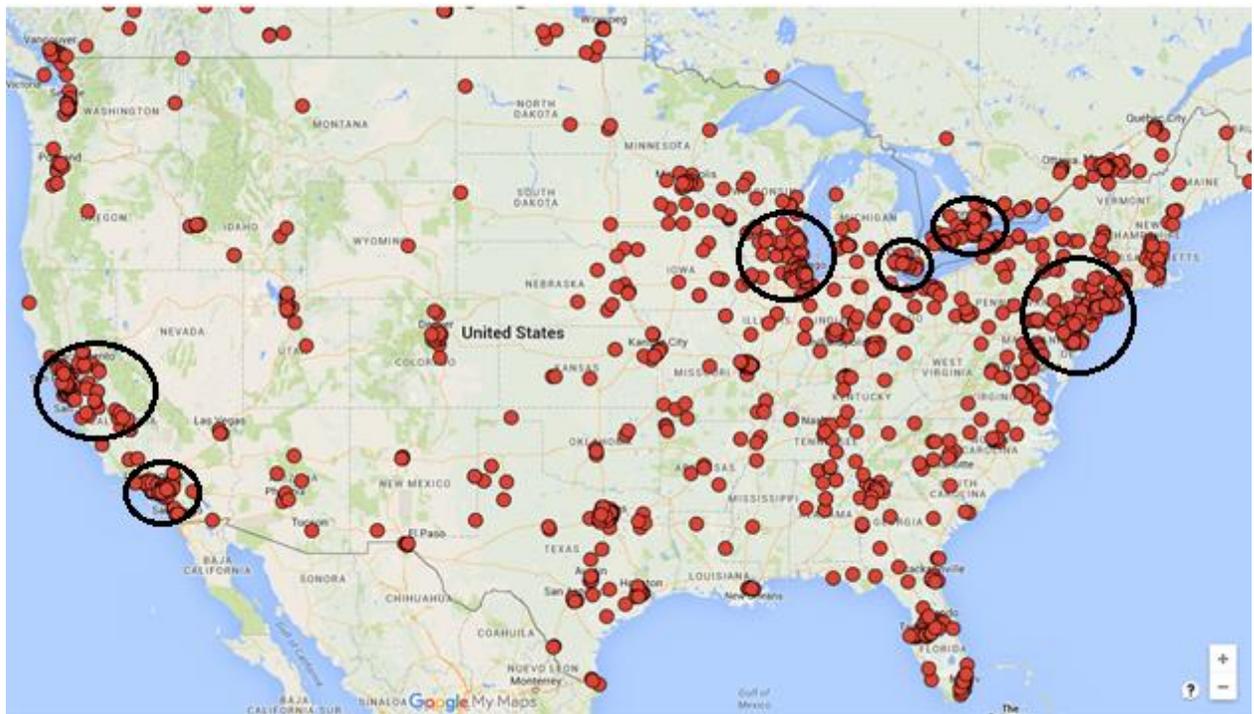
The figures below thus give a visual hint that foreign subsidiaries in different sectors effectively tend to regroup in specific geographical locations. For instance, **Figure 3** shows that besides being found around large urban cities, subsidiaries in the Food Processing and Manufacturing sector are found in great importance around the Great Lakes. For the Aerospace and Defence sector, on the other hand, the Great Lakes region presents a significantly lower density of foreign subsidiaries (**Figure 4**), suggesting therefore that this

region offers advantages for the Food Processing and Manufacturing sector that do not equally suit the needs of the Aerospace and Defence sector.

The comparison of these two sectors also gives interesting insights when looking more closely at states like Wisconsin and Minnesota, two states in which agriculture and manufacturing are important sectors⁸. Not surprisingly then, there is a great concentration of firms in the Food Processing and Manufacturing industry in these States, whereas only a few firms in the Aerospace and Defence sector can be found. These visual insights are further confirmed by the data on employment share and sector specialization found in the *US Cluster Mapping* database. The Aerospace and Defence sector shows a specialization indicator of 0.32 in Minnesota and 0.06 in Wisconsin, while the employment in this sector is 3799 employees in Minnesota and 677 employees in Wisconsin in 2014. On the other side, the Food Processing and Manufacturing sector is very dynamic in Minnesota and Wisconsin, with respectively a specialization score of 1.42 and 2.26, as well as 31 311 and 49 064 employees in 2014.

⁸ See Bureau of Labour Statistics

Figure 3. Food Processing and Manufacturing



*Note: The maps were created using *Google Map*. The circles represent single foreign subsidiaries and were located using their zip+4 codes.

On the other side, it is clear from **Figure 4** below that the subsidiaries in the Aerospace and Defence sector tend to be located in specific areas as well, such as in the north-east region of the USA, Los Angeles, Toronto and Montreal. In the case of this sector, the grouping of subsidiaries around specific regions looks even more important, as very few other locations seem to have a large base of subsidiaries.

These figures propose that foreign subsidiaries effectively agglomerate around specific regions, and those are different depending on the sector of activity, which is in line with what was previously discussed in the literature review.

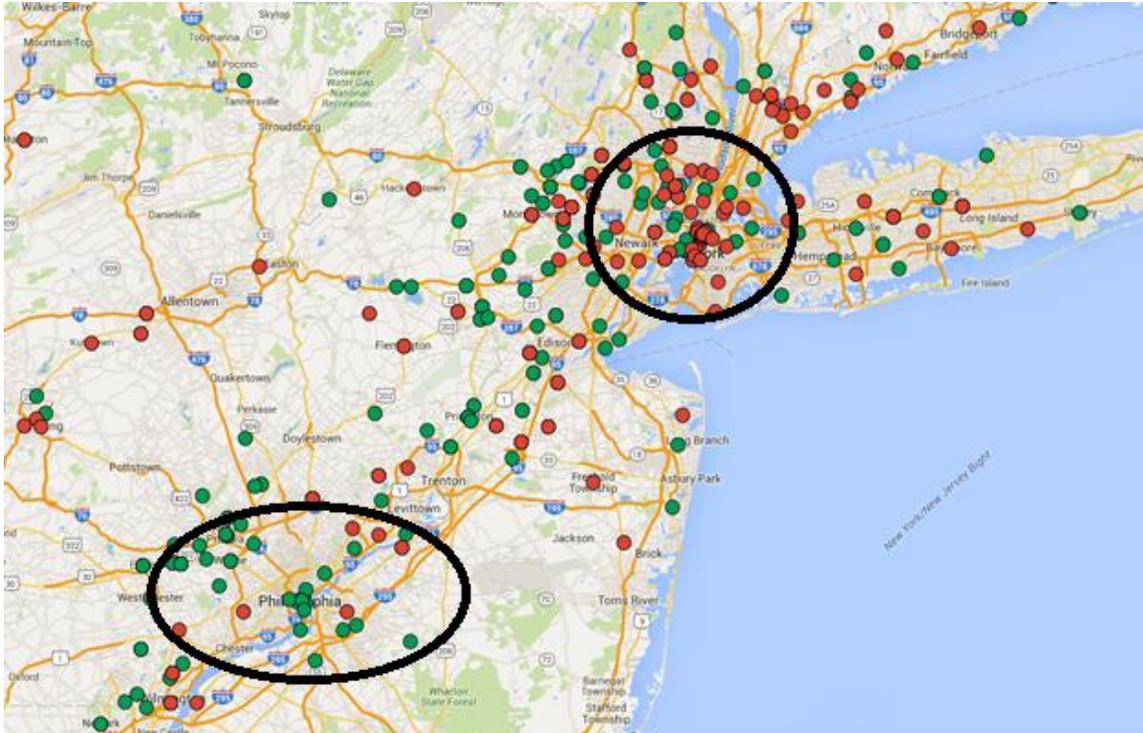
Figure 4. Aerospace and Defence



*Note: The maps were created using *Google Map*. The circles represent single foreign subsidiaries and were located using their zip+4 codes.

At a smaller scale, the spatial distribution of the subsidiaries in the Food Processing and the Biopharmaceutical industries in Pennsylvania also gives some good clues about the differences that can exist between two sectors of activity. **Figure 5** shows that there are multiple foreign establishments around Philadelphia in the Biopharma sector (green), whereas there is almost none of the Food Processing and Manufacturing (red). On the other side, New York City and the surroundings seem to harbour more companies in the Food Processing and Manufacturing sector than in the other. This suggests that regional differentiation is not solely found at the state level, but also at a regional and city levels, supporting the methodological choice of focusing on counties.

Figure 5. Comparison between the Biopharmaceutical and Food processing and Manufacturing Sectors



*Note: The maps were created using *Google Map*. The circles represent single foreign subsidiaries and were located using their zip+4 codes.

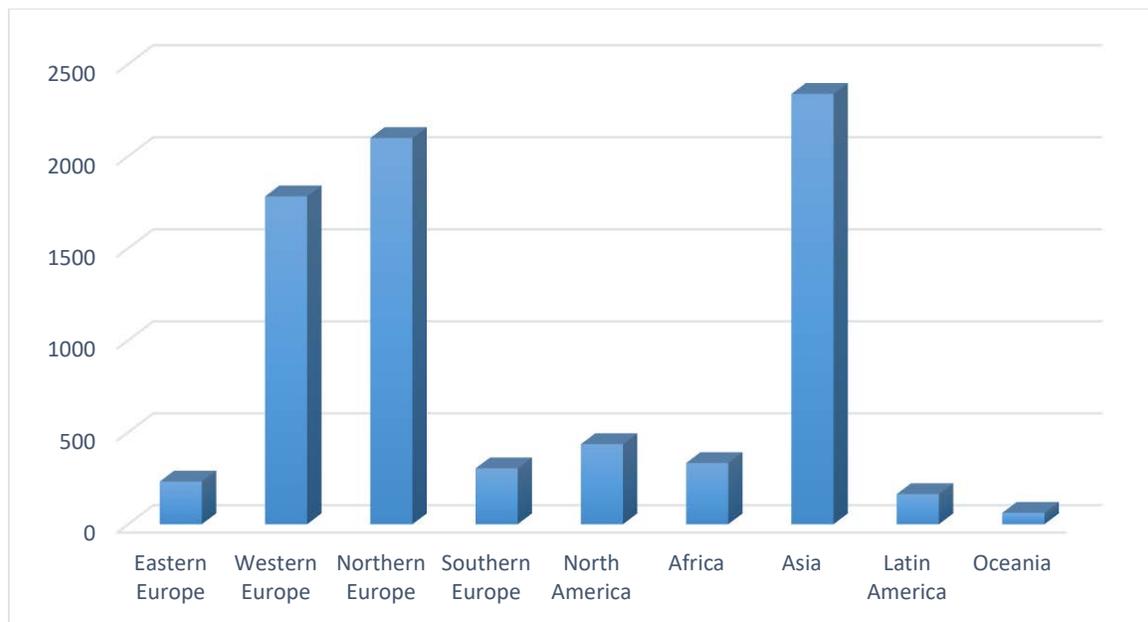
In sum, these visual representations suggest that there is seemingly a pattern in the location choice of multinational companies in the US and that depends on the sector of activity of this firm and the advantages different regions offer. This statement will be further explored in the statistical section by looking at whether counties in which there is the presence of a cluster attract more foreign subsidiaries of the same sector than non-clustered locations.

3.9.3 Country of origin

In addition, primary statistics show that parent companies also come from various regions of the world. Although a great majority comes from Northern Europe, Western Europe and Asia, all regions are more or less represented in the sample. The distribution reflects modern trends in global FDI, as Asia is now the biggest investing region, while European

and North American MNEs are still important investors. The importance of North American FDI is indeed not represented, as inward investments in the US were not included in the dataset. North America thus solely includes Canada and Mexico. Also in accordance with the global distribution of FDI, Africa and Latin America are not massive investors in the US (UNCTAD, 2015)

Figure 6. Country of Origin



In sum, the diversity in the sectors of activity, the country of origin of parent firms, the location in the US, and in the size of the corporations suggests a strong coherence in the dataset and allows to avoid potential biases of non-representative samples. Moreover, these descriptive statistics already highlight some patterns in the distribution of FDI in the US around specific locations, which is in line with hypothesis 1.

4. Statistical design

The sample is further analyzed in this section to test the hypotheses developed in the conceptual section. The first hypothesis is tested using a T-Test. Group 0 represents sectors

in counties with a LQ below 1 (non-clustered regions; n=1624) and Group 1 represents county clusters with a LQ above 1 (n=1033). The t-test allows to analyze whether there is a higher average of foreign subsidiaries in clusters (of the same type) than in non-clustered locations, which would reflect a greater attraction power of clusters toward MNEs.

For the main model on the impact of the proportion of foreign subsidiaries and the cultural distance on the innovative performance of the cluster, the multinomial regression presents the best features. First, the distribution of patents did not follow a regular pattern. Instead, most counties were grouped around low levels of patents whereas other groups of counties were clustered in the data around a few other levels of innovation. Considering the gaps between these different levels of innovation, regrouping them into categories was the best option. Moreover, the nature of the test allows to give a certain scale of intensity for the effect of independent variables on the dependent variable by observing the relative risk ratio (rrr), which indicates how a change in X increases the probability of a county to fall into a category of innovation. Therefore, four categories were created for the patents count in accordance with the clusters of data present in the distribution: (1) No patents (0 patents, n=434); (2) 1-24 patents (n=397); 25-49 patents (n=58); 50+ patents (n=87).

The general model goes as follows:

$$\frac{\log \{ P(Y = n | X_1, X_2, X_3, X_4, X_5, X_6) \}}{\log \{ P(Y = 0 | X_1, X_2, X_3, X_4, X_5, X_6) \}} = \frac{\beta_{01} + \beta_{1n} \text{Foreignsubsidiaries} + \beta_{2n} \text{Culturaldistance} + \beta_{3n} \text{Culturaldistance}^2 + \beta_{4n} \text{Sizecluster} + \beta_{5n} \text{RDexpenditure} + \beta_{6n} \text{Federal funding} + \beta_{7n} \text{Sizecorporations} + \mu n}{\beta_{6n} \text{Federal funding} + \beta_{7n} \text{Sizecorporations} + \mu n}$$

n=3

The results are reported in relative risks ratios, which allow to calculate how an increase of 1 for a given X multiplies the propensity in falling in Y=n over Y=0 (base outcome). The McFadden R2 is reported for the whole model. According to Sonka et al. (1989), the typical range of this R2 is between 0.2 and 0.4 for such type of model. As robustness checks, three tests are run for the model. First, multicollinearity is tested using VIF. Secondly, Wald's test is used to assess whether the model comprises the right categorization of Y. Finally, a Hausmann test is run to check for the independence of alternatives.

5. Results

Table 6 presents the correlation matrix for all the variables included in the model.

First for the control variables, they all show a positive and significant correlation with the level of patent count. The proportion of foreign subsidiaries is significant but negatively correlated with the level of patents, suggesting that a higher level of foreignness in a cluster undermines the innovative performance of the cluster. However, such correlations are not so relevant given the nature of the dependent variable and the clustering of data around some levels of innovation. The scatter plot below shows the relationship between foreign subsidiaries and patents. We can see that it does not follow a linear relationship, therefore explaining why the correlation cannot be interpreted as it is presented.

Figure 7 Scatter Plot

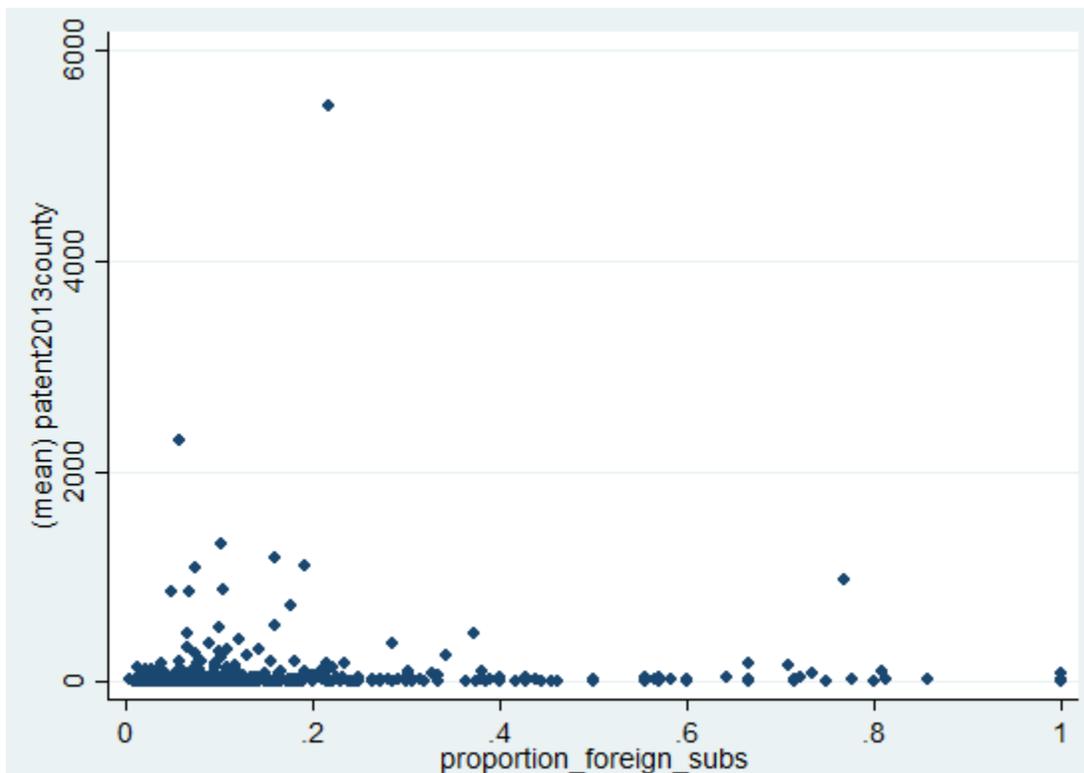


Figure 7

Thus, multinomial regression will be better suited to assess of this relationship. Cultural distance is not significant, but as it will further shown, its relationship with innovation rather follow a U-Shape curve, which is not captured by the correlations.

Table 6 Correlation Matrix

	Patents count	Proportion of foreign-owned subsidiaries	Cultural distance	Size of the cluster	R&D expenditure	Federal funding	Size of the corporations
Patents count	1.00						
Proportion of foreign-owned subsidiaries	-0.14***	1.00					
Cultural distance	0.03	-0.10***	1.00				
Size of the cluster	0.53***	-0.69***	0.11***	1.00			
R&D expenditure	0.30***	-0.14***	-0.01	0.25***	1.00		
Federal funding	0.15***	-0.08**	0.08**	0.08**	0.66***	1.00	
Size of the corporations	0.36***	0.06	-0.05	0.32***	0.10***	-0.01	1.00

Note: *** is significant at the 1% level; ** is significant at the 5% level; * is significant at the 10% level.

Furthermore, Hypothesis 1 is tested using the t-test between two groups, non-clustered locations ($lq < 1$) and clusters ($lq > 1$). The results shown in **Table 7** below **confirms H1** that foreign companies in the selected industries tend to favour clusters of similar and related industries over other locations to establish a subsidiary. The difference in the means is around 1 and is highly significant ($P < 0.01$), with a robust number of observations. The means are rather low given that some counties encompass a low number of firms. The standard deviation is quite high, on the other hand, because in spite of the relative low number of subsidiaries in some counties, some others show a high number, for example in

counties in California, New York or New Jersey, leading to an important standard deviation. Nevertheless, the test is strongly significant and does confirm that clusters attract in general a higher number of foreign subsidiaries.

Table 7. T-Test for Regional Clusters and Non-Clustered Locations

	n	Mean	SD	t	df	P
Non-clustered locations	1624	2,55	4,41	-3,99	2655	0,0001
Clusters	1033	3,58	8,76			

Finally, **Table 8** presents the results of the multinomial regression to test for **H2** and **H3**. The multinomial regression shows highly significant results ($P > \text{Chi}^2 < 0.01$; McFadden's $R^2 = 0.21$). For the control variables, the level of RD expenditure has a positive and significant effect on the propensity to be in higher categories of innovation in comparison to the base outcome. However, the rrr (1.0004; 1.0006; 1.0007) show that the effect of having more investments in R&D at the state level, representing the innovative dynamism around the cluster, has only a marginal effect on innovation. The size of the cluster also impacts the likelihood for a region to be highly innovative. The rrr is stronger the higher the category, suggesting that the effect of size is increasingly important to reach higher levels of innovation, which was expected given the logical link between a greater number of establishments and more patents. Concerning the size of the subsidiaries' corporations, the variable is positive and significant solely for the last category. This suggests that a greater size does not influence the propensity for the cluster of being in a lower or in the middle category of innovative performance in comparison to a non-innovative region, while it increases the chances of falling into the highest innovation category (RRR= 1,28; $p < 0,1$) over the base outcome. This is in line with the theoretical argument showing that larger corporations generate broader knowledge and thus provide more diversified and complementary knowledge to the cluster, increasing its innovative capabilities (Mudambi

2002; Mudambi et al. 2014; Miller et al. 2007; Markides and Williamson, 1994). Finally, public support through federal funding is not significant for any of the categories.

For the explanatory variables, the proportion of foreign subsidiaries is strongly significant for all categories and the intensity of the relative risk ratio (rrr) is increasing exponentially for higher categories. That means that having a higher proportion of foreign subsidiaries increase the propensity for the cluster of being in higher categories of innovation in comparison to the base outcome, and that effect is stronger the higher the category: rrr 1-24 patents = 4,49; 25-49 patents = 26,16; 50+ patents = 452,65. This result strongly confirms H2.

For the cultural distance, our results provide interesting insights. The regular variable is negative and significant for the low and medium innovators categories (-1,46, $p < 0,01$; -2,31, $p < 0,01$). The quadratic term is, on the other hand, positive and significant for the same 2 categories. This suggests that the relationship follows a u-shape curve (See **Figure 7** below). Thus, both little and high cultural distance have a positive impact on the propensity to innovate more, whereas a moderate cultural distance has a lower impact, but only for the low and medium levels of innovation. The cultural distance (in both directions) is then not a significant determinant that influence the propensity of a cluster to fall in the highest level of innovation in comparison to non-innovative clusters. This result contradicts H3.

Table 8. Multinomial Results (next page)

	Base outcome =0 (n=434)	1-24 patents (n=397)	25-49 patents (n=58)	50+ patents (n=87)			
Dependent Variables	Variables	Coefficient	95% CI	Coefficient2	95% CI2	Coefficient3	95% CI3
Proportion of foreign-owned subsidiaries	1.50*** (4.49)	0.51 -2.49 (1.67 - 12.02)	3.26*** (26.16)	1.24 -5.28 (3.48 - 196.23)	6.12*** (452.65)	3.72 -8.52 (41.06 - 4990.21)	
Cultural Distance	-1.46*** (0.23)	-2.38 -0.54 (0.09 - 0.58)	-2.31*** (0.10)	-3.79 - -0.841 (0.22 - 0.43)	-0.72 (0.49)	-2.73 - 1.3 (0.07 - 3.65)	
Cultural Distance2	0.55*** (1.73)	0.13 -0.97 (1.14 - 2.63)	0.9*** (2.47)	0.36 -1.45 (1.43 - 4.24)	0.47 (1.60)	-0.35 -1.30 (0.70 - 3.66)	
Control Variables							
Size of the cluster	0.67*** (1.96)	0.42 -0.92 (1.52 - 2.52)	1.44*** (4.22)	0.97 -1.91 (2.63 - 6.77)	2.79*** (16.31)	2.19 -3.39 (8.96 - 29.69)	
RD expenditure	0.0004*** (1.0004)	0.0001 -0.0007 (1.0001 - 1.0007)	0.0006*** (1.0006)	0.000 -0.001 (1.00 - 1.001)	0.0007*** (1.0007)	0.0001-0.001 (1.0001 - 1.001)	
Federal Funding for RD	0.00006 (1.0001)	-0.0031 -0.0033 (0.997 - 1.003)	0.0009 (1.001)	-0.004 -0.006 (0.995 - 1.007)	0.003 (1.004)	-0.002 -0.01 (0.998 - 1.01)	
Size of the corporations	0.063 (1.07)	-0.31 -0.16 (0.97 - 1.17)	0.146 (1.16)	-0.74 -0.37 (0.93 - 1.44)	0.25* (1.28)	-0.03 -0.53 (0.968 - 1.70)	
Constant	-2.05 (0.13)	-2.95 - -1.14 (0.52 - 0.32)	-7.06 (0.0008)	-8.92 - -5.20 (0.0001 - 0.005)	-14.54 (4.82e-07)	-17.23 - -11.86 (3.28e-08 - 7.09e-06)	

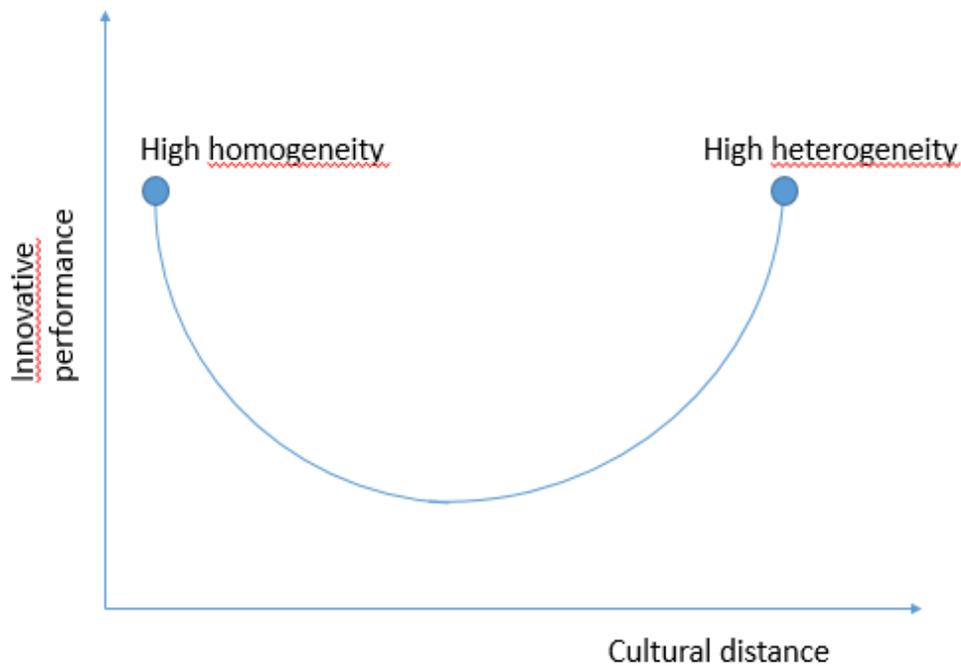
n = 776

LR chi2(18) ***

McFadden's R2: 0.21

Notes: *** significant at the 1% level; ** significant at the 5% level ; * significant at the 1% level

Figure 8. Cultural Distance



A linear regression was further run to test for multicollinearity between the variables. The results show no issues on that matter; the highest value (VIF) is lower than 3. Concerning the categorization of the dependent variable, the Wald's test rejects the possible combinations of categories, i.e. the hypotheses that the variables do not differentiate between categories are rejected ($p < 0,01$; $p < 0,01$, $p < 0,01$). The Hausman test also holds for the assumption that alternatives are independent (25-49: $p = 0,1$; 50+: $p = 1,0$).

6. Discussion

The results hence bring many elements of discussion and contribute in many aspects to the understanding of the relationship between foreign subsidiaries and industrial clusters. To date, few empirical studies had explored the potential impact of the presence of foreign subsidiaries on the performance of clusters, especially with regards to innovation. With a database comprising close to 8000 subsidiaries distributed in around 3000 counties, the results give a good indication of the positive interplay between clusters and MNEs.

Those results suggest that MNEs and industrial clusters are interdependent for knowledge sourcing. The conceptual design of this research was based on two broad literatures: international business and economic geography. At the core of the conceptual development lied the role of tacit knowledge as a source of development and competitiveness both for regions and MNEs (Grant, 1996; Boshma, 2004; Amin and Cohendet, 1999; Breschi and Lissoni, 2001). The exploration of the notion of knowledge through the works of Polanyi, Nonaka and Grant underlined the uniqueness of knowledge developed within the organization and the related difficulty to communicate it, especially in its tacit form. These arguments highlighted the importance of close interactions between individuals and organizations to acquire and share tacit knowledge (Storper and Venables, 2004; Bathelt et al. 2004; Ibrahim et al. 2009). Maskell (2001) argued in that vein that as knowledge circulates between actors in a same region, no single actor can actually claim the property over this knowledge that is accumulated in the cluster. This strengthens the argument that tacit knowledge has a localized nature which calls for co-location.

In parallel, Dunning (1998), Cantwell (2009), Dellestrand and Kappen (2012), Mudambi et al. 2014, among others, extensively developed the idea that MNEs were increasingly relying on intangible resources for the development of their competitive advantage. In that matter, the clusters can represent attractive locations given their dynamic and highly innovative environment, and given the fact that tacit knowledge is hardly accessible from outside. Our results show in that matter that the high dynamism and the important knowledge base of the clusters do attract more foreign subsidiaries than other locations, revealing the global attractiveness of clusters towards MNEs. That suggests that MNEs tend to establish their subsidiaries more importantly in industrial clusters to access specialized knowledge.

This research also explored the perspective of the cluster in its relationship with MNEs. The hypothesis that clusters would benefit from a greater presence of foreign subsidiaries was confirmed by our results, showing that a higher proportion of foreign subsidiaries in the cluster was strongly associated with higher levels of innovation. In line with Bathelt and Li (2014), those results suggest that foreign subsidiaries act as permanent pipelines to

external sources of knowledge for the cluster and hence contribute to its innovative performance.

However, this research extended Bathelt and Li's conception of the foreign subsidiary as a link between related clusters to rather argue that the foreign subsidiary represented in fact a permanent connection to the corporation pool of knowledge developed through its global network of subsidiaries and partnerships. From the cluster perspective then, the subsidiary is a repository of the corporation knowledge in addition to be the recipient of frequent knowledge transfers coming from the corporation network. Consequently, through frequent interactions and formal and informal linkages, their presence in the cluster represents a source of external knowledge for the local firms, which was reflected in the results.

The role of the foreign subsidiary as a permanent bridge between the cluster and the corporation knowledge pools can thus better explain both the motivations of the MNE to establish a foreign subsidiary in a cluster in order to benefit from localized knowledge, and the advantage for a cluster to attract foreign subsidiaries that provide external knowledge to the other organizations.

Another important contribution of this research concerns the consideration of the cultural distance between the country of origin of the parent and the location of the cluster (US). It was developed that culture was important in two broad ways in this relationship. It was argued on one side that firms need to share a certain level of proximity to facilitate communication and knowledge transfers (Eriksson, 2011; Sotarauta, 2011; Boschma, 2005). On the other side, those firms need to share a certain cultural distance in order to acquire new forms of knowledge (Nooteboom, 1999; Wuyts et al. 2005). The results contradicted this idea and rather showed that either high homogeneity or high heterogeneity were beneficial for innovation in the cluster while moderate distance reduced the intensity of cultural distance on innovation. However, cultural distance was not significant for the highest category of innovation, which could suggest that cultural distance is an important moderator of the relationship between foreign and local firms with regards to innovation particularly in the phase of maturation of the cluster.

The literature in team management can bring interesting analytical insights about these results. Earley and Mosakowski (2000), through three studies on international teams and their performance, show that highly homogeneous teams and highly heterogeneous teams performed better than teams with a moderate heterogeneity. Homogeneous teams are defined as members “sharing key salient characteristics” (p. 28), relating to perceptions, roles and responsibility, which are strongly connected to culture. The authors show that homogeneous teams could readily and efficiently start working together and thus show a good team performance. In the case of high heterogeneity in the team, better performances would come after a period of adaptation. Over time, members of such teams are able to create common norms, a shared language and shared expectations, superposing an “artificial” culture over the individuals, defining the roles and responsibilities of each. This process led both to creativity and efficiency in the working process, leading to better performances.

The least performing groups were the ones with moderate heterogeneity. In such teams, the authors observed problems of subgrouping. Individuals with similar cultures would regroup together, leading the whole group to live “communication problems, relational conflict and low levels of team identity” (p. 45). These general results were also put forward by Richard et al. (2004), which showed that in a highly innovative context, low and high management group heterogeneity had a stronger positive impact on productivity than groups with moderate heterogeneity.

Stahl et al. 2010 advance some more complex results. The authors pursued a meta-analysis of different studies to assess the impact of cultural diversity on team performance. They highlight that cultural diversity has a positive impact on team creativity, and that cultural diversity did not significantly affect communication effectiveness. This is in line with the study aforementioned which stated that culturally diversified groups tended to create overlying norms enabling communication. Stahl et al., however, find that cultural diversity could hamper team work effectiveness because of task conflict, without specifying exactly at what level of diversity this would happen.

Those insights from the management literature provide many avenues for reflection. Those studies focused on teams of individuals rather than the interactions between organizations

themselves. Further studies would be needed to understand the processes through which a high heterogeneity or a high homogeneity can affect innovation in a cluster context. The results suggest, on the one hand, that clusters with high cultural distance enhanced the innovative performance. It can be expected that this situation is due to the diversified knowledge those different organizations bring to the cluster, enlarging its knowledge base. Building on the literature on management, organizations could be able to create a shared language and shared norms in the cluster that would become specific and overlying, allowing knowledge flows. On the other hand, clusters with high homogeneity were also more conducive to show higher innovation performances. It could be stated that the efficiency of communication means and facilitated collaboration offset the potential lack of diversity in the cluster, thereby contributing to innovation. Conversely, knowledge transfers in clusters in which there is a moderate distance between the organizations would be hampered. It could be hypothesized at that level of analysis as well that in such clusters, there is a process of subgrouping between a few groups of organizations that share a similar culture, but that communication between those subgroups is not very efficient.

The results also raise questions on why cultural distance is not significant for the higher category of innovation. Two main avenues for reflection arise. First, as the cluster reaches maturity in its innovative capabilities, it could be hypothesized that firms have been able to create effective communication channels and partnerships regardless of the cultural distance that exists between the firms. This relates to the question of embeddedness discussed earlier, which would suggest that firms are increasingly integrated over time, facilitating knowledge transfers (Martin and Sunley, 2006). The second potential explanatory factor is that over time, firms in highly innovative clusters have been able to develop strong absorptive capacities, therefore reducing the perceptible distance with their partners (Boschma, 2005). Those ideas therefore call for further studies.

7. Limits and further studies

These last remarks on cultural distance pave the way to expose some limits of this research and the potential for further studies. The first limit that needs to be exposed refers to the choice of patents as a proxy for innovation. As discussed in the methodology section, the

use of patents is controversial, since it fails to capture a whole set of innovations that are deemed important for organizations but that do not necessarily lead to patenting. The use of this proxy must then be used with respect to its limits. In that case, the choice of the sectors is important, since some sectors of activity can be more prone to patenting than others. This study took into consideration these limits by selecting industrial sectors focusing on high-end products and preliminary showing high levels of innovative activities. The use of patents also calls for caution for studies that seek to compare innovation between countries, as the intellectual property regimes can vary.

Another limit of this study was partly imposed by the nature of the test. Multinomial regressions are not necessarily efficient for a large number of variables, thus limiting the amount of control variables that could be added to the model. In addition, some firm and region-level variables would have been relevant to be included as controls, but were partly or totally missing from the database. For instance, the statistical tests did not take into consideration the presence and the quality of supportive institutions in the region, the maturity of the cluster (in terms of age) and the level of control of the parent over the subsidiary. Those factors should be taken into consideration in further studies as they could be strong explanatory factors influencing the relationship between MNEs and clusters' performance.

Furthermore, although significant relationships were found between the presence of foreign subsidiaries, the cultural distance and the level of innovation, the cross-sectional nature of the statistical methodology does not allow to imply any causality. Yet the results show that higher proportions of foreign subsidiaries are associated with higher levels of innovation, it is not possible to tell at what stage of development of the cluster is the attraction of foreign subsidiaries happening and beneficial. Further studies should consider an evolutionary perspective of the establishment of foreign subsidiaries in industrial clusters. Gathering panel data over long cluster life cycles would allow to inform public authorities if the development of the cluster is fostered by the attraction of foreign firms, or conversely, if a performing cluster attracts foreign firms over a certain period of time. Understanding the relationship between MNEs and clusters in an evolutionary perspective

would allow economic strategies for the development of clusters to be well adapted to their maturity level.

These questions call for a more systematized data collection, organization and availability from public/private organizations on both industrial clusters and foreign subsidiaries. Few available data permits to explore the characteristics of foreign subsidiaries in a specific region and data on clusters are not complete and not systematically available for many regions, including Canada.

Conclusion

This research extends the understanding of the relationship between MNEs, clusters and culture. The changing economic landscape has challenged the way regions are conceived in front of a globalized environment. In parallel, multinational companies have extended their network of activities, while their motivations are manifold. This research has observed these phenomena through the lens of a knowledge-based approach, which considers both the interests of the clusters and the MNEs to lie on the search of new and diversified knowledge to extend their capabilities and performance.

This research provides empirical evidence of the positive relationship between MNEs and clusters. From a dataset comprising over 7800 subsidiaries and 3000 counties regrouped around 9 types of industrial clusters, this study shows that a stronger proportion of foreign subsidiaries is positively associated with better innovative performances. This study further contributes to the understanding of the relationship between clusters and MNEs by showing that cultural distance was an important moderator. The inclusion of an indicator of the cultural distance between foreign and local firms highlights that both high heterogeneity and high homogeneity are beneficial to innovation in clusters, whereas a moderate distance is detrimental. This study therefore contributes to providing empirical insights of the impact the attraction of foreign subsidiaries can have on the industrial cluster along with providing a comprehensive conception of the role of the subsidiary as a bridge between the cluster and the corporation knowledge.

Yet further studies are needed to explore this relationship in an evolutionary perspective to dig deeper the role of culture between organizations in a cluster. Exploring an evolutionary perspective on the impact of the establishment of foreign subsidiaries in clusters would allow to better align public policies targeted at regional economic development. Nevertheless, this research allows to understand the important role of the subsidiary in the modern economy as an important incarnation of global knowledge flows and suggest that the presence of those subsidiaries is capital for innovation in clusters. This consequently inform policy makers about the attraction of foreign subsidiaries as an important tool to foster the development and to reinvigorate the innovative capabilities of clusters in specialized sectors.

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Appendix 1

<i>Knowledge-based theory of the firm</i>		
Definition of knowledge		
	Grant (1996)	Circulation of knowledge within organizations; the diffusion of knowledge is a fundamental reason of the existence of firms
	Nonaka (1991)	Knowledge embedded and accumulated in organizations
	Nonaka et al. (1996)	Definition of knowledge as “a meaningful set of information that constitutes a justified true belief and/or an embodied technical skill...” (p. 205)
	Nonaka and Von Krogh (2009)	Conceptualization of the nature of knowledge in a continuum explicit-tacit
	Polanyi (1966)	Develop the idea of the intangibility of knowledge
Tacit knowledge as a competitive advantage (of firms and geographical locations)		
	Antonelli (2000)	Tacit knowledge is created and accumulated in clusters through interactions between various actors
	Amin and Cohendet (1999)	Tacit knowledge represents a unique asset for firms and a vital dimension of its competitiveness
	Boshma (2004)	Tacit knowledge represents the fixed capital of the firm
	Breschi and Lissoni (2001)	Collective process of knowledge creation is embedded in relations of proximity and spatially bounded

Maskell (2001)	Knowledge is accumulated within regions and found within geographical boundaries
Maskell and Malmberg (1999)	Tacit knowledge is found at the organizational level in the routines and processes
Morgan (2004)	Firms agglomeration around tacit knowledge pools
Nonaka (1991)	Four mechanisms of knowledge creation in organizations
Nooteboom (1999)	Tacit knowledge can represent good practices, specializations related to specific contexts, problem-solving mechanisms.
Rigby (2000)	Knowledge is accumulated in networks, institutional contexts and geographical locations

Theories of agglomerations

Different perspectives on agglomerations

Furman et al. (2002)	The role of education in systems of innovation
Hervas-Oliver et al. 2015	Literature review on the different research streams in the economic geography field.
Krugman (1991)	Theory of industrial districts
Lundvall (2010)	The role of formal and informal institutions in systems of innovation
Marshall (1919)	Concentration of economic activities in specific geographic areas
Markusen (1996)	Typology of industrial districts
Narula (2002)	Cumulated knowledge in systems of innovation
Nelson (1993)	Theory of the systems of innovation

Industrial Clusters

	Altenburg and Meyer-Stamer (1999)	Development of the idea of industrial clusters as a tool for policymaking
	Felbinger and Robey (2001)	Development of the idea of industrial clusters as a tool for policymaking
	Ibrahim et al. (2009)	Three categories of externalities that can emerge from clusterization
	Ketels and Memedovic (2008)	Development of the idea of industrial clusters as a tool for policymaking
	Martin and Sunley (2003)	Criticism on the limits and flaws of the concept of industrial clusters
	Maskell (2001)	There are two dimensions of relationships in clusters that lead to positive externalities - the horizontal (competitors) and the vertical (value chain) dimensions.
	Porter (1990)	Theorization of the factors that lead to geographical specialization; theory on industrial clusters
	Porter (2000)	Definition of industrial clusters as “geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions, in a particular field that compete but also cooperate.”
	Saxenian (1994)	Geographical concentrations lead to higher performance/innovation
Physical proximity/Local buzz		
	Amin and Cohendet (1999)	Frequent interactions and their role in trust building and cooperation
	Antonelli (2000)	Five types of communication channels that accompany geographical co-location
	Bathelt et al. (2004)	Local buzz and external pipelines
	Bathelt (2005)	Information and knowledge sharing in the local buzz
	Bathelt and Turi (2014)	The role of face-to-face contacts in the establishment of trust

Granovetter (1985)	The role of trust for knowledge sharing
Grillitsch et al. 2015	Empirically showed that co-location and face-to-face contacts strengthen innovative capabilities
Murphy (2006)	Three levels of trust; Micro-level: based on shared experiences between individuals; Meso-level: trust is based on social ascriptions; Macro-level: institutionalized attitudes
Nonaka and Takeuchi (1995)	The role of trust in a network
Nonaka et al. (1996)	The importance of face-to-face interactions to communication and trust building
Owen-Smith and Powell (2004)	Spillovers in the context of local buzz
Sonn and Storper (2008)	Empirically showed that co-location and face-to-face contacts lead to better performance
Storper and Venables (2004)	Develop the concept of local buzz to explain the particular dynamism in a location
Trippl et al. (2009)	Empirically showed that co-location and face-to-face contacts strengthen innovative capabilities
Lock-in	
Hassink (2005)	Socio-institutionalist approach to regional lock-in
Kogut et al. (1993)	Network-based approach to explain regional lock-in
Kogut (2000)	Network-based approach to explain regional lock-in
Martin and Sunley (2006)	Evolution of regional embeddedness and lock-in situations
Maskell and Malmberg (2007)	Socio-institutionalist approach to regional lock-in
Nooteboom et al. (2007)	Socio-institutionalist approach to regional lock-in
Sotarauta (2011)	Socio-institutionalist approach to regional lock-in

External pipelines

Bathelt et al. (2004)	Forms and reach of external pipelines
Bathelt (2005)	Lack of external linkages caused the decline of the media industry in Leipzig
Bathelt and Henn (2014)	Forms and reach of external pipelines
Giuliani and Bell (2005)	In the wine industry in Chile, the connections with external partners are a source of dynamism for the cluster
Grillitsch et al. 2015	Establishing external pipelines enhance innovative capabilities
Morrison et al. (2011)	External pipelines are beneficial only when two conditions are met: a certain prior level of knowledge and a high-quality buzz
Owen-Smith and Powell (2004)	Definition of <i>pipelines</i> as a linkage to acquire external knowledge
Sotarauta (2011)	Establishing external pipelines enhance innovative capabilities
Todtling (2012)	Establishing external pipelines enhance innovative capabilities
Tracey and Clark (2003)	Actors increasingly seek to establish external linkages either to source knowledge, to align strategies with the state of the global market or to develop markets
Trippel et al. (2009)	External linkages help to diversify the knowledge base of the cluster and help improving innovative capabilities

MNEs in clusters

Location determinants

Bathelt and Li (2014)	Found that firms located within clusters tended to target FDI towards other clusters
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Cantwell (2009)	MNEs seek dynamic locations to enhance their own capabilities
Dunning (1998)	Multinational companies have switched their internationalization strategy from resource-seeking to strategic-asset seeking
Dunning (2001)	Multinational corporations are vehicles for augmenting competitive advantages
Guimaraes et al. (2000)	Empirically found that foreign investors take into account the presence of agglomeration economies as a determinant factor in their location decision
Meyer et al. (2011)	There is an increasing number of MNEs evolving in knowledge-intensive sectors which rely on intangible forms of capital to operate.

The subsidiary

Almeida and Phene (2004)	Subsidiaries are more likely to benefit from knowledge spillovers in dynamic locations
Andersson et al. (2002)	Risk of over-embeddedness of the subsidiary
Birkinshaw and Hood (2000)	The subsidiary allows the MNE to tap into diversified pools of knowledge
Dellestrand and Kappen (2012)	The subsidiary has a major role to play in the construction of the corporation's competitive assets

Frost (2001)	The subsidiary allows the MNE to tap into diversified pools of knowledge
Morgan (1997)	The subsidiary can fulfil different more or less active roles for the corporation.
Mudambi et al. (2014)	The knowledge that is gathered and generated by the subsidiary benefits the whole corporation through reverse knowledge spillovers
Poon et al. (2013)	Empirical evidence that being located in a cluster increased the innovative capabilities of the subsidiary
Song et al. (2011)	MNEs use internal mechanisms such as FDI to exploit localized knowledge and expertise
Un and Curvo-Cazurra (2008)	The subsidiary allows the MNE to tap into diversified pools of knowledge
Impact of the establishment of a foreign subsidiary on the cluster	
Aitken and Harrison (1994)	Crowding out effect of local firms is stronger in the short-term
Birkinshaw and Hood (2000)	Three possible consequences to expect from the presence of foreign subsidiaries in industrial clusters
Branstetter (2006)	Empirically finds that the presence of Japanese firms in the US benefitted local firms through knowledge spillovers
Fosfuri and Ronde (2004)	Geographical proximity between firms allow to directly benefit from knowledge spillovers

Garcia et al. 2013	The establishment of foreign subsidiaries increase competition and foster innovation
Ghoshal and Bartlett (1988)	Knowledge flows internally within the multinational corporation network
Higon and Vasilakos (2011)	Geographical proximity between firms allow to directly benefit from knowledge spillovers
Kosova (2010)	Crowding out effect of local firms is short-term
Mudambi (2002)	The MNE acts as a carrier of knowledge between different locations
Wang and Wu (2016)	Firms in a cluster are more likely to benefit from knowledge spillovers because of their greater integration

Cultural Proximity

Boschma (2004)	The role of institutional and cultural proximity
Boshma (2005)	Five types of proximity between firms
Boshma and Frenken (2011)	Sharing the same values and language foster the development of trust between firms
Eriksson (2011)	Geographical proximity play the role of enabler for the reduction of cognitive distance between partners
Maskell and Malmberg (1999)	The development of trust is influenced by cultural proximity
Sotarauta (2011)	Geographical proximity has a positive effect on innovation through the development of cognitive and institutional proximity

