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Multinational and Indigenous IT Companies in Ireland: Exploring the Spatial Relationships between the Two Tiers

Completed Research Paper for the pre-ICIS workshop on "LOCATIONAL ANALYTICS, SPATIAL DECISION MAKING AND BIG DATA: RESEARCH AND TEACHING"

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Introduction

Information Technology (IT) multinational enterprises (MNEs) have garnered a significant amount of attention in relation to the growth of indigenous IT sectors (Brannigan and McManus, 2014; Siedschlag, Zhang and Smith, 2013; van Oort and Atzema, 2004). Compared to some sectors, the IT industry - which trades in immaterial goods - may be less dependent on spatial constraints since it does not rely on large scale labor force or massive movement of raw materials. This alleged 'death of distance' promises great changes in international business and poses questions about how indigenous economies and spatial policy are being affected (Maeng and Nedovic-Budic 2008 and 2010). Even though in principle international business is open to organizations of any size, in practice it tends to be dominated by MNEs. MNEs can sustain the cost and capacity of operating across countries and to address the volatility of functioning across diverse jurisdictions. Still, MNEs do not exist in a solely stateless space. They need to 'touch the ground' in specific places to hire people and get work done, to set headquarters and formalize legal bounds. They also play an important role in the formation of industrial clusters and networks (Nadvi, 1995)

From the perspective of local host economies, attracting an MNE is perceived as a means of stimulating the growth of indigenous companies through knowledge spillovers (Motohashi and Yuan, 2010; Breznitz, 2010). Often, a question for governments is if the presence of MNEs within their territory benefits the indigenous economy and if there is a satisfactory number of new firms emerging from the purported knowledge and capital spill-overs. This is especially the case for IT as there are lower barriers to accessing means of production for entry into the market (Benkler: 2006), resulting in a higher potential for small businesses to start and grow. The objective of policy makers in attracting MNEs is not only job creation via MNEs, but job and wealth creation via the emergence of new indigenous IT companies and the strengthening of existing indigenous companies, through transfer of knowledge and other forms of capital from MNEs. The policy process is also focused on encouraging regional innovation systems which comprise of both international and indigenous companies, and ultimately helps build a national innovation system (Chung, 2002).

Against this broad background, the presented research focuses on networks of inter-organizational relations (rather than the classic dichotomy hierarchy vs. market), which are approached through a spatial analysis of clusters. More precisely, it focuses on the spatial dimension of their interactions and the nature of their communications. While we recognize the complexity of these phenomena, with this research we aim at a concrete contribution to the debate on clustering and proximity as locational factors (among others: Mole et al.: 2011).

Literature review

The studies of how various sectors emerge, what their locational requirements are and how the relationships are established within and across sectors, offer the basis for enabling and stimulating their development through policy and related provision of infrastructure and amenities. This kind of understanding is as important nowadays as it has been traditionally for industrial and service sectors, with the IT sector presenting the unique characteristics and challenges. The relevant factors include the general forces of sectoral growth and inter-organizational relationships as well as locational proximity and spatial clustering factors.

Organizational relations are often conceived as regulated by market or hierarchical forces. Powell (1990) criticizes this usual dichotomy as insufficient for classifying organizational forms. The traditional explanation behind this dichotomy is that transaction cost determines one form or the other. By giving examples of a variety of organizational arrangements (subcontracting, franchising, joint ventures, HR incentive schemes) and industry sectors (construction, publishing, media), the author argues that networks of inter-organizational relations (Reimers, Johnston, Klein, 2008 and 2010), rather than markets or hierarchies, are likely to emerge when goods traded are difficult to price and when knowledge, experimentation, innovation have prominent roles. All those characteristics are prominent in intellectual goods and IT industries. Networks are not determined by competition like markets nor by command like hierarchies. Instead, they rely upon reciprocity, mutuality, and trust. In the same work, Powell (1990) places a special emphasis on industrial districts, i.e. clusters of firms that benefit from closer spatial relations. More precisely, transaction costs, especially transportation costs and spatial communication costs tend to play a significant role in the location of companies (Gordon and McCann, 2000). So, if Powell's networks are made of inter-organizational relations, Oliver's (1990) formalization of the principles of inter-organizational relations (i.e. necessity, asymmetry, reciprocity, efficiency, stability, legitimacy) can help in interpreting those relations.

Studies on the growth of the IT sector to date have focused on the agglomeration of IT companies in industrial clusters and the factors that lead to their formation in specific locations (van Oort and Atzema, 2004; Gordon and McCann, 2000; Iammarino and McCann, 2006). Drawing on the traditional business economics literature clusters are defined as geographic agglomerations of companies, suppliers, service providers, and associated institutions in a particular field (Porter, 1996). The author states that the two key characteristics of clusters are the proximity of individual activities in terms of geography and value creation and are industry specific. Ron and Sunley (2003) argue that cluster concept defined by Porter is too vague and elastic. It does not specify what range of related activities should be included or how strong the linkages to firms have to be. They argue that the identification of clusters based in industry specific knowledge is too subjective and point to the limitations of the cluster concept as a guide to regional development policy. All firms whether clustered or not may benefit from support and diversity rather than specialization may be more important to cluster development and regional adaptability.

The issues that plague the definition of what is an industrial cluster are further manifested in the vagueness of its key concept of proximity. Torre and Rallet (2005) propose two categories of proximity – geographical and organized, while Knoben and Oerlemans (2006) extend the geographical, organizational and technological dimension of proximity as relevant for inter-organizational collaboration. Broekel and Boschma (2011) analyze the knowledge exchange in Dutch aviation industry by adding social and cognitive proximity to the geographical and organizational. Interestingly, they find that cognitive and organizational proximity, had a reduced or no effect on the innovative performance, respectively, and term this occurrence as the 'proximity paradox.'

The significance of the geographic agglomerative advantage is further questioned by Lublinski (2003). Using the case of the German clustered and non-clustered aeronautic industry, the author affirms that all expected effects of geographic proximity – labor market pooling, knowledge spillovers, demanding local customers, and trust-based effects – are present but weak. In addition, the ways in which the various effects operate is quite complex. For example, Shankar's et al. (2005) extensive study of the US optics industry reveals that e-mail communications have a greater impact on knowledge spillovers and related new product outcomes than face-to-face communication and that relational ties are more likely to be at work than geographic proximity.

While these factors are relevant for cluster formation in general, IT is assumed to facilitate all sorts of delocalization (Cairncross: 2001, for instance) and it is reasonable to hypothesize that geographical distance between trading partners is not a determinant any longer. In fact, it should be considered that, by its nature, the IT sector differs from other industrial sectors that have been studied for knowledge spill-overs gained from clustering. For instance, Motohashi and Yuan's (2010) study comparing the spill-over effects of MNEs in the automobile and electronics industries demonstrated how industry characteristics play a role in knowledge transfer. Their study found that the integrated architecture of the automobile industry, promoted the transfer of knowledge from MNEs to indigenous companies. However, the electronics industry being part of a global supply chain and being highly competitive did not experience as much knowledge spill-over from MNEs (Motohashi and Yuan, 2010).

The trend manifested in the electronic industry may be even more pronounced in the case of digital goods and services. The literature on IT off-shoring is relevant here to the extent that it addresses the span and shape of inter-organizational relations. For instance, Olsson et al. (2008) argue that typically, Irish companies act as two-step bridges for companies that offshore from the US to third countries, particularly to Asia. To those offshoring companies, Ireland offers a convenient time zone for such two-step arrangements (Hogan and Hutson, 2005; Holmstrom, Conchuir Agerfalk, Fitzgerald, 2008; Agerfalk, Fitzgerald, 2008, Kelly and Noonan, 2008). This role may not give Ireland a stable position in the value chain to allow spill-overs to indigenous IT businesses.

A study of the spatial distribution of the Dutch IT sector conducted by van Oort and Atzema (2004) looked at how agglomeration economies influenced the growth of the sector. Countering the decentralization thesis, the authors find that 'the IT sector tends to be concentrated in urban areas that are already relatively specialized in this sector' (p. 287). Empirical studies conducted around the turn of the century show that metropolitan areas dominate the IT industry because of their better access to well-equipped IT infrastructure, trained labor force, creative and agglomerative business environment and venture capital (Graham, 1999; Maeng and Nedovic-Budic, 2010; Malecki, 2002; Moriset, 2003; Zook, 2000). In the case of Ireland, research conducted by Williams et al. (2012) on the spatial nature of different sectors of the Irish economy, used hot spot analysis to identify clusters of economic growth. Analysis of the information and communication sector suggested that urban hubs of this sector do exist, specifically in Dublin, Cork, Limerick and Galway (Shahumyan et al., 2013). However, the research did not focus specifically on the IT sector alone, and neither did it investigate the nature of these hubs in relations to indigenous IT businesses (Williams et al, 2012).

Different factors seem to be in play in cases when the companies were dispersed, where the choice of location was influenced by factors other than proximity, economic factors in particular (van Oort and Atzema, 2004). Pointing to the relevance of both local and global factors, a study focused on the Netherlands by Van Geenhuizen and Nijkamp (2012) describes the co-existence of spatial clusters and advantages of setting up businesses in densely populated urban areas and the reliance on knowledge networks on a global scale. The results of those studies are somewhat inconclusive as to the primary driving forces in circumstances when related companies are not clustered and do not benefit from the mutual proximity. One possibility is that the type of relationship that indigenous companies have with MNEs plays a role in their choice of location. This question has not been examined with spatial analysis techniques in the context of research on indigenous-international tiers and cluster formation in the IT sector. Thus, it offers an original focus of research.

Research Design

This research is situated in the context of industrial clustering and inter-organizational relations. It focuses on the intersection of the concepts of geographical proximity (measured as spatial clustering and communing time) and the type of relationship and communications between IT firms. The literature review illustrates the cornerstones of how the connections between MNE in IT industry and indigenous businesses have been researched. Within this broad set of studies, our aim is to use spatial analysis to investigate the inter-organizational relations between the two tiers of indigenous and international IT firms in Ireland and to learn if clusters can be identified. Building on Williams et al.'s (2012) line of enquiry, this study aims to determine if a spatial component is relevant in understanding the type of the relationship between the tiers of MNEs and indigenous IT businesses. Similarly, to Roy et al.'s (2011)

work, this research considers both the distances between individual MNEs and their partner indigenous IT companies, and the nature of their relationship. Inter-organizational relationships between indigenous and international IT business tiers are considered according to a threefold classification: a) subcontracting (a MNE business outsourcing tasks to another independent local company); b) spin-offs (local companies that have emerged from a MNE); c) former employees of a MNE who are hired by indigenous IT businesses (thus constituting a spill-over of capital and know-how). Further, when these relationships exist we investigate how they are maintained in terms of frequency and mode of communication. Both MNEs and indigenous IT businesses are targeted based on their location in Ireland.

Drawing from the literature on industrial clusters, our hypothesis is that on average the companies engaging in inter-organizational relations that imply more frequent interaction correlate positively to physical proximity of indigenous company to MNEs. Therefore, our main research question is: Is the Irish indigenous IT industry geographically dispersed or clustered around MNEs? This question has been examined comparing distances for each of the three types of relationships introduced earlier.

Our second research question builds on the first: If relationships exist between MNEs and indigenous companies how are these relationships maintained? In this case we refer to modes of communication (face to face, email, etc.) and frequency.

It is in this context that this research sets out firstly to present the spatial distribution of indigenous IT companies in Ireland both in general and in relation to MNEs with whom they might have a relationship. Secondly, we examine if the type of relationship that indigenous IT companies have with MNEs (spin-off, subcontracting or former employee) is correlated with their proximity to the respective MNEs. Finally, we analyze the communication modes by type of relation between the indigenous IT businesses and MNEs.

Methodology

The relationships between MNEs and indigenous IT companies (spin-off, subcontracting or former employees of MNEs) in Ireland were examined though a survey. The target population of IT companies operating in Ireland were sourced from the Industrial Development Authority (IDA) which provided a list of international IT businesses. The locations of IT businesses were extracted from GeoDirectory - a database developed by An Post and Ordnance Survey Ireland combining accurate postal and geographic addresses for whole country. Geographic Information System (GIS) was used to conduct spatial analysis and depict the location of companies and hotspots. Further statistical analysis was also applied.

Data Collection: Sampling and Surveying

The list of companies to be included in the research and targeted in the survey were narrowed based on selecting NACE Rev. 2 classification codes for the IT sector in GeoDirectory, the primary category being J, i.e. Information and Communication. The following sub-categories were included within this NACE classification:

- 58.1 – Software publishing,
- 61 - Telecommunications,
- 62 - Computer programming, consultancy and related activities,
- 63 - Information service activities.

Since the NACE code used is broader than purely IT categories, our selection of sub-categories may have excluded or misclassified some companies as IT companies. In recognition of this the survey included a question in relation to the NACE code for companies to self-identify their category. However, the responses to this question did not provide conclusive answers, but rather probable reasons for misidentification.

Instead of sampling, the survey was sent out to all the companies for whom email addresses were available or could be found on the Internet. For some indigenous IT companies with multiple office locations, the head office was used as the primary point of contact. A survey was designed to ask about the relationships between the two tiers of IT industry in Ireland and about the ways those relationships were maintained. It was first piloted to check for its clarity and response time. Then the representatives of each

of the businesses included in the target population were emailed a link with the survey and invited to participate. The survey asked the following questions:

(1)   Does your company have a business relationship with an IT Multinational Enterprise (MNE)?

(2)   If yes, which IT Multinationals are you related to?

(3)   Are you a spin-off, subcontractor or did some of your employees work for an IT MNE?

(4)   How do you communicate with your top 3 multinational partner(s) over the past year?

(5)   With MNEs, do you use any established electronic data interchange?

(6)   What is the turnover of your company?

(7)   What percentage of your revenue comes from your relations with the 3 multinationals?

(8)   What NACE code is your company classified under?

Given the number of included companies as well as taking into account their involvement in the IT sector, a web-based survey was identified as the most efficient mean of acquiring data. The initial group of 2,147 companies was reduced to 861 indigenous IT companies, since many were determined to be ineligible for inclusion in this research for the following reasons:

●   NACE codes not matching precisely our focus on 'IT business',

●   Identified as international companies and reclassified accordingly,

●   Identified as non-IT,

●   Absence of a current website.

The survey questionnaire was sent out to 861 companies in four waves. The first wave involved sending an email explaining the study, the time required to complete the survey and the link to the questionnaire. As the response rate was low, the second and third waves were sent as reminder emails. With the number of responses still low, the URL link to the survey was shared on social media in the fourth wave.

In the course of sending out the survey 7 non-IT companies and 77 non-existing companies were identified in the list. Thus, the number of companies constituting our population of indigenous IT companies was reduced to 777. After the four waves, there were 63 respondents to the survey in total with 59 valid responses. This included 42 responses stating no working relationship with MNEs and 17 responses with relationship. Interpreting the number of responses to the finite population of 777, we estimated a margin of error of approximately 13% at a 95% confidence level. Those 17 responses identified 55 relationships of varying nature with MNEs in Ireland.

Mapping and analysis

The mapping of the MNEs and indigenous companies and further spatial analysis were implemented using ArcGIS 10.2 package. Hot spot analysis was applied to find statistically significant concentrations of IT companies. Hot spot analysis compares the distribution of values (e.g. number of companies) associated with the geographic features (e.g. administrative areas) to a hypothetical random distribution to discover statistically significant clustering. All IT companies identified from GeoDirectory were aggregated to administrative areas known as electoral divisions (ED). The null hypothesis was that companies were randomly distributed among the EDs. The hot spot analysis uses the following equation to calculate z-scores (statistic) for every ED:

$$G_i^* = \frac{\sum_{j=1}^{n} w_{i,j} x_j - \overline{X} \sum_{j=1}^{n} w_{i,j}}{S \sqrt{\dfrac{n \sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i,j} \right)^2}{n-1}}}, \; where \; \overline{X} = \frac{1}{n} \sum_{j=1}^{n} x_j \;, \; S = \sqrt{\frac{1}{n} \sum_{j=1}^{n} x_j^2 - \overline{X}^2} \;\;,$$

where xj is the attribute value (number of companies) for feature (ED) j, wi,j is the spatial weight between features i and j, n is equal to the total number of features (Getis and Ord, 1995). Very high or very low z-scores are found in the tails of the normal distribution; and indicate significant deviation from a random pattern. For such cases the null hypothesis can be rejected. The resultant z-scores and p-values point where EDs with high/low values cluster spatially. The larger (or lower) the z-score is, the more intense the clustering of high (or low) values. A z-score near zero indicates no apparent concentration.

The parameters of the ArcGIS Hot Spot Analysis tool were defined based on the characteristics of the region. In particular, the ED areas vary substantially between different parts of Ireland. Therefore, the 'Fixed distance' method was used, as it works well where there is a large variation in polygon sizes. Clustering is an evidence of an underlying spatial process and the distance band that exhibits maximum clustering is the distance where that spatial process is most 'active'. Therefore, Global Moran's I Spatial Autocorrelation tool was applied to find the fixed distance when the z-score reaches its peak.

Further analysis involved investigating the frequency of relationship types in each hotspot. The frequency of the relationships that began and ended inside a hotspot, those that began outside and ended inside of a hotspot and vice versa were counted. The purpose of this was to identify potential patters of spatial distribution in relation to hubs, i.e. if indigenous companies in subcontracting relationships with MNEs tend to locate within the hub.

Statistical analysis of the responses was conducted to determine if there were correlations between the indigenous companies and the MNEs in terms of the nature of their relationship, and the geographical distance and journey time. Additional statistical and spatial analyses were conducted on the means of communication used by indigenous IT companies to maintain relationships with MNEs. Geographical distance was calculated in meters and based on the most direct route (as the crow flies), and journey time was calculated based on trip duration estimation in Google Maps in case of normal travel conditions without traffic. Overall, the statistical analysis options were limited given the low absolute number of responses to the survey. There was insufficient data to apply network analysis on the survey responses.

Findings

The first research question about the spatial distribution (i.e., of the Irish indigenous IT industry relative to the geographical location of MNEs) is examined relative to three types of relationships with MNEs: a) subcontractors, b) spin-offs, and c) former employees.

To answer this question, we first introduce relevant GIS maps showing the distribution of IT companies in Ireland and the relationships indicated by the survey respondents. We also present the results from our survey in terms of travel times and communication modes differentiated by type of MNE-indigenous IT company relationships indicated by the survey respondents.

Global Moran I spatial autocorrelation analysis indicated that the indigenous IT companies are clustered (Figure 1).
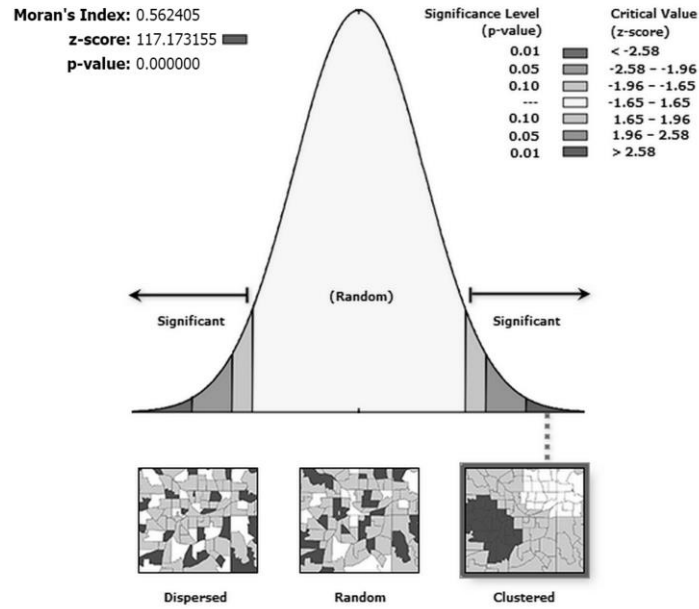
Figure 1. Global Moran's I spatial autocorrelation analysis summary.

Indeed, given the z-score of 117.17, there is a less than 1% likelihood that this clustered pattern could be random. While confirming this, the hot spot analysis also highlighted the actual locations and intensities of those clusters (Figure 2). Red areas in Figure 2 represent EDs with large and positive z-scores (GiZ Score); and the larger the z-score is, the more intense the clustering of companies.
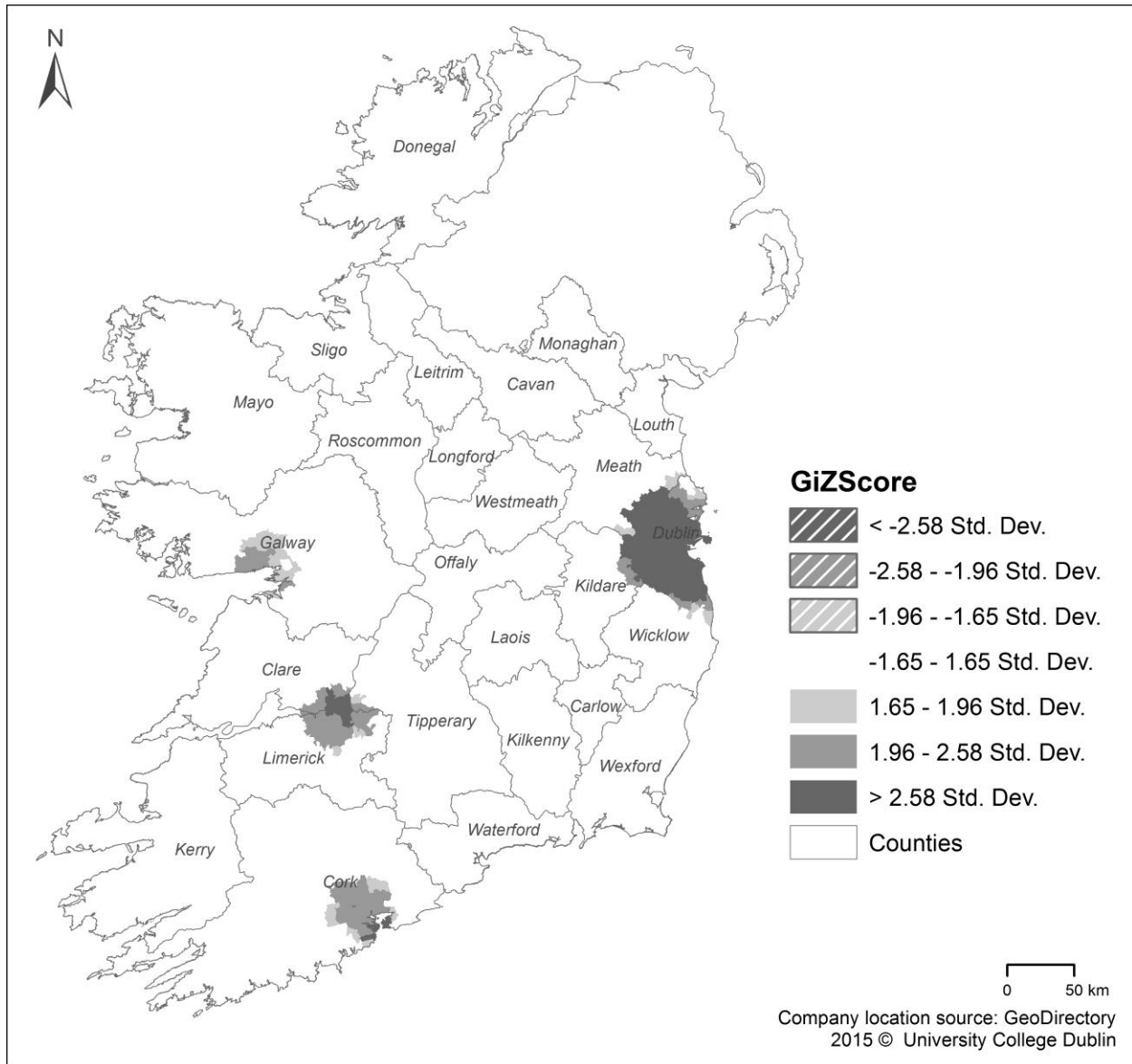
Figure 2. Hot spots of IT companies in Ireland.

The results are consistent to Shahumyan et al.'s (2013, 2015) who detected similar hotspots in Ireland for the whole information and communication industry. Figure 3 presents the boundaries of hotspots overlaid with the actual locations of IT companies and zoomed in four major clusters in the capital (Dublin) and in the other three main urban areas (Cork, Limerick and Galway).
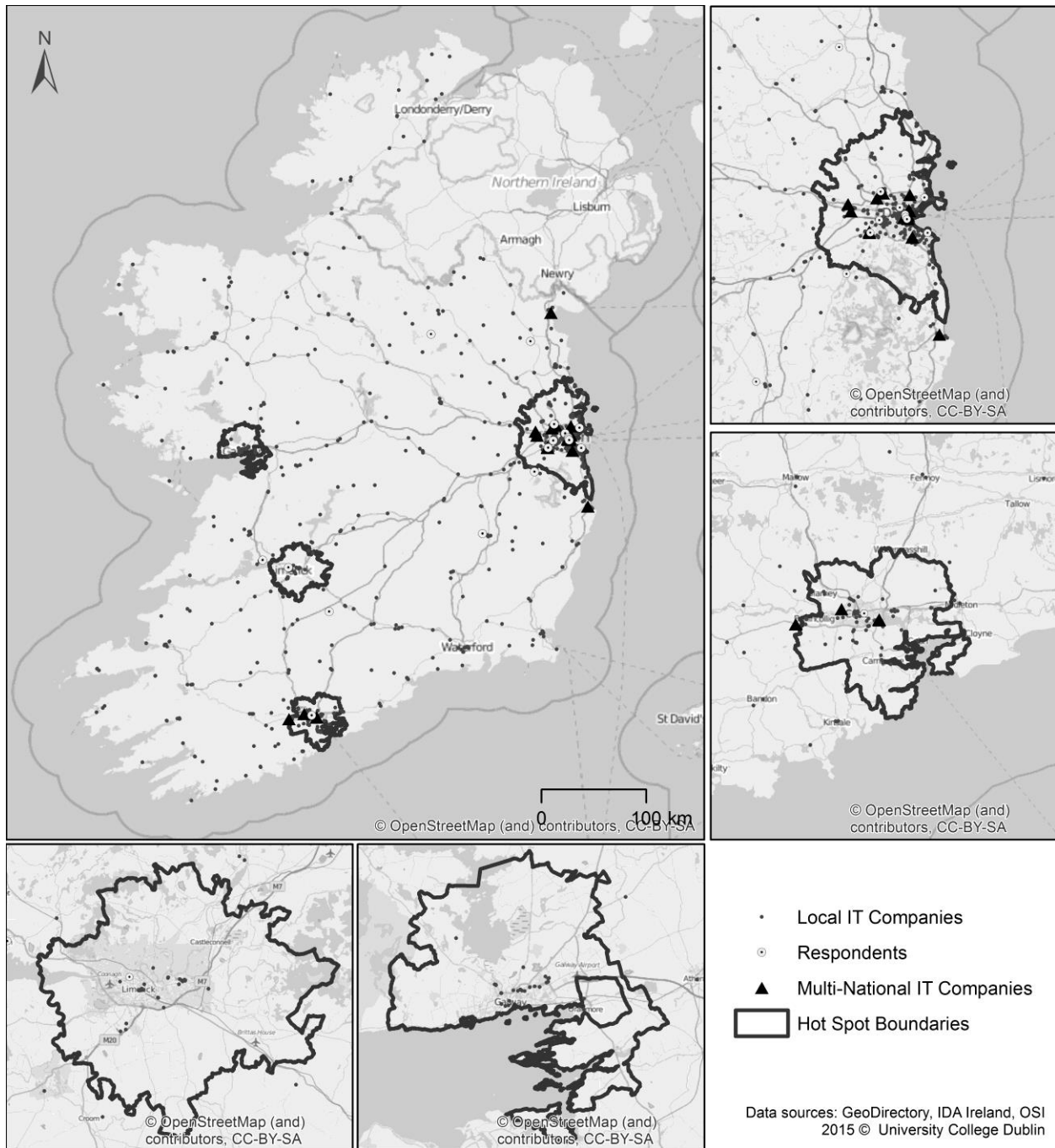
Figure 3. Spatial distribution of MNEs and Indigenous Companies

The hotspots clearly are the main location of MNEs, while the indigenous IT companies are present both inside and outside the hotspots, with the survey respondents paralleling this general pattern, i.e., the indigenous IT companies are located within and outside the hotspots, while the MNEs are predominantly within the hotspots (Table 1).

	Total	Dublin Hotspot	Cork Hotspot	Limerick Hotspot	Galway Hotspot	Total in Hotspots	Total outside hotspots	Total in Hotspots %
Indigenous IT companies	1039*	481	68	52	29	630	409	**60.6%**
Respondents Related to MNEs	19	9	1	1	0	11	8	**55.6%**
MNEs	23**	17	3	0	0	20	3	**94.1%**

Table 1. Distribution of IT companies in regards to identified hot spots. Note: * This includes multiple office locations in contrast to above mentioned list of 777 containing only head offices of companies with multiple office locations and was used for contacting purposes. ** This includes only MNEs located in Ireland.

The vicinity between indigenous and international companies as presented in Figure 3 should not be assumed to imply ongoing inter-organizational relations. Indeed, indigenous IT businesses may maintain relations with MNEs other than those they are close by and may have no relationship to MNEs located close by. The existence of such relationships was revealed by the survey. Of the 59 respondents to the survey 17 declared to have relationships with MNEs. A confidence interval based on the survey data [0.56, 0.79] would indicate that the large majority of indigenous IT businesses do not have working relationships. The two tiers of the Irish IT industry are poorly connected. The average number of MNEs to which the respondent related was 3.25, e.g. an indigenous IT company may subcontract for multiple MNEs. The minimum number was 1 while the max reported was 11. The map below (Figure 4) shows the relations that respondents declared to have with MNEs.
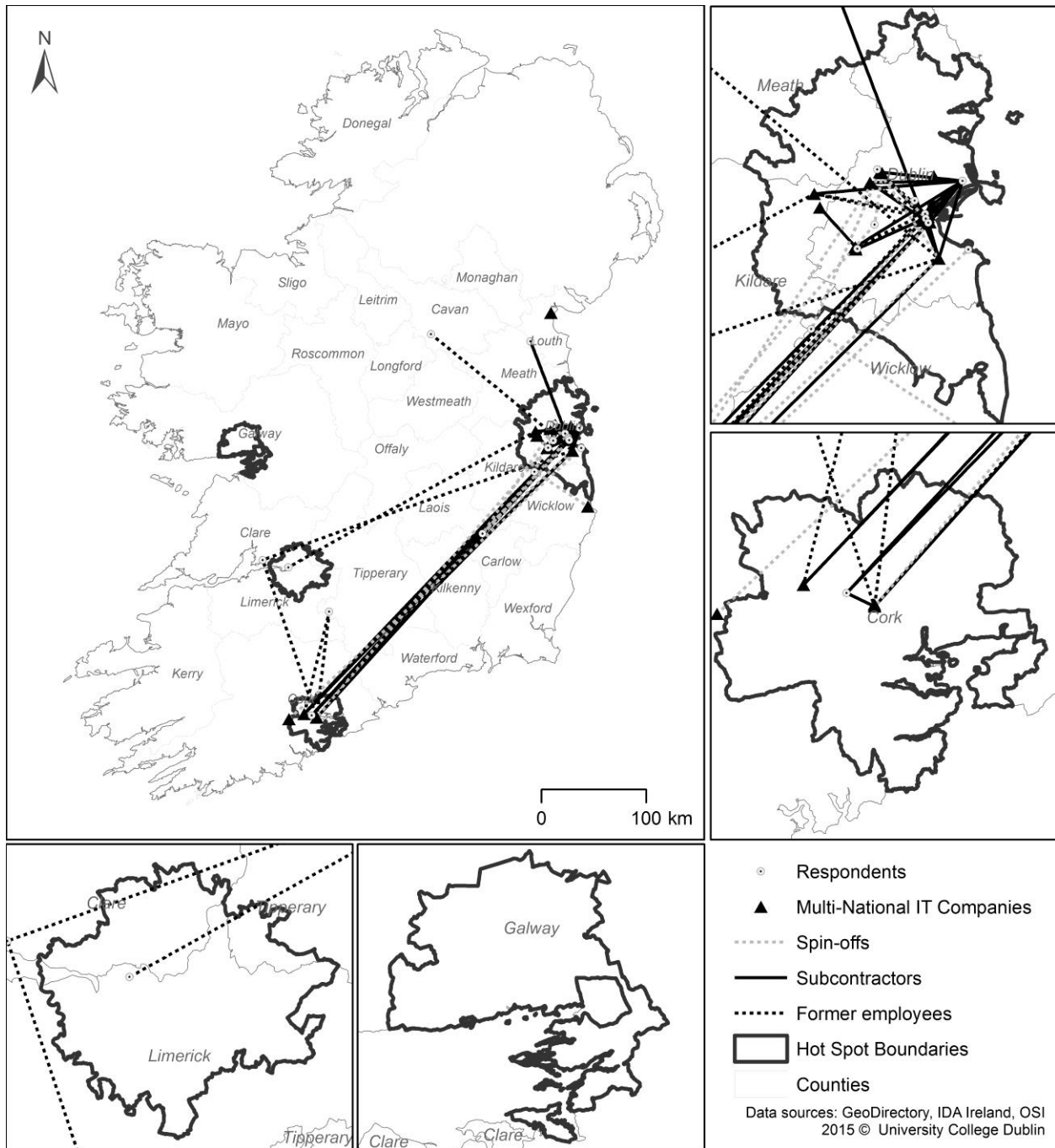
Figure 4. Inter-organizational relations between MNEs and indigenous businesses.

As anticipated, geographical proximity does not necessarily imply inter-organizational relations. In fact, it is visible that all three types of relationship span considerable distances, even across distinct hotspots. This is particularly the case of Cork, possibly also because a major MNE maintains its Irish presence there and relations with Dublin area.

We look at this in two ways: considering if inter-organizational relations exceed a cluster and considering if the commuting times between the indigenous IT companies and corresponding MNEs are below or above 60 minutes. Table 2 shows that out of the 59 relations captured across the two tiers, 16 or about one third are across the hotspot boundary. However, the results vary with the relationship type with

indigenous IT companies engaged in subcontracting locating in closer proximity to the MNEs, and in majority of cases (i.e. over 80%) within the hotspots.

	Relationship Links	Links Starting from outside of hot spot	Extra-cluster dispersion
Spin-offs	12	5	41.67%
Subcontracting	27	2	7.41%
Employment	16	5	31.25%
TOTAL	**55**	**12**	**21.82%**

Table 2. Extra cluster dispersion of inter-organizational relationships.

This makes sense given the fact that this type of relationship requires more frequent interactions. Reversely, we find that spin-offs and companies with former employees of an MNE tend to locate outside hotspots, where costs may be lower. The extra-cluster dispersion of former MNE employees is somewhat lower than of spin-offs, possibly in order for those employees to avoid relocation.

With regard to levels of dispersion as measured by commuting times, we established 60 minutes as a reasonable time limit per travel (assuming two). We opted for commuting time over the geographical distance on the assumption that people find the time more relevant in making their location decisions. Figure 3 shows that the indigenous IT companies engaged in subcontracting tend to locate close to MNEs, with majority within the 60-minutes commuting area.
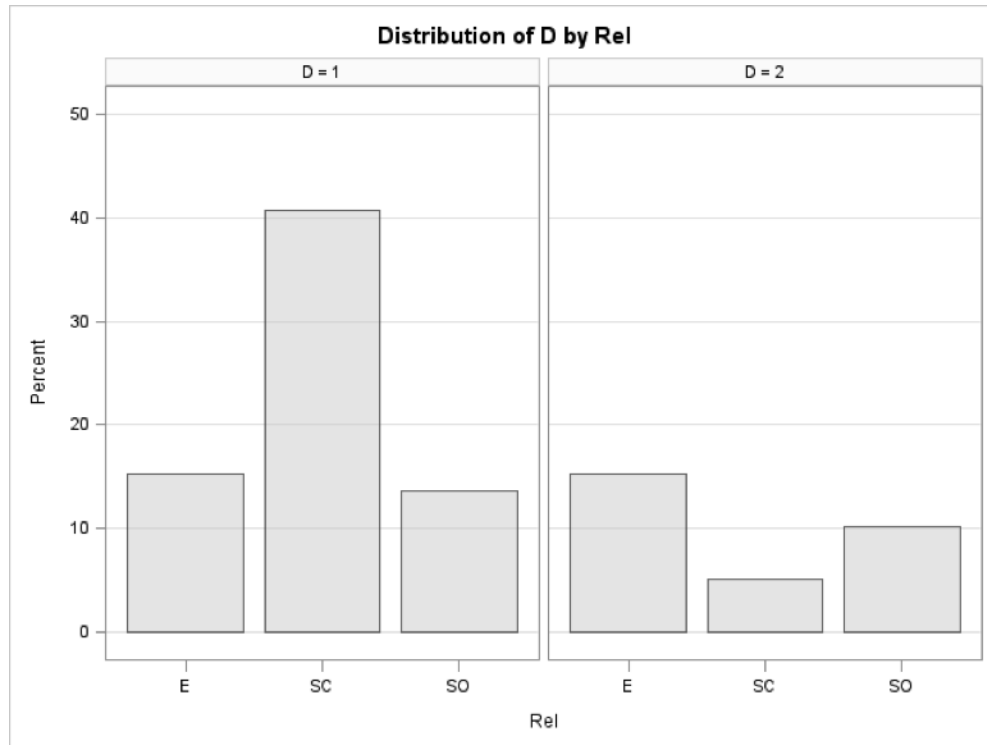
Figure 5. D= 1: commuting distance ≤ 60 minutes, D = 2: commuting distance > 60 minutes

This result is statistically significant at p-value of 0.011 of a Chi squared test for difference in the relationship type for the two distance categories. Spin-offs and indigenous IT companies with former MNE employees seem to be less considerate of the distance. The differences shown are further confirmed by box plots (Figure 4) in which the subcontracting is associated with vicinity more consistently, whereas the distances of spin-offs and former employees relative to MNEs display much more variability (the blue range in the graph is much wider).
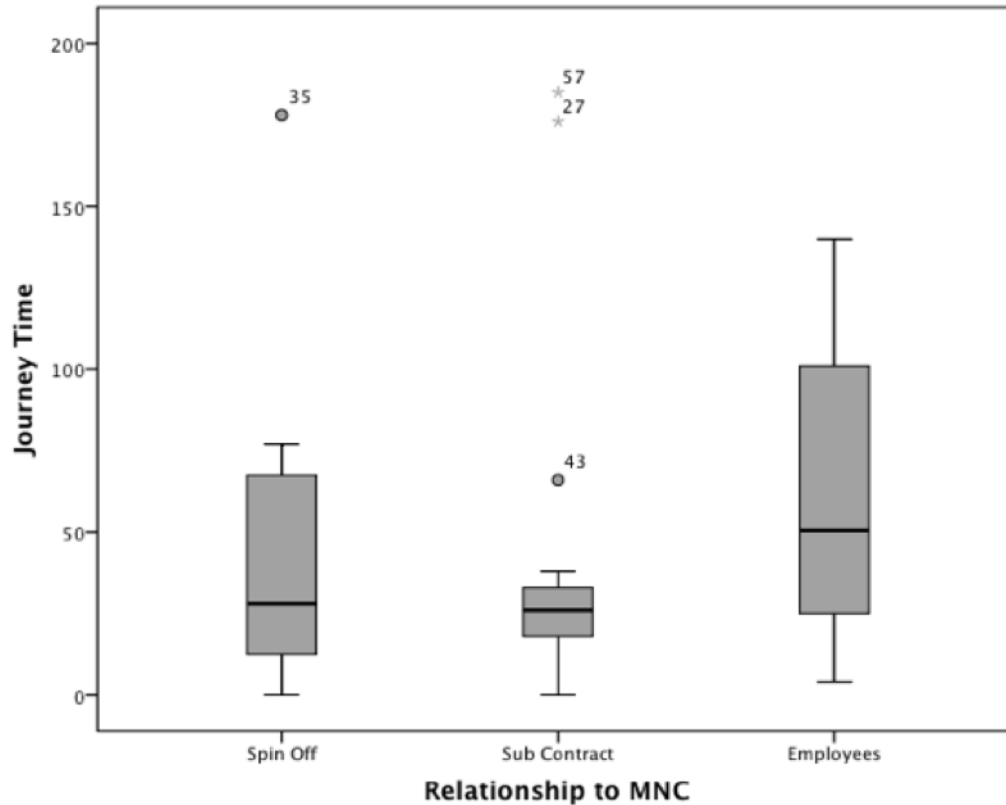
Figure 6. Box plot of journey time for the relationship categories

On the basis of the above, we can answer our research question:

a)   Indigenous IT companies with subcontracting relationship with MNEs, tend to locate within the same hotspot and within 1 hour commuting time;

b)   An indigenous IT spin-off company is less bound by distance to the relevant MNE or by clustering within the IT hotspots.

c)   Former MNE employees moving to indigenous IT businesses are also unrestricted by the MNEs location and IT clusters. On average, they are less dispersed than the spin-offs, but tend to exercise more extreme behavior than the spin-offs with wider range of commuting times (again, pointing to a possible avoidance of changing the place of residence after leaving an MNE).

The second main research question we asked is about relationship maintenance and builds on the first: If relationships exist between MNEs and indigenous companies how are these relationships maintained? In this case we refer to modes of communication (face to face, voice or email) and frequency.

The analysis shows that indigenous IT companies engaged in subcontracting relationship with MNEs have communication of all types and display a clear preference for communication type depending on the frequency of communication – the face to face being more used for monthly communications, voice for weekly and e-mail for daily exchanges (Table 3); they use all three modes more or less equally and regularly (p = 0.028). The indigenous spin off IT companies tend to engage in a more mixed communication pattern on daily, weekly and monthly bases. This is interesting in the sense that face to face meetings, a likely reason to locate close to MNEs do not substitute other forms of mediated communication. Rather, physical and mediated communication grow together both depending on the kind of inter-organizational relationship in place. Finally, among our respondent indigenous IT business

which employed former employees of MNEs, there was no reported communication with MNEs, as could be expected.

Frequency	*Type*	Relationship to MNE		
		Spin-off (14)	**Subcontract (27)**	**Employee (18)**
Daily	*In Person*	4	0	0
	Telephone/Skype	4	0	0
	Email Electronic	4	18	0
Weekly	*In Person*	0	0	0
	Telephone/Skype	1	18	0
	Email Electronic	8	0	0
Monthly	*In Person*	5	18	0
	Telephone/Skype	6	1	0
	Email Electronic	2	1	0

Table 3. Communication with MNEs by type and frequency.

Conclusion

The conceptual ambiguity in defining both the cluster and proximity creates a difficulty in achieving consistent findings with respect to most significant factors and understanding the policy implications (Gordon and McCann, 2000). Among several forces at play, Breznitz (2010) identifies knowledge spill-overs as a key factor in the development of policy pertaining to the growth of the IT sector in Ireland. The assumption that knowledge spill-overs are a driver for formation of clusters, implies that new companies will locate in proximity to partner companies (typically an MNE) to reduce those costs and benefit from knowledge gains (Iammarino and McCann, 2006; Motohashi and Yuan, 2010; Van Oort and Atzema, 2004; Shahumyan et al., 2013). Key factors that play a role in the process of selecting a location are: presence of similar companies, supporting industry in host country, tax rates, transportation costs, and availability of labor (van Oort and Atzema, 2004; Lahiri, 2009; Siedschlag et al, 2013).

Overall, we found no evidence of a strong connection between the two tiers (indigenous and MNE) of the IT sector in Ireland. Where a working subcontracting relationship exists, there is evidence that such companies are more likely to be located in relative close proximity. So, according to this study – which selects a few aspects of a complex set of relationships and dependencies which include locational patterns, innovation process and industrial clusters – proximity is a factor in establishing location when inter-organizational relationships within the IT sector need frequent interactions to be maintained and developed. This extends Iammarino and McCann (2006) suggestion that transaction-cost applies to knowledge-based taxonomy of clusters.

The Irish case provides evidence of clustering of indigenous IT companies (using Porter's definition) in geographical proximity to MNEs when inter-organizational relations require sustained interaction. This finding is countering the rather generic 'death of distance' thesis. However, this does not dismiss the

thesis that the presence of MNEs might benefit the indigenous economy through the emergence of new IT firms, even in the cases they do not maintain relations. The exact nature of any spillover effect merits further exploration but it is possible that the government policy of fostering IT hubs has had the desired economic beneficial effect if the type of necessary inter-organizational relations are considered.

In sum, the answers to our research questions do not suggest a final death of distance in the IT industry, in particular in those cases where inter-organizational relationships need to be maintained through face to face as much as IT mediated communication. In further work, it would be very interesting to compare these levels of extra-cluster dispersions both in other countries and to other industries trading both material and immaterial goods.

References

AGERFALK, P., and B. FITZGERALD. 2008. "Outsourcing to an Unknown Workforce: Exploring Opensourcing as a Global Sourcing Strategy." MIS Quarterly, Vol 32, No.3, pp. 385-410.

BAVARIA-PUIG, A., N. ROIG-TIERNO, J. BUITRAGO-VERA, and F. MAS-VERDU. 2013. "Comparing trade areas of technology centres using 'Geographical Information Systems'." The Service Industries Journal, 33(7-8): 789-801.

BENKLER Y. The wealth of networks: How social production transforms markets and freedom. Yale University Press, 2006.

BRANNIGAN, I., and L. MCMANUS. 2014. Chapter 7: Creative Industries – Global Potential Local Talent. Dublin: ESRI

BREZNITZ D., and ZEHAVI A. "The limits of capital: Transcending the public financer–private producer split in industrial R&D." Research Policy 39.2 (2010): 301-312.

BREZNITZ, D. 2012. "Ideas, structure, state action and economic growth: Rethinking the Irish miracle." Review of International Political Economy 19(1): 87-113.

BROEKEL, T. and RON B. 2011. Knowledge networks in the Dutch aviation industry: the proximity paradox. Journal of Economic Geography Volume 12, Issue 2, Pp. 409-433.

CAIRNCROSS, F. 2001. The death of distance: How the communications revolution is changing our lives. Boston: Harvard Business Press.

CHUNG S. 2002. Building a national innovation system through regional innovation systems. Technovation, Volume 22, Issue 8, 485–491.

DEPARTMENT OF PUBLIC EXPENDITURE AND REFORM, 2014. Budget 2015, Economic and fiscal outlook. Dublin Online: http://budget.gov.ie/Budgets/2015/Documents/141014%20Economic%20and%20Fiscal%20Outlook%20REV%202.pdf (Accessed on August 5, 2015)

GETIS, A., and J. ORD. 1995 "Local spatial autocorrelation statistics: Distributional issues and an application." Geographical Analysis. 287–306.

GORDON, I.R., and P. MCCANN. 2000. "Industrial Clusters: Complexes, Agglomeration and/or Social Networks?" Urban Studies 37(3): 513-532.

GRAHAM, S. (1999) 'Global grids of glass: on global cities, telecommunications and planetary urban networks', Urban Studies, Vol. 36, Nos. 5–6, pp.929–949.

HIRSCHMAN, A. O. 1988. The strategy of economic development. London: Westview Press.

HOGAN, T., and E. HUTSON. 2005. "Capital Structure in new technology-based firms: Evidence from the Irish software sector." Global Finance Journal 15: 369-387

HOLMSTROM, H., E. O CONCHUIR, P. AGERFALK, and B. FITZGERALD. 2008 "Two-Stage Offshoring: An Investigation of the Irish Bridge." MIS Quarterly 32 (2): 201-224.

IAMMARINO, S., and P. MCCANN. 2006. "The structure and evolution of industrial clusters: Transactions, technology and knowledge spillovers." Research Policy 35: 1018-1036.

KELLY, S., and C. NOONAN. 2008. "Anxiety and psychological security in offshoring relationships: the role and development of trust as emotional commitment." Journal of Information Technology 23(4): 232-248.

KENNEDY, J., 2013. "Homegrown Irish tech sector thinks differently to overcome talent bottleneck." Siliconrepublic. Online: https://www.siliconrepublic.com/careers/2013/12/17/homegrown-irish-tech-sector-thinks-differently-to-overcome-talent-bottleneck

KNOBEN, J. and OERLEMANS L.A.G. 2006. Proximity and inter-organizational collaboration: A literature review. International Journal of Management Reviews Volume 8, Issue 2, pages 71–89.

LAHIRI, S. 2009. "Foreign direct investment: An overview of issues." International Review of Economics and Finance, 18:1-2.

LUBLINSKI A. E. (2003) Does geographic proximity matter? Evidence from clustered and non-clustered aeronautic firms in Germany, Reg. Studies 37 , 453-467.

MAENG, D., and Z. NEDOVIĆ-BUDIĆ. 2008. "Urban form and planning in the information age: Lessons from literature." Spatium 17-18: 1-12.

MAENG, D., and Z. NEDOVIC-BUDIC. 2010 "Relationship between ICT and urban form in knowledge-based development: empirical analysis of Washington, DC metro region." International Journal of Knowledge-Based Development 1.1-2: 97-117.

MALECKI, E.J. (2002) 'The economic geography of the internet's infrastructure', Economic Geography, Vol. 78, pp.399–424.

MOLE, K., M. HART, S. ROPER, and D.S. SAAL. 2011. "Broader or Deeper? Exploring the Most Effective Intervention Profile for Public Small Business Support." Environment And Planning A 43: 87-105.

MORISET, B. (2003) 'The new economy in the city: emergence and location factors of internet-based companies in the metropolitan area of Lyon, France', Urban Studies, Vol. 40, No. 11, pp.2186–2186.

MOTOHASHI, K., and Y. YUAN. 2010. "Productivity impact of technology spillover from multinationals to local firms: Comparing China's automobile and electronic industries." Research Policy 39: 790-798.

NADVI, K. 1995 Industrial Clusters And Networks: Case Studies of SME Growth and Innovation Article No. 47

O'RIAIN, S., 2000. "The Flexible Development State: Globalization, Information Technology, and the 'Celtic Tiger'." Politics and Society 28: 157-194.

O'RIAIN, S., 2004. The politics of high tech growth: Developmental network states in the global economy. Cambridge: Cambridge University Press.

OLIVER, C., 1990 "Determinants of interorganizational relationships: Integration and future directions." Academy of Management Review 15(2): 241-265.

OLSSON, H. H., et al. "Two-stage offshoring: An investigation of the Irish bridge." MIS quarterly (2008): 257-279.

PORTER, M. E. "The competitive advantage of nations." Harvard business review 68.2 (1990): 73-93.

PORTER, M. E. "Competitive advantage, agglomeration economies, and regional policy." International regional science review 19.1-2 (1996): 85-90.

PORTER, M. "Location, competition, and economic development: Local clusters in a global economy." Economic development quarterly 14.1 (2000): 15-34.

POWELL W. "Neither market nor hierarchy." The sociology of organizations: classic, contemporary, and critical readings 315 (2003): 104-117.

REIMERS, K., R.B. JOHNSTON, and S. KLEIN. 2008 "Theorizing evolution of inter-organizational information systems on long timescales." Proceedings of JAIS Theory Development Workshop.

REIMERS, K., R.B. JOHNSTON, and S. KLEIN. 2010. "The difficulty of studying inter-organisational IT phenomena on large scales: critical reflections on a research journey." Electronic Markets, 20(3-4): 229-240.

RON M. AND SUNLEY P., 2003 "Deconstructing clusters: Chaotic concept or policy panacea?" Journal of Economic Geography 3 (1): 5-35.

ROY, P., A.J. MARTÍNEZ, G. MISCIONE, M.H.P. ZUIDGEEST, and M.F.A.M VAN MAARSEVEEN. 2011. "Using Social Network Analysis to profile people based on their e-communication and travel balance." Journal of Transport Geography. doi: 10.1016/j.jtrangeo.2011.09.005

SHAHUMYAN H., B. WILLIAMS, and W. FOLEY. 2013. Spatial Analytic Approaches Assessing Socio-Economic Development of the Dublin Region Compared with Other Regions in Ireland. Dublin Regional Authority, Dublin, Ireland.

SHAHUMYAN H., B. WILLIAMS, and W. FOLEY. 2015. "Spatial Cluster Analysis Informing Policy Making in Ireland." In Gervasi, O., Murgante, B., Misra, S., Gavrilova, M.L., Rocha, A.M.A.C., Torre, C.,Taniar, D., Apduhan, B.O. (Eds.) Computational Science and Its Applications - ICCSA 2015, Volume 9157 of the series Lecture Notes in Computer Science pp 511-524.

SHANKAR G., MALTER A. J., RINDFLEISCH A. (2005) Does Distance Still Matter? Geographic Proximity and New Product Development. Journal of Marketing Vol. 69, No. 4, pp. 44-60.

SIEDSCHLAG, I., ZHANG, X., and SMITH, D., 2013. "What determines the location choice of multinational firms in the information and communications technology sector?". Economics of Innovation and New Technology 22(6):581-600.

TORRE A. and RALLET A. 2005. Proximity and Localization. Regional Studies, Volume 39, Issue 1, 47-59.

VAN GEENHUIZEN, M., and NIJKAMP, P. 2012. "Knowledge virtualization and local connectedness among young globalized high-tech companies". Technological Forecasting & Social Change 79:1179-1191.

VAN OORT, F.G., and ATZEMA O.A.L.C.. 2004. "On the conceptualization of agglomeration economies: The case of new firm formation in the Dutch ICT sector." The Annals of Regional Science 38: 263-290.

VIEHOEVER J. 2013. The Clustering of Software Firms around the SAP Industrial Centre in New technology-based firms in the new millennium. Ed Oakey, R. P.. Bingley: Emerald.

WILLIAMS B., W. FOLEY, J. CUDDEN, and H. SHAHUMYAN. 2012. Synthesis Report: Dublin Ireland's Flagship. Dublin Regional Authority, Dublin, Ireland.

WILLIAMS B., W. FOLEY, J. CUDDEN, and H. SHAHUMYAN. 2012 "Dublin's Role in the Irish and Global Economy 2012" Working Paper Report 4

ZOOK, M.A. (2000) 'The web of production: the economic geography of commercial internet content production in the United States', Environment and Planning A, Vol. 32, pp.411–426.