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# Space, Interaction, and Innovation: Does proximity really matter for high tech firms?

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## Abstract

There is a widespread assumption in economic geography and innovation economics that firms located in the same geographic clusters benefit from being together and that proximity promotes knowledge externalities leading to innovative activity. However, proximity provided by geographic clusters is by no means a guarantee of the development of interactions between firms located in them. Especially in an environment where technological developments in ICT has reshaped the meaning of distance, business behavior, and strategy of firms, whether spatial boundaries of geographic clusters still matter for firms in forming interactions with others is an important question. The aim of this paper is to address this issue by examining interactions between high tech firms located in a technology park in Turkey. The results show that the geographical proximity provided by science and technology parks (STPs) is not a source or driver for the formation of interactions between high tech firms. In fact, it is the match between the goals and needs of the firms and the structure of benefits of interaction that determines the significance of locational proximity for firms in STPs. These results suggest that more focused polices and measures are needed to develop interactions between firms in STPs or geographic clusters in order to ensure knowledge spillovers and innovation.

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**Keywords:** Proximity, Science and Technology Parks, High Tech Firms

## 1. Introduction

Studies on transfer and diffusion of knowledge have opened up new avenues for research on the relation between space and innovation in recent years. However, it is widely assumed that firms sharing the same physical space within geographic clusters benefit from being together through knowledge externalities leading to innovative activity in the literature of economic geography and innovation economics. The main argument regarding the spatial aspects of this is that firms located in the same geographic space benefit from industrial atmosphere (Marshall, 1925), noise in the area (Grabher, 2002), local buzz (Storper and Venables, 2002) or local broadcasting (Owen-Smith and Powell, 2002) by just 'being there' (Gertler, 1995).

A number of studies show that close, face to face and repeated interaction between firms is associated with improved chances of successful commercialization of early-stage, unproven technologies (Almeida and Kogut, 1997; Jensen and Thursby, 2001; Mowery et al., 2001). It is also argued that geographic clusters provide knowledge and information channels which could not be accessed outside, and through these channels firms get access to different sources for innovation, funding, or hiring (Rutten and Boekema, 1997; Murray, 2004, Owen-Smith and Powell, 2004; Zaheer and George, 2004). However, firms need to interact and develop relationships with other firms at first to access such channels and sources in order to get benefit from clustering. Therefore, the proximity provided by geographic clusters is by no means a guarantee of the development of interactions between firms located in them. Especially in an environment where technological developments in ICT have reshaped the meaning of distance, business behavior, and strategy of firms, whether spatial boundaries of geographic clusters still matter for firms in forming interactions with others is an important question. It would be more meaningful to search for the answer to this question in Science and Technology Parks (STPs) which are geographic clusters of high-technology firms whose survival depends on innovation, which is a highly interactive phenomenon.

This paper attempts to understand the role of physical proximity in developing interactions or ties among high tech firms located in the same science and technology park. To do so, the first science and technology park established in Turkey, namely METU Technopolis, is chosen as a case study and the dyadic relations of high tech firms within the technology park together with their external relations are examined. This study focuses on high tech SMEs since for such firms knowledge is rapidly changing and broadly distributed, which makes innovation a more difficult matter (Grant and Baden-Fuller, 1995; Liebeskind et al., 1996; Powell et al., 1996; Powell, 1998). Therefore, such firms are more dependent on interorganizational networks to share knowledge and innovate.

## 2. Theoretical Background, and Research Question

The number of studies trying to show the link between clustering and innovation has been increasing over the last decade. Some studies show that physical closeness of firms enables knowledge and information to be exchanged more (Jaffe, Trajtenberg, and Henderson, 1993; Utterback, 1974). Also as exchanging tacit knowledge necessitates a dense relation (Dyer and Nobeoka, 2000), it is claimed that being close to other actors permits obtaining such knowledge although technological developments has made communication easier among actors in remote places (Uzzi, 1996). Furthermore, there are studies showing that other types of proximities like social, cognitive, or institutional proximities are important factors in knowledge dissemination (Breschi and Lissoni, 2009; Nooteboom, 1999; Rallet and Torre, 2005). On the other hand, some studies underline other factors rather than physical proximity

for benefiting from being together. For Becattini (2005), knowledge shared within a district can gain value within a specific activity of a firm, but it loses value with alternative uses. Likewise Adler and Kwon (2002) mention the importance of task contingencies to determine the value of benefits of localized networks.

In clustering of firms, the underlying idea is that firms benefit from the positive externalities of being together in a physical area. Marshall (1925, p.271) defines the externalities as:

> The mysteries of the trade becomes no mysteries; but are as it were in the air, and children learn many of them unconsciously. Good work is rightly appreciated; inventions and improvements in machinery, in processes and the general organization of the business have their merits promptly discussed: if one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus it becomes the source of further new ideas.

Therefore, firms in industrial districts benefit from the pool of resources like human resources, suppliers, technological spillovers (Krugman 1991) or intangible externalities like mutual knowledge, repeated and long-term relationships that build trust and cooperative attitude (Paniccia, 1998). Actors which are geographically close to each other will have more opportunity to know each other better. It will be more likely for them to be engaged in informal relations and to develop a trust relation with each other. Actors located in the same area have more formal and informal channels to get access to information flows and benefit from the trust relations fostered by face to face interactions. Agents can minimize the risks from networking with less known actors in remote locations and decrease the costs of monitoring and communicating by taking advantage of geographical proximity.

Like geographic clusters, science and technology parks provide a territorial based network of relationships. An STP can be defined as a property-based organization having an administrative center and which concentrates on business acceleration with knowledge agglomeration and resource sharing (Phan et al., 2005). There are minimum standards required for being a knowledge cluster for STPs although there is not an agreed model for them (Link, 2009). STPs are established to provide an environment to allow firms to access easily key factors and the resources like research and development, human capital, innovation infrastructure, financers, venture capitalists, technological capital and social capital (European Commission, 2008). In this environment, ensuring interaction among tenant firms is vital to perform well for STPs as their role necessitates an effective networking to encourage transfer of knowledge, resources and innovation among the firms (Hansson et al., 2005).

Firms located in STPs are mainly in high technology industries and their survival and growth strategies are based on research and innovation activities. For such activities, interaction with other actors is crucial as it facilitates the acquisition and creation of knowledge (Yli-Renko et al., 2002). These firms are generally small or medium sized. Previous studies underline the significance of informal networks, trust and cooperation for small firms (Granovetter, 2000). Big firms have more opportunity to access different resources like financial and human resources. On the other hand, small and medium sized companies are more likely to rely on their informal relationships, solidarity or trust to grow. Therefore, STPs are established to create an innovative environment through interaction among high tech firms in a geographically bounded area. By forming interactions or developing relations with other firms in STPs, they can get benefit from being together. However, it is questionable that sharing a geographically bounded area with other firms is a sufficient condition for the creation of

interactions among them. Although there are some studies showing that geographically localized networks ease face to face interaction among actors or that sharing the same physical space facilitates the emergence of informal social and professional networks, there is still many issues waiting to be explored to understand the effects of being together with other firms in a science and technology park as a geographically bounded area and mechanisms needed for such effects for high tech firms. Therefore, in this study the main research question is whether physical proximity provided by STPs really matter for high tech firms located in science and technology parks while having interactions or ties with other firms.

## 3. Research Context, Method and Data

As stated earlier, interactions with other actors play an important role especially for high tech firms firms as they are more dependent on interorganizational networks to share knowledge and innovate. In STPs, there are mainly high tech firms which develop technology with the purpose of exploiting an invention or a technological innovation.

In order to find answers to the research question, a mixed approach including both quantitative and qualitative methods was applied. By this way, the results taken from one method are able to contribute to the other method, especially in the sampling and evaluation stages. Deep analysis of case studies on the chosen context is used for this study. For this aim, a multiple case study design is used as the evidence from multiple cases is more compelling and the overall study is more robust (Yin, 2003). For the research study, a grounded theory approach is used as a qualitative method.

In order to analyze the sources and benefits of social capital among technology based firms in science and technology parks, METU Technopolis (known also as METUTECH) located in Ankara, Turkey, is selected as a case. It is the oldest science and technology park in Turkey. The history of the park is rooted in the foundation of incubation centers in the METU SMIDO Technology Development Centre in 1992. As it is the first science and technology park in Turkey, it provides enough history and time for the generation of relations among the firms it houses compared to the other technology parks in Turkey.

METU Technopolis has a closed area of about 105.000 $m^2$. There are 338 firms and 7098 people working in the firms in METU Technopolis. This represents 12% of the firms located in science and technology parks in Turkey and 25% of the people working in the firms. Being a large technology park in terms of number of firms and their employees, METU Technopolis provides a rich pool of cases to study both the dyadic relations between high tech firms and network of relations within the park as a whole. For the sectoral distribution of the firms in METU Technopolis, nearly 30% of them are in the software sector; ICT and electronics have second and third place with a share of 13.61% and 12.13%, respectively. 45.5% of the firms in METU Technopolis have 0-5 years of operation. 25.1 % of them have 5-10 years of operation, 16.4 % of them have 10-15 years of operation, and the share of firms older than 15 years is 13%. Therefore, we can say that nearly half of the firms located in the park have 0-5 years of operation.

**Selection of cases**

In the qualitative research method, participants are purposely selected (Creswell, 2002) with the purpose of reaching out to different and important information which would not be received with other research choices. In order to maximize the information that can be

obtained from cases, 9 firms having different features in terms of their year of operation and sector have been selected. As most of the firms are in the sectors of software, ICT or electronics in METU Technopolis, it was difficult to form a heterogeneous sample. Therefore, rather than general sector differentiation, sub-sectors as a more specific field of operation have been taken into consideration.

**Data Collection and Analysis**

Quantitative data has been collected by means of questionnaires. The questionnaires were sent to the e-mail addresses of the owners of 100 firms located in METU Technopolis whose contact information were able to be reached out of a total of 182 firms on the main campus and also characterized as SMEs. 53 of the firms sent back their responses. About half of them are in the software sector. 34% of them are in electronics. The share of firms in consulting & education, ICT and nanotechnology is 7.5%, 5.7% and 3.8%, respectively. The years of operation of the 53 firms differ from each other but nearly half of them are in the 0-5 years group. The proportion of firms in the 0-5 year of operation range is nearly same with the proportion of all firms located in METU Technopolis.

The data collected with interviews has been analyzed by means of the grounded theory approach. Quantitative data collected was used to support the results reached with the grounded theory approach. The data has been analyzed by using the statistics program called IBM SPSS Statistics 22.

## 4. Results

For the high tech firms located in the same technology park, being geographically close to each other has not been found to be an effective factor to form ties among them. Some firms interviewed depict the situation by saying:

> All the firms in the technopark are busy with their own business. To know other firms, you need to make an effort and this necessitates spending time for it. This is making an investment. But here firms do not make such an investment. There are some workshops arranged by the Technopark Administration. But we do not find the firms that we work with this way. According to our needs, we investigate *firms. [….] So what I need is important. If I do not* need anything, I do not feel the need to know other firms in the technopark. (Firm 4)

> *It is not known which firm does what in the technopark. I know my friends'* firms. However, I do not know what the firm next to me does specifically. We say hello to each other but when we talk, we do not talk about our work. (Firm 3)

> There are seven firms that we are in touch within the technopark. We met the owners of five of them in a workshop in the USA. Although we work in same area, are located in same technopark, *we did not know each other before then."(Firm* 1)

> Our firm works together with a firm in the technopark. We did not know the firm *before. A firm in OSTİM [an organized industrial area in Ankara] that we work with suggested the firm to us. [……] It is like* going the longer way. (Firm 9)

Therefore, our qualitative analysis shows that being in the same location; i.e., the METU Technopark, is not enough to know other firms and develop relations or ties for high tech firms.

In order to look at the issue from the quantitative point of view, an index developed by Krackhardt and Stern (1988) is used. It is called the E–I index used to measure group embeddedness. The index is defined as:

$$E - I\ Index = \frac{E - I}{E + I}$$

where E is the number of external ties, and I is the number of internal ties.

The measure varies between +1 (all ties are external) and −1 (all ties are internal), where larger values indicate that the group is outward looking and negative values show that there are closed group relations. The index is used to analyze the role of physical proximity for the formation of relations among the high tech firms. In the questionnaire, firms were asked to state the location and the number of their ties, which add up to 2187. Accordingly, the number of ties and the geographical characteristics of the ties were analyzed. As Figure 3 shows within the total of 2187 ties, only 10% of the ties take place within the technopark where they are located.

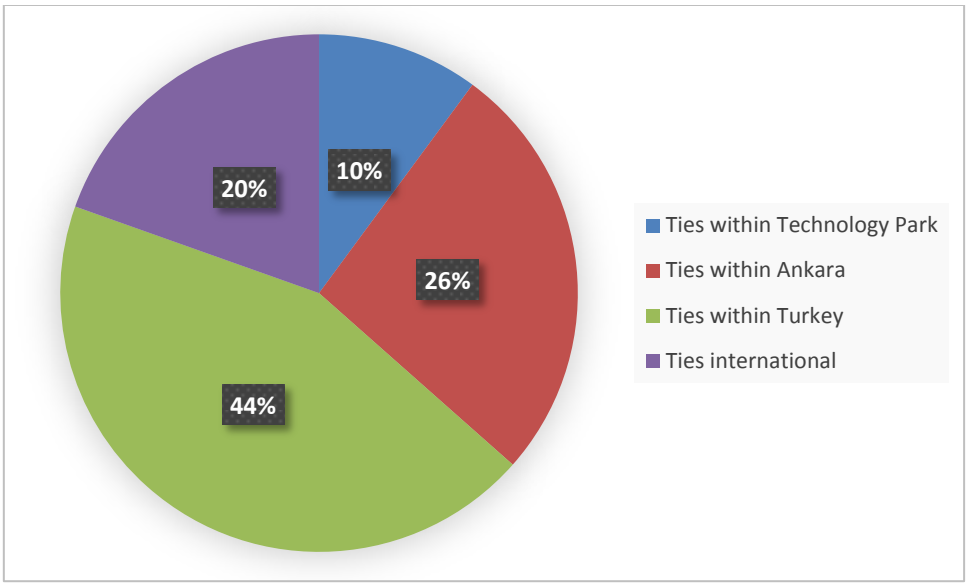


Figure 1: Geographical Distribution of Ties.

The ties taking place within the technopark are taken as internal to see whether or not the technology based firms are outward looking. The frequency of the values of the E-I Index for the ties within the technology park can be seen in Figure 4. It shows that majority of the values are between 0 and 1.

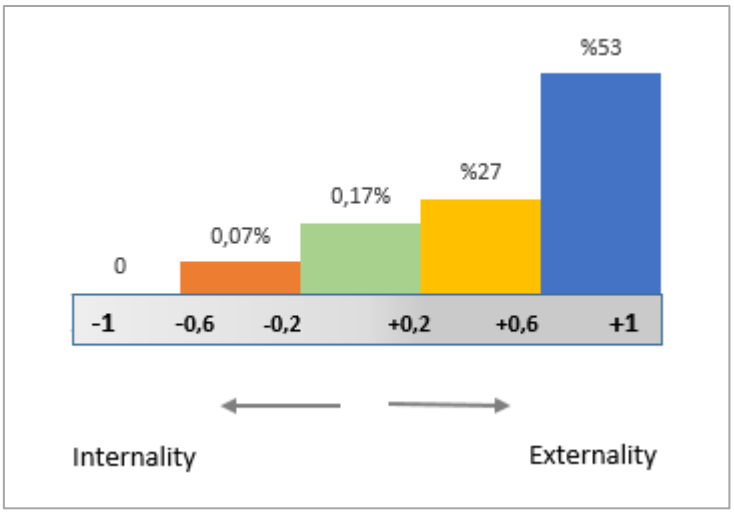

Figure 2: The Frequency of E-I Index Values Within the Technopark

The E-I index score for the ties within the Technopark is 0.52 as it is shown in Table 1, meaning that the density of ties within the geographical boundary of the park is less than the density of ties outside the park for the technology based firms. The firms prefer to form relations or ties with firms outside the technopark and so the quantitative results are in parallel with the qualitative ones.

When we compute the E-I index for the ties within the boundary of the city, namely Ankara, we see the predominance of ties within the city over the firms' external ties. The score is -0.14 (see Table 2) which shows that relations of high tech firms within the city is substantial within their total ties.

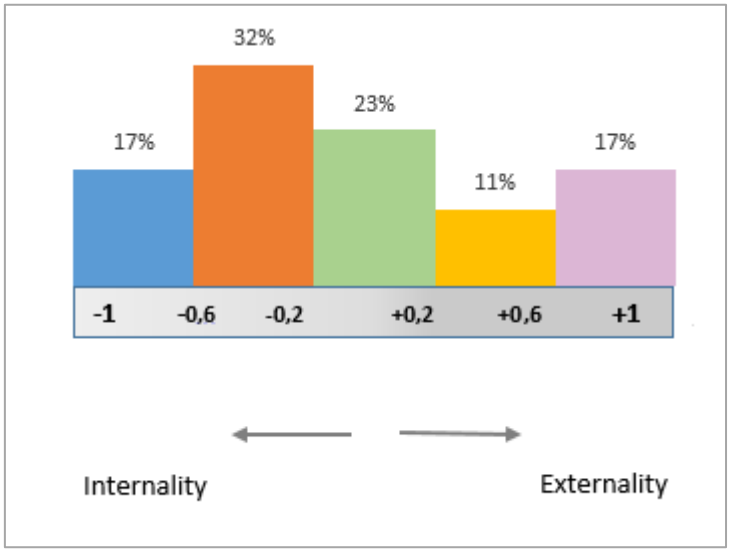

Figure 3: The Frequency of E-I Index Values Within Ankara

Table 1: The E-I Index Score for the Ties within the Technopark

| | N | Range | Minimum | Maximum | Mean |
|---|---|---|---|---|---|
| E-I Index for Technopark | 53 | 1.50 | -.50 | 1.00 | .5223 |
| N | 53 | | | | |

| Firms | E-I Index Value For Ties in Technopark | Firms | E-I Index Value For Ties in Technopark |
|---|---|---|---|
| 1 | 0.67 | 27 | 0.78 |
| 2 | -0.20 | 28 | 0.00 |
| 3 | 0.82 | 29 | 0.50 |
| 4 | 0.50 | 30 | 0.00 |
| 5 | 0.94 | 31 | 0.08 |
| 6 | 0.50 | 32 | 1.00 |
| 7 | 0.80 | 33 | -0.20 |
| 8 | 0.20 | 34 | 0.73 |
| 9 | 1.00 | 35 | 0.33 |
| 10 | 0.75 | 36 | 0.45 |
| 11 | 0.00 | 37 | -0.25 |
| 12 | 0.29 | 38 | 1.00 |
| 13 | 0.25 | 39 | 1.00 |
| 14 | 0.88 | 40 | 0.43 |
| 15 | 1.00 | 41 | 0.90 |
| 16 | 0.00 | 42 | 0.88 |
| 17 | 0.80 | 43 | 0.00 |
| 18 | 0.83 | 44 | 0.00 |
| 19 | 0.44 | 45 | -0.50 |
| 20 | 0.40 | 46 | 0.67 |
| 21 | 0.80 | 47 | 0.98 |
| 22 | 0.80 | 48 | 0.75 |
| 23 | 0.60 | 49 | 0.95 |
| 24 | 0.75 | 50 | 0.68 |
| 25 | 1.00 | 51 | 0.84 |
| 26 | -0.14 | 52 | 0.00 |
| | | 53 | 1.00 |
| **TOTAL** | | | **27.68** |

Table 2: The E-I Index Score for the Ties Within Ankara

| | N | Range | Minimum | Maximum | Mean |
|---|---|---|---|---|---|
| E-I Index for the City | 53 | 2.00 | -1.00 | 1.00 | -.1487 |
| N | 53 | | | | |

| Firms | E-I Index Value For Ties in Ankara | Firms | E-I Index Value For Ties in Ankara |
|---|---|---|---|
| 1 | -0.17 | 27 | 0.11 |
| 2 | -1.00 | 28 | -1.00 |
| 3 | -0.09 | 29 | -0.50 |
| 4 | -1.00 | 30 | -0.40 |
| 5 | 0.80 | 31 | -0.23 |
| 6 | -0.50 | 32 | 0.82 |
| 7 | -0.40 | 33 | -0.60 |
| 8 | -0.60 | 34 | 0.33 |
| 9 | -0.50 | 35 | 0.33 |
| 10 | -0.25 | 36 | 0.09 |
| 11 | -1.00 | 37 | -0.75 |
| 12 | -0.14 | 38 | 1.00 |
| 13 | -0.50 | 39 | -0.33 |
| 14 | 0.65 | 40 | -0.43 |
| 15 | 0.75 | 41 | 0.80 |
| 16 | -0.40 | 42 | 0.68 |
| 17 | -0.20 | 43 | 0.00 |
| 18 | -0.67 | 44 | 0.00 |
| 19 | -0.11 | 45 | -1.00 |
| 20 | -0.60 | 46 | -0.33 |
| 21 | -0.20 | 47 | 0.60 |
| 22 | -0.20 | 48 | -0.42 |
| 23 | 0.20 | 49 | 0.55 |
| 24 | -0.25 | 50 | 0.52 |
| 25 | -1.00 | 51 | 0.20 |
| 26 | -0.14 | 52 | -1.00 |
| **TOTAL** | | | **-7.88** |

According to the results, it is proposed that locational proximity provided by the technopark is neither a source nor a driver for the formation of relations or ties for high tech firms.

After identifying the insignificance of geographical proximity for the creation of ties among high tech firms in the selected technopark, conditions or situations in which physical proximity provided by STPs become significant for high tech firms they are located in has been investigated. It is known that through their network of relationships, firms can reach different types of information. This decreases their search costs (Granovetter, 1985; Burt,

1992).In the interviews, high tech firms were asked the source of information they use irrespective of the importance of the information they needed. All of them referred to the same source: i.e., the internet, as the following quotations show:

> We get most of the information we need from the internet. (Firm 3)
>
> From the internet we get the information we need. (Firm 5)
>
> *From the internet, we look for the firms that we need. […] For academic* information, we use academic journals. All of them can be accessed through the internet. (Firm 1)
>
> I use the internet to learn what is going on in the sector. In our market, most of the firms are in the USA. So I look at the internet to see what type of products and services are provided by the big firms. (Firm 8)

Therefore, the primary source of information for the high tech firms is the internet. With this resource, they can access codified technical information, follow technology, obtain information about the market and check the credibility of a future business partner. By providing limitless and varied information quickly, the internet can surpass the range of information that can be obtained solely through network of relations. The information that the firms get from their networks within the Technopark is seen mostly as "limited" or "not of good quality" such as information about a workshop, seminar, or financial support given by public institutions. Therefore, it is found that the internet is an important factor limiting the information benefits of forming interaction or tie with other firms for high tech firms in STPs. In other words, the internet has a restrictive effect on the information benefits of networking for high tech firms.

For high tech firms, information or skill acquired through interactions plays an important role in the tradeoff between their weak and strong ties. With some ties, firms can benefit from exchanging information at a limited level, whereas with other ties, they can get important information that cannot be acquired from elsewhere. The firms interviewed make this distinction according to two types of relationship: a relationship in which firms work together for a project, innovation, or R&D, and a relationship in which firms just exchange limited and simple information with each other.

> Our ties with other firms in the Technopark have a different nature. If I work together with another firm, like wo*rking on the same project, it is different […] It* means our relationship is deeper. (Firm 1)
>
> There are different firms with whom we interact here. With one of them we work together in a project, so the type of interaction is a bit different than the others. (Firm 4)

The distinction is somewhat similar to the distinction of Granovetter (1973) discussing the quality of ties as strong and weak ones. If there is time and energy invested in a relationship where parties interact frequently, then it is a strong tie. On the other hand, weak ties are seen as just acquaintances. For example, working together with another firm for an R&D or innovation project necessitates a deeper interaction where parties get to know each other and their competencies, and believe that mutual expectations are to be met. An increased strength

of relation refers to enhanced interaction and trust; hence such a relation is perceived as "strong" by the high tech firms as stated by following quotations:

> Our relationship with the firm that we do R&D with has developed step by step. First we worked on a small part of a project together and analyzed the information that we got from the other firm, his approach to your firm etc. Then we cooperated more for a bigger project. We let our relationship develop deeper *step by step. First "Hi", then "What do you think about this?", then it turns into a* real project. (Firm 4)

> We are developing a product together with a firm in the Technopark. I have known the firm for one year. During this year, we began to know each personally and trust has developed between us. (Firm 8)

In accordance with the type of the relations as a strong or weak, the type and the value of the received from the relation differ. For the high tech firms, the internet is a valuable source to get various codified information on a range of topics. Taking into consideration the role of weak ties which mainly facilitate the cost-effective search for codifiable information (Hansen, 1998), the internet has a substitution effect over weak ties of high tech firms. Therefore for the firms, the more valuable benefits are those received from their strong ties, as the following quotations express:

> From firms with which we have a close relationship, we get information about which way we should go in our business, whom we can trust, which firms we can work together. The information is not very detailed and is ordinary but important *for choosing our business path. […] Through the relationship with other firms, I* just monitor the sector and technology. (Firm 4)

> We can get to-the-point information from the firms we are close to, like material we can use for our product. (Firm 2)

> If the relationship with other firms is strong, like working together, it helps you see the needs of your firm, your capacity areas to be developed. Otherwise our relationship cannot go further from passing on to the other firm a business demand irrelevant to you. (Firm 2)

According to the results, it is proposed that high tech firms perceive their weak ties as substitutable with the internet to a large extent, and hence, less valuable than their strong ties. Therefore, geographical proximity provided by STPs comes to be important when firms are in need of developing their strong ties.

## 5. Conclusions, Implications and Future Research

The main objective of this study is to analyze whether physical proximity provided by STPs is important in developing interactions or ties among high tech firms located in them. For this aim, the dyadic relations of the high tech firms within the internal structure of the technology park and the external relations of the firms have been examined.

Actors which are geographically close to each other will have more opportunity to know each other better. It will be more likely for them to be engaged in informal relations and to develop

a trust relationship with each other. Actors located in same area have more formal and informal channels to get access to information flows and benefit from the trust relations fostered by face to face interactions. Therefore, in the related literature, localized activities in a geographically bounded space are widely assumed to be a sufficient condition for obtaining benefits from clustering for firms. However, the results of this research indicate that for the high tech firms located in the same technopark, being geographically close to each other is not an effective factor to form an interaction or relation among them. Analysing the ties of 53 technology based firms within the same technology park with the E-I Index, it is shown that the density of external ties is higher than the ties internal to the technopark. The high tech firms do not see the social structure of the technopark as a source of network of relationships. Therefore, the locational proximity provided by the technopark does not constitute a source for the formation of interaction or relation for high tech firms. Sharing the same geographic location is not enough to get benefit from being together for the high tech firms as it does not ensure creation of interaction among them. In that sense geographic border of STPs loses its significance within the geographic border of relations of the firms they locate.

As a second step, under which conditions physical proximity provided by STPs become important for high tech firms in them has been analyzed. A number of studies show that through their network of relations, firms can reach different types of information and this decreases their search costs. However, the high tech firms mainly use the internet to get the information they seek. The internet provides them with a limitless pool of information in a fast manner. Furthermore, they have the ability to use and exploit the information they get from the internet as people in the firms have at least an undergraduate degree. With this rich resource, they can obtain the codified technical information they need, monitor development in technology and market and also check the credibility of a future business partner. A high tech firm can get codified information from the internet instead of obtaining it through the network of relations. Therefore, the internet is an important factor limiting the information benefits of interactions with other firms within STPs.

According to Krackhardt and Hanson (1993), in forming relations "what matters is the fit, whether networks are in synch with company goals". Similarly, Adler and Kwon (2002) mention "task contingency" to refer the fit between network features and the organization's objectives. Therefore, task contingencies determine whether a strong tie or a weak one is more valuable. Hansen (1998) shows that weak ties provide a benefit of a cost effective search for codified information; on the other hand, strong ties are helpful to have a cost effective transfer of complex information and tacit knowledge. Also, Uzzi (1997) indicates that the embedded ties in which frequent exchanges take place between parties in small numbers are more preferable if the task necessitates trust and cooperative activities. In that sense, in accordance with the type of the relation as a strong or weak, the type and the value of the benefits taken from the relation differ. For the high tech firms, the internet is a valuable source to get various codified information in a range of topics. Taking into consideration the role of weak ties which mainly facilitate the cost-effective search for codifiable information (Hansen, 1998), the internet has a substitution effect over weak ties of the firm. On the other hand, if there is time and energy invested in a relationship where parties interact frequently then it is a strong tie and this type of tie provides parties more value as the tacit knowledge taken from such ties directs them towards innovation or R&D activities. Therefore, high tech firms perceive their weak ties as substitutable with the internet to a large extent and hence, less valuable than their strong ties. Therefore, they are more willing to increase their interactions within the STPs through the strong ties. Therefore, geographical proximity

provided by STPs becomes important when firms are in need of developing their strong ties which can lead them to innovation.

According to the results reached by this study, some policy implications can be drawn. STPs need to increase the interaction among the firms they host to fully perform their technology transfer and economic development functions. Ensuring interaction among tenant firms should be the key objective of STPs' administrations. In order to do this, the generation of interaction or ties among the firms within STPs is vital. To do that, administration of STPs should make more efforts as providing a physical layout for firms is not enough to ensure interaction among them. Task contingency is an important factor for the high tech firms in forming ties with other firms. In that sense, the range of the firms located in STPs should ensure to meet the business strategies of the firms. Firms should band together for specific goals like doing a big project together in which all firms put their efforts and capacities complementary fashion to each other. Similarly cluster based small groups can be created which are not sectoral but rather horizontal or vertical manner.

The findings of our research open up new paths for further research. For instance, the effects of geographical proximity on development of other types of proximities like cognitive or organizational in clusters or STPs can be analyzed to see which type of proximity constitutes the formation of interactions between firms or the emergence of innovation.

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