PATENT ACTIVITY OF COMPANIES LOCATED IN TECHNOLOGY PARKS

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Abstract

The article deals with the problem of inventive activity of enterprises located in the structures of science and technology parks. The purpose of the publication was to determine to what extent the status of a park tenant influences the level of inventive activity and the process of network absorption and diffusion of knowledge. For its implementation, research was carried out using tools specific to patent statistics, based on the quantitative and qualitative analysis of technical documentation of inventions submitted for protection in the Patent Office of the Republic of Poland. Research results indicate that despite the potential benefits of spatial concentration of intellectual capital, enterprises located in Polish technology parks are characterized by low level of inventive activity and low utilization of knowledge that is a network resource of parks.

Key words: science and technology parks, innovations, inventions, patents, knowledge diffusion

JEL Code: O310, O340, O380

Introduction

Technological parks, which are a complex structure of mutual network links between the park as a community, economic entities and universities, have become the flagship of regional economic policies. Their ability to stimulate innovation is supposed to be a contributing factor to the success of global technology-based competition. The mission of technology parks is to optimize the creation, transfer and commercialization of research results obtained through the cooperation of scientific institutions with business practices. Thanks to them, the theory is gaining commercial value. Hypothetically, technology parks have the potential for this, primarily related to the provision of infrastructure and tools that intensify diffusion and then the commercialization of knowledge. Whereas the idea of establishing science and technology centres is based on two foundations. The first is the assumption that the spatial concentration of intellectual capital strengthens the presence of so-called positive externalities of R & D activities. Second, in the face of market imperfections, public support may be crucial to the

innovation process. However, contrary to the original assumptions, the real impact of parks on the processes of innovation, the implementation of scientific knowledge and driving regional economic development has not been unequivocally confirmed. Therefore, the main purpose of the study is to determine whether the status of technology park tenant affects the inventive activity of companies. The secondary objective will be to determine whether the innovation processes utilize the opportunities for collaboration and knowledge resources available through the presence of park structures. Own research was based on methods specific for the patent statistics. They have the character of comparative analysis based on research of companies patent documents - tenants of five Polish science and technology parks.

1 Literature review

The number of technology parks, recognized as an elementary tool of regional innovation policies, has been systematically increasing for many years (Phan et al. 2005). However, neither in the literature of the subject nor in the results of empirical research do we find clear evidence of the assertion or rejection of the thesis that they are effective as a tool of economic policy. The implications for practice vary widely and depend on the case study and the estimation method. In the literature of the subject, the incubation function of parks is strongly emphasized. It manifests itself in providing fledgling businesses not only with the necessary infrastructure for their development, but also almost automatically introducing into a business and scientific network. Thus, companies in the most critical initial period have a chance to root themselves and enter the next stage of development (Colombo, Delmastro, 2002), by providing funding, advice and expertise, including university expertise. Technological parks also play a marketing role, promoting regional research systems, innovation centres, and local intellectual capital, creating an image of the creative region open to new concepts and investors, thereby strengthening the competitiveness and, ultimately, increasing the well-being of the local community. In addition, they allow to undertake and strictly focus academic activities on market demand (Mian, 1996). Lindelöf and Löfstein prove that, in the case of park companies, there is a greater likelihood of co-operation with local research centres, than in the case of non-park companies, and higher job creation dynamics (2002). This happens, among other things due to spatial proximity, generating local external effects as a consequence of technological changes. However, results from the area of innovative activity of companies from the park are ambiguous. Although companies are initially selected for their innovative potential, it would seem that if parks affect stimulation of innovations, they are rather follow-on innovations than

radical inventions (Felsenstein, 1994). At the same time, in the aspect of enhancing innovativeness, small businesses are the biggest beneficiaries of park location (Huang et al. 2012). The strong impact of parks on stimulating innovation and investment in research and development, results from studies conducted for Italian companies and parks (Lamperti et al. 2017). Research conducted with regard to tenant companies in other regions does not always confirm the importance of cooperation network in the innovation process, but often indicates the link between location in the park and the patent activity of the companies. Therefore, the assumption that park location creates added value for businesses requires further case studies. Also the assumption about the impact of parks on regional economic development and the profitability of companies located in the park, has resulted in varied outcome (Lamperti et al. 2017; Gkypali et al. 2016, s.327). From the perspective of this paper, the problem of influence of technological parks on the process of accumulation and diffusion of knowledge of the entities operating in it is significant. Undoubtedly, parks should accelerate the absorption and diffusion of knowledge, including informal ones, whose sources undergo significant diversification. This knowledge flows from university resources, from business practice and individual or team creativity. Parks are here in a double role. On a macro scale they can influence the spread of knowledge generated in their structures, among others by commercializing new solutions. On a micro scale, in connection with the Griliches' knowledge production function, they stimulate the individual to intensify research efforts and condition success in this area. While both Griliches' basic model and its complex modifications focus primarily on closed innovation models, in the concept of parks important is co-operation. It is precisely the co-operation in the area of knowledge that determines innovative activity (Vásquez-Urriago et al. 2016), though unfortunately it often does not appear at all or only to a negligible degree (Liberati et al. 2016, s.719). Few publications on the impact of the parks on opening of innovation processes show that the benefits in this area as long as they appear, are related to small businesses (Şimşek, Yıldırım, 2016, s.727). In the literature, attention is also drawn to the fact that the establishment of a technology park can have adverse effects resulting in the possibility of abandonment basic research by scientific staff, shift from basic research to applied research and to interests of individual park tenants.

2 Methodology

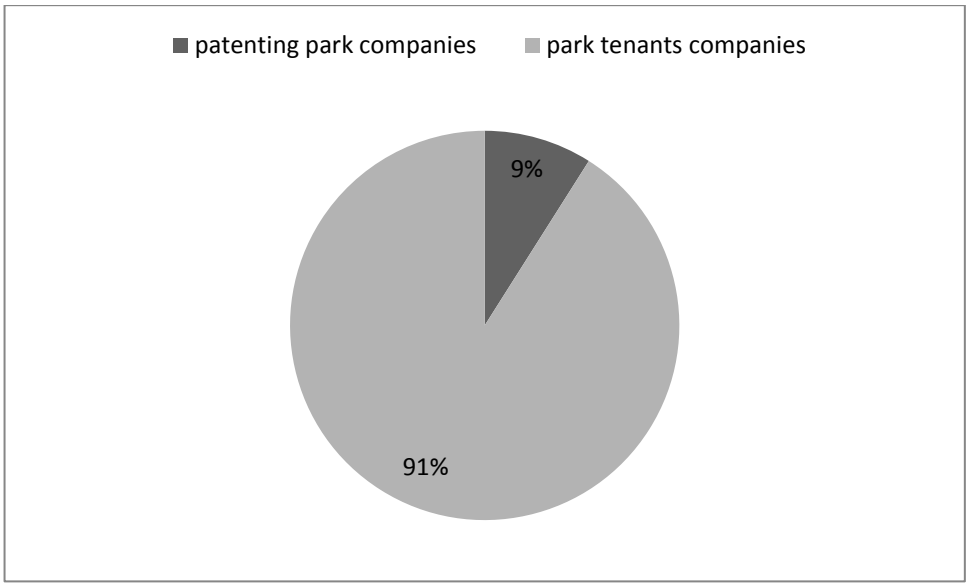
Attempts to model innovative processes conditioned by absorption and diffusion of knowledge encounter many barriers. This is related, among others, with the lack of universal indicators allowing to measure the flow of knowledge in a holistic way, which embraces both the interaction of environment, social elements and technological achievements. This is partly due to the varied essence of knowledge itself. Much of it is informal. This so-called quiet knowledge (tacit), which results from experience, daily practice, real use, and yet its core misses codification. How to quantify something beyond the possibilities of formal measurement, since the relationships between implicit and available knowledge are subject to continuous conversion. The above problem also applies to innovation indicators using patent data bases as a source of data on the absorption and diffusion of knowledge. Patent-based methodologies do not give an overall picture of innovation activity, but only its slice associated with innovations reported for protection and thus made available to the public (not including modifications to already existing solutions or enterprise know-how). In spite of its weakness, patent statistics show considerable potential in the field of knowledge flow and is quite widely used for modeling innovative processes. One of its methods is the analysis of patent citations found in the technical documentation. It is based on examining contained in patent applications references to predecessors' knowledge contained in publications or protection laws. While citing literature raises a variety of doubts (MacRoberts, MacRoberts, 1996; Agrawal, Henderson 2002), the citation of patents has been fairly widely accepted, though this method is not error free (Alcacer, Gittelman 2006). For the publication, 115 patent applications of 642 companies in five Polish science and technology parks were examined. Subsequently, both the patent citations cited for the technical solutions of predecessors and publications related to the subject matter of the invention have been analyzed. The first step allowed to define the total number of patent applications, which was adopted as a measure of the innovative activity of entities. On the other hand, the second step, using patent citations, allowed to identify sources and directions of knowledge that inspired or grounded the development of a new solution.

3 Results of patent applications of companies - technology parks tenants

The analysis of patent activity covered a total of 642 companies that were tenants of five selected parks. These included technology parks located in Wroclaw, Poznan, Szczecin, Opole and Pomeranian Science and Technology Park. Such selection of parks resulted from the length of their operation, the oldest Poznan Science and Technology Park was established in 1995,

next in 1998 (Wroclaw), 2000 (Szczecin) and 2001 (Pomeranian and Opole). They are the oldest of established technology parks in Poland. It is important that in the literature of this subject, it is believed that effects related to the stimulation of innovative activity, including patents, appear around the twentieth year of park's operation. Analyzed parks are therefore in the range from twenty-two to sixteen years of existence. However, despite a relatively long period since the establishment of the park, only 9% of businesses showed any patent activity. Whereas this activity was measured on the basis of all patent applications filed with the patent office, without rejection of those which, as a result of the verification, did not receive definitive protection (Fig.1).

Fig. 1: The share of patenting companies in general number of park tenants companies



Source: own elaboration

The largest number of patenting companies was at the Wroclaw Science and Technology Park, where 25% reported their solutions for protection, whereas only one company showed such activity in the Opole Technology Park (Tab.1).

Tab. 1: The share of patenting companies in general number of park tenants companies

Opole Science and Technology Park	Poznan Science and Technology Park	Wroclaw Technology Park	Pomeranian Science and Technology Park	Szczecin Science and Technology Park
3%	13%	25%	28%	31%

Source: own elaboration

Patententing companies have made a total of 166 patent applications. The highest number of applications fell to the Poznan Technology Park, the smallest to the Opole Technology Park (Tab. 2).

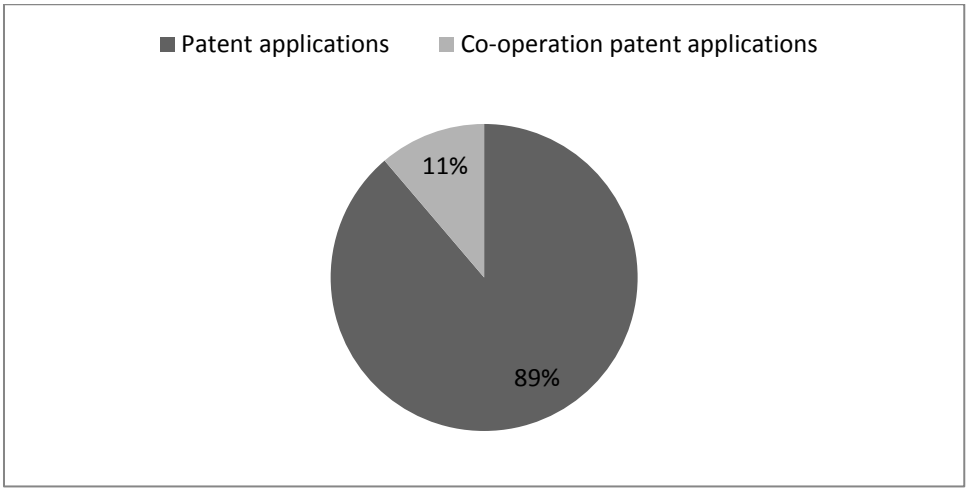
Tab. 2: Patent applications per technology parks

Poznan Science and Technology Park	Wroclaw Technology Park	Pomeranian Science and Technology Park	Szczecin Science and Technology Park	Opole Science and Technology Park
40%	31%	20%	7%	2%

Source: own elaboration

What is most disturbing is the fact that, contrary to the fundamental ideas underlying the establishment of science and technology parks – the premise of opening innovation processes, among others by stimulating research and development cooperation among park tenants and between tenants and research centers, only 21 solutions were developed as a result of the cooperation. This represents just 11% of all patent applications. Moreover, cooperation has only appeared in two of the five analyzed parks - Wroclaw and Poznan Science and Technology Park. Companies in other parks do not show the slightest tendency for any R & D cooperation (Fig. 2).

Fig.2 Share of co-operation projects in the total number of patent applications



Source: own elaboration

Entities co-creators, affiliated with the park in case of Wroclaw were - Wroclaw University of Environmental and Life Sciences, Wroclaw Technology Park, Technology Transfer Agency and Tetra company. On the other hand, among entities from the Park cooperating in Poznan, there are only academic centers - Adam Mickiewicz University Foundation, Poznań University of Economics and Business, Poznan University of Medical Sciences, Institute of Bioorganic

Chemistry of the Polish Academy of Sciences, Poznan University of Life Sciences, Poznan Institute of Plant Genetics of the Polish Academy of Sciences, Institute of Natural Fibres and Medicinal Plants. Collaboration with park tenants was a dominant feature over cases of external co-operation.

Qualitative analysis of patent citations, to determine sources used in knowledge projects, covered the number of 191 references contained in applications. It turned out that knowledge outside the parent organization was most often referred to by companies from Poznan Science and Technology Park (92 citations) and the Pomeranian Science and Technology Park (78 citations). The overall number of references was dominated by foreign citations (which accounted for more than half of all references). In only 6 cases, the company referred to its neighbours-companies or research centers from the same park. At the same time, however, geographic dependencies appeared only in two parks - Wroclaw and Szczecin. Four times were cited solutions of entities operating in Wroclaw Technology Park or its associated academic centers. In the latter context, each case was individual, as co-creator appeared University of Life Sciences, University of Wroclaw, academic staff of Wroclaw University of Technology and a team of researchers from the University of Wroclaw. Two times a reference to academic solutions appeared in the Szczecin Science and Technology Park and concerned applications filed by the Maritime University of Szczecin. This means that the advantage of geographical proximity is only used in 3% of the total number of reported inventions.

Conclusion

The role of technology parks in promoting an innovative culture has been unequivocally defined, making them the basic tool of regional economic policies. It is assumed that science and technology parks are a tool for stimulating the flow of specialized knowledge, which otherwise would be unique. It is possible, among others, thanks to a geographic concentration facilitating the exchange of informal knowledge, including university, using the effects of learning through action and application. Accumulation of knowledge leads to the introduction of process and product innovations, strengthening regional competitiveness and improving the quality of life of its inhabitants. In this way, parks are at the same time an important element in the currents of thinking over the accumulation and use of knowledge in innovative processes. However, contrary to the assumptions underlying their creation, the actual impact of parks on economic growth based on innovation has not been unequivocally documented. Also, results of the study carried out for this publication do not support either the hypothesis that the innovation

of businesses is based on knowledge generated in science sector, nor that parks support research and development cooperation. It turns out that companies traditionally rely primarily on their own potential and internal sources of innovation. On the other hand, it is clear that science and technology parks have an important incubation role, without their support, many businesses probably would not have been created at all.

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