FEP WORKING PAPERS
FEP WORKING PAPERS

Research Work in Progress

n. 302, Nov. 2008

Bridging Science to Economy: The Role of Science and Technologic Parks in Innovation Strategies in "Follower" Regions

Alexandre Almeida
Cristina Santos
Mário Rui Silva

Faculdade de Economia, Universidade do Porto

U.PORTO
FEP FACULDADE DE ECONOMIA UNIVERSIDADE DO PORTO

BRIDGING SCIENCE TO ECONOMY: THE ROLE OF SCIENCE AND TECHNOLOGIC PARKS IN INNOVATION STRATEGIES IN "FOLLOWER" REGIONS

Alexandre Almeida

Phd Student

University of Porto – Faculty of Economics

alex.fep@gmail.com

Cristina Santos

Phd Student

University of Porto – Faculty of Economics

cris.fep@sapo.pt

Mário Rui Silva

Full Professor

University of Porto – Faculty of Economics

mrui@fep.up.pt

ABSTRACT

The concept of Regional Innovation System (RIS) builds upon an integrated perspective of innovation, acknowledging the contribution of knowledge production subsystem, regulatory context and enterprises to a region's innovative performance. Science and Technology parks can act as a platform to the production of knowledge and its transfer to the economy in the form of spin-offs or simple knowledge spillovers, enhanced by the co-location of R&D university centers and high technology enterprises on site. Although reflecting mainly a science push perspective, they may constitute central nodes in an infrastructural system of competitiveness that articulates other entrepreneurial location sites and bridges Universities to the economy in a more efficient and effective way, being crucial to increasing technology transfer and interchange speed, promoting the technological upgrading of the regional economy. In this paper we discuss the importance of Science and Technology Parks in the building up of a Regional Innovation System, promoting the technological intensification of the economy, a more effective knowledge transfer and sharing and the construction of competitive advantages, with particular importance in follower regions facing structural deficiencies. We oppose to the predominant closed paradigm, which understands science parks' role in a narrow and "enclavist", arguing in favor of an open and "integrative" paradigm where the interconnection to other infrastructures and agents boosts the park's performance and upgrades the regional economies competitiveness infra-structures and innovation capability. We further stress the importance of science parks in signaling capabilities and hence attracting R&D external initiatives, namely, R&D FDI.

Keywords: Science Parks; New technology-based firms; Innovation; Regional Policy

JEL Codes: O31, O33, O38, R58

1- INTRODUCTION

The concept of Regional Innovation System (RIS) builds upon an integrated perspective of innovation, acknowledging the contribution of knowledge production subsystem, regulatory context and enterprises to a region's innovative performance. The regional approach stresses the importance of proximity to maximize synergies and spillovers, highlighting the need for deepening collaboration and networking to innovation. The importance of easing technology transfer to the productive system emerges as a policy priority.

Science and Technology parks can act as a platform to the production of knowledge and its transfer to the economy in the form of spin-offs or simple knowledge spillovers, enhanced by the co-location of R&D university centers and high technology enterprises on site. Although Science Parks reflect mainly a science push perspective, they may constitute central nodes in an infrastructural system of competitiveness that articulates other entrepreneurial location sites and bridges Universities to the economy in a more efficient and effective way, being crucial to increasing technology transfer and interchange speed, promoting the technological upgrading of the regional economy. However, literature revealed that this bridging perspective follows a closed view that neglects the need to articulate a science park with different infrastructures and organizations. This set the ground for our motivation because in lights of the systemic approach to innovation, science parks role still follows a linear conception of innovation, frequently bearing only a science push approach and thus limiting its structuring regional effects. Hence, our goal in this paper is to discuss the importance of Science and Technology Parks in the building up of a Regional innovation system, promoting the technological intensification of the economy, a more effective knowledge transfer and sharing and the construction of competitive advantages. Hence, in the first section we start by discussing the definitions and different typologies of science and technology parks. In the second section, we discuss where science parks stand on the traditional debate on "science push" and "demand pull" as well as what is their role in a set of regional competitiveness infra-structures. In the third section we explore the role (but also the possible failures) of science parks in the specific context of follower and laggard regions. Finally, we present our preliminary conclusions in terms of the role of science parks, illustrating in interfacing science to economy and also as a propeller of structural change.

2- SCIENCE AND TECHNOLOGY PARKS: TUNING THE CONCEPT

The first science park dates back to 1950 and was established in Stanford, United States. Cambridge Science Park was the first European example to be established still in the 60s. Nevertheless, it was only in the 80s that this concept became popular as a policy instrument designed to promote technological transfer between universities and other research facilities and firms. Storey and Tether (1998) accounted for 310 science parks in 15 European Union Countries. This boom aimed to promote reindustrialization, regional development and synergies (Castells and hall, 1994). However, even though this policy instrument's increasing popularity, its concept is still blurred (Hanson et al., 2005), creating confusion with other concepts like technopole, technology park, innovation centre or even business park (Stockport, 1989). In this section we review the different concepts proposed for science park and identify essential characteristics that distinguish science parks from other typologies.

The International Association of Science Parks define this concept as "an organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation … a science park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities". The UK Science Park Association (UKSPA provides a similar definition defining science park as "a cluster of knowledge-based businesses … associated with a centre of technology such as a university or research institute". According to the UKSPA (1996), science parks' goals include the encouragement and promotion of New Technology Based Firms (NTBF), the creation of an environment that may attract international R&D facilities and linking the science park to the university's reservoir of technology.

UNESCO's definition states that a science park is "an economic and technological development complex that aims to develop and foster the application of high technology to industry,… formally linked a centre of technological excellence, usually a university". Thus, science parks would be a platform to establish a set of links between firms and universities, thus providing access to knowledge and fostering technology transfer.

According to UNESCO, a science park aims at promoting the cooperation of Universities and industry in R&D activities, fostering the creation of NBTFs, stimulate technology transfer and constitute a space of close interaction between firms and with R&D centers. Link and Scott (2006) use the definition of the National science Board that acknowledges science parks as a "cluster of technology-based organizations that locate on or near a university campus in order to benefit from the university's knowledge base. The university not only transfers technology but aims to develop knowledge more effective given the association with tenants…". Stockport (1989) highlights the infrastructural aspect of a science park, namely the close geographical proximity to universities, the low ratio of buildings with high quality design and landscaping. In the "software" aspect, Stockport (1989) states that a science park must provide a comprehensive range of services to support NBTFs, as well as accommodate firms with high level of R&D and low level of in-park manufacturing. The support to NBTFs also lays in the centre Bakouros et al. (2002) definition which describes science parks an infrastructure in the proximity of universities, which provides a range of administrative, logistic and technical services and most importantly, convey a technology transfer function.

More recently, Monck et al. (1998) defined a science park as a property based infrastructure with close links to university, designed to promote knowledge-based firms through the provision of technology transfer and business support services to firms. The United States Association of University Science Parks (AURP) also stress the property dimension, stating that a science park (in this case, university owned) convey a planned land, buildings and a range of support services designed for R&D activities by public and private organizations and high technology firms. It should have a formal link to a university or research centre of excellence, promoting its link to industry and the interactions between firms and the university in terms of R&D cooperation and technology transfer.

In simpler terms, Link et al. (2003) defined science park as "an infrastructural mechanism for transferring technologies from universities to firms". Also focusing the infra-structural dimension, Phan et al. (2005) define science parks as property-based organizations with an administrative centre which goal is to promote knowledge production and interactions that promote NBTFs. Asheim and Coenen (2005) defined science parks as planned innovative milieu comprising firms with a high level of competences. The role of these infrastructures is to provide proximity between academic organizations and firms and thus promoting interactions and formal and informal links (Hanson et al., 2005).

In light of these examples, it is clear that there is no consensual definition on science parks (Fukugawa, 2005). Nevertheless, some essential and common features may help clarify the concept. In terms of objectives of a science park, it must foster technology transfer from universities or other research centers to firms stimulate start-ups and spin-offs and ultimately cater for reindustrialization and boost regional innovative performance. In terms of characteristics, a science park, university owned or not, must have formal links with relevant knowledge production infrastructures, providing a low construction density high quality infrastructure and a range of services that support innovation and firm NBTFs. Finally, science parks must restrict access to knowledge intensive activities. Table 1 synthesizes the main features of a science park resulting from our literature review.

Synthesis of important features
Goal: enhancing knowledge transfer from universities to the companies , fostering NTBFs
Infrastructural: High quality, low building construction ratio, coupled with a wide range of business support services, including, technological and adequate scale.
Links: university or a adequate scale R&D centre must be formally committed to collaborate with the science park and firms (commonly, universities should have an important role in the science parks management).
Access: restricted to knowledge intensive activities, with possible sectoral preferences (if knowledge base is significant across different scientific fields and there is entrepreneurial critical mass – not likely in many "follower" regions)

Table 1: Synthesis of the most important features regarding science park's concept.

However, in what way do these features distinguish science parks from other typologies? According to Stockport's (1989) survey, research parks constitute an overlapping typology to science parks, with a small possible distinction on not conveying a direct dependency on a University. Technopoles, the French approach, differentiate themselves from science parks in scale and scope (Oh, 1995). A technopole is a far more ambitious project, comprising a completely new settlement, involving the setting up of an industrial site, research institutions and also a residential component. It is the creation of complete new city, following a concept similar to an innovation hub. Its larger scale makes them, usually, a national rather than a regional political endeavor (Oh, 1995).

An Innovation Centre is an infrastructure built on a restricted space, usually an industrial building where a more emphasis is placed on innovation instead of invention. Though a science park aims to tap university's knowledge, concentrate R&D and translate it into innovation, the focus on innovation is not so intense than in an innovation centre. A technology park is a property development that presents similarities to science parks in terms of the high technology profile of its tenants. However, it does not necessarily have a link to a university and is far less restrictive in terms of accommodating production facilities rather than just R&D centers. A Science and Technology park is a typology that mixes the concept of a science park but is less restrictive in terms of tenants, allowing for the installment of small production units but still carrying a strong focus on R&D.

A high quality business park may present a low construction density but usually does not accommodate technological infrastructures, nor is near or closely linked to a university or to other research centers. Still, it is a quality property that conveys some amenities and facilities, thus distinguishing itself from a less qualified and dense industrial area. Table 2 summarizes the main distinctions between science parks and these other typologies.

Other Typologies	Distinctive features
Science and Technological Park	Access: unlike Science parks, small production units in high tech sectors are admitted.
Technopole	Infrastructural: project comprises a complete new deployment of activities, including residential.
Technology Park	Goal: provide a quality environment to attract technology intensive companies that install production units and not necessarily R&D centers.
	Links: not necessarily linked to university or research centre.
Innovation Centre	Goal: Innovation in the R&D spectrum, intense focus on innovation rather than invention, allowing less R&D intensive but highly innovative activities.
	Infrastructural: smaller scale, comprising a building.
Business Park	Less demanding in all features, simply aims to develop a quality and attractive environment for firms to install production units, taking advantages of economies of scale in certain common use infrastructures

Table 2: Distinctive features of other infrastructures in relation to the science park's concept

Finally, figure 1 resumes the distinction between science parks and other infrastructures in terms of position along the R&D spectrum.

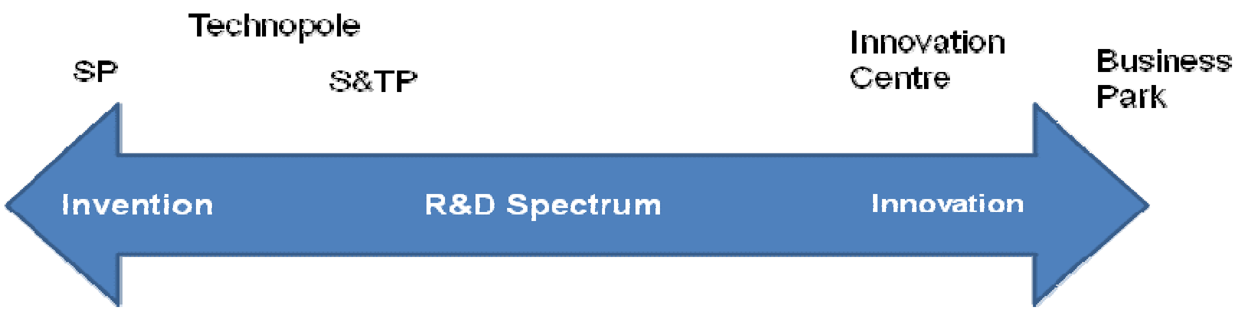

Figure 1: Science Parks and other typologies along the R&D Spectrum line.

3- Assessing Science Parks place and effectiveness on a RIS: literature review and discussion

The perception of Science parks as seedbeds for innovation (Felsenstein, 1994) and promoters of systemic industry-university cooperation and NBTFs (Asheim and Coenen, 2005), put this type of infrastructure on the political agenda on regional innovation policies. This explains the proliferation of science parks across developed countries, in spite of increasing doubts regarding their actual effectiveness and value added. In this section, we review the literature on science parks, highlighting the discussion on where science parks stand in terms of innovation process conception, role among the institutional and infrastructural framework of a RIS framework and also discussing their effectiveness.

A science park is supposed to enable a higher return on university R&D through the commercialization, transfer and spin-offs promotion. In a sense this is a view founded on a linear conception of innovation (MacDonald and Deng, 2004, Hanson et al., 2005) and leaning towards a science push policy type. According to Hanson et al. (2005), the science park is usually perceive in a narrow and closed way, as an infrastructure where the simple proximity to a university will allow firms to innovate and profit on that knowledge, disregarding the relevance of interactions and dynamic learning processes among tenants. Quintas et al. (1992) had already pointed out the flaws on the conception of such parks not only in terms of the linear conception of innovation, but also in terms of the closed perspective on this infrastructure. This "enclave" perspective neglected the importance of articulating science parks with other infrastructures and firms off park and the RIS in general.

In essence, a science park follows a science push perspective, assuming that knowledge production access will lead to innovation and its economic exploitation. In other words, and in line with the underlying linear conception of innovation, a science park would be a platform where the knowledge and basic research outputs of Universities would be tapped by firms that would undertake applied and experimental research and ultimately, innovate (Quintas et al., 2002). But even when considering the importance of networking, science parks are still implemented following a science push approach. Löfsten and Lindelöf (2005) state that it is assumed that providing the science park infrastructure and the knowledge base will be enough to enable firms to establish the necessary networks and develop. Westhead (1997) synthesized this perspective claiming that science parks were based on the assumption that innovation is a result of scientific research and that parks are the perfect "habitat" to catalyze the transformation of pure research into innovation and production. The poor results of different science parks, even though literature is focused in frontier and fast catching-up regions, have highlighted the need to balance the science push perspective with a demand pull consideration (Watkins-Mathys and Foster, 2006). If the return on R&D, especially, public R&D must be maximized, Watkins-Mathys and Foster (2006) state that governments need to pay more attention to entrepreneurship in the process of innovation and technology transfer. This is extensive to the promotion of technological spin-offs, to the attraction and clustering of external R&D initiatives (from multinationals but also from public and nonprofit institutions) and also to off-park firms. In follower regions, the demand pull consideration seems to us even more pressing since the regional economies specialization is usually characterized by industries locked in trajectories, with limited absorptive capacity. Furthermore, an effort to aid the development of emerging sectors should lead to a concentration of resources rather than a profusion of initiatives of a wide sectoral spectrum. This policy direction should take into consideration the demand characteristics, establishing a proximity relationship of firms to universities that goes beyond the mere spatial dimension.

It is important to understand how a science park infrastructure fits in the RIS concept, namely in terms of the different taxonomies proposed by Asheim and Coenen (2005) and the potential roles.

Science parks are a regional innovation policy instrument that aim to promote interactions and technology transfer, thus stimulating innovation and growth. These infrastructures have also been described as seedbeds for innovation (Felsenstein, 1994) bearing a regional embedded focus.

Despite the booms of science parks during the 80s and the 90s (Bakouros et al., 2002) the discussion on their actual effectiveness in enhancing innovation performance and accelerating the emergence of new technology intensive clusters has been subject to intense criticism and discussion.

Massey et al. (1992) defined science parks has an high tech fantasy that actually had a small effect on promoting technology transfer, linking universities to industry or enhancing the performance and growth of NBTFs. Westhead's (1997) survey on NBTFs on and off a science park concluded that there was no significant differences I terms of R&D intensity. More recently, Bakouros et al. (2002) in a rare analysis of a follower region concluded that science parks in Greece presented poor results in terms of cooperation and networking. Hanson et al. (2005) attribute these poor results to the misconception of the innovation process presiding the science park which lead to the neglecting the support in terms of managerial skills to University spin-offs. Hence, different studies have challenged the catalytic role that a science park would supposedly convey on a region. Nevertheless, though we must acknowledge that there have been poor results, other studies have confirmed that a science park can be an effective tool of regional development. Fukugawa (2006) states that NBTFs located on a science park have a higher propensity to participate in joint research with other institutions. Similarly, Löfsten and Lindelöf (2002) assessed positively the performance of Swedish Science Parks, stating that the parks milieu had a positive impact on the growth of sales and employment. Also Squicciarini (2008) acknowledges a superior performance of firms located in Finish science parks. Hence, the controversy is still ongoing. However, some insights have been provided by literature and we will also put forward some possible explanations for the limited effects of science parks. Castells and Hall (1994) attribute the low performance on science parks to the low density of firms. Low managerial skills of universities regarding technology transfer and NBTF's support (Bakouros et al., 2002) together with flawed conception of the innovation process (Quintas et al., 1992) may account for at least part of these bad results. To these explanations we further ad two. On one hand, for NBTFs it is important to identify proximity demand. Science parks development has targeted mostly less developed territories where low levels of cooperation exist. The disregard of the demand pull, namely, the creation of a technological market, may hinder the developments of NBTFs and negatively affect science parks' performance. On the other hand, a closed and restrictive view of the role of a science park has presided its implementation policy. Even empirical assessments have mostly focused on the within impact of a science park, not paying much attention to its role beyond the physical boundaries or the relevance of articulating it with a set of other regional knowledge infrastructures. In following, Hanson et al. (2005) argue that maybe science parks role is to cater the development of the social capital required to enable future networking.

In the next section, we propose an open framework to reposition the science park role in the context of a RIS, highlighting the articulation with other institutions. Thus, we propose an open approach, opposite to the previously described closed conception, that stresses the networked and systemic approaches to institutional strengthening policies, further discussing the roles of a science park in promoting regional innovation, growth and structural change. We also analyze the potential difficulties arising in follower regions and operationalize the need to complement demand pull with science push.

4- THE ROLE OF SCIENCE PARKS IN FOLLOWER REGIONS INNOVATION STRATEGIES

Our literature review highlighted important issues that we take here into consideration. First, science parks conceptual framework is commonly built on a closed science push perspective, ignoring the insights of the systemic and dynamic learning characteristics of innovation. The closed framework makes parks “enclaves” and not a structuring instrument for a region, lacking integration and articulation with the remaining organizations of a RIS.

Second, science parks primary goal appears to be the incubation and fostering of NBTFs. However, its closed perspective neglects the importance of combining demand pull aspects in an innovation policy framework that provides these firms the crucial proximal demand.

Finally, like in general happens in RIS literature, the focus has been on frontier or close follower regions (Bakouros et al., 2002).

Hence, in this section we try to operationalize an integrated innovation strategy that uses science parks has an important structuring element, but following an open and articulated perspective, also discussing the roles that these instruments may have in the core of an innovation strategy devising for follower regions.

Arguing against the closed perception of a science park, we uphold that science parks must follow an open paradigm, being a focal point for Universities, research laboratories, firms, NBTFs, venture capital and other financial institutions, regional government agencies and vicinity business parks. In follower regions, given its structural deficiencies, it is imperative to cluster and network the few resources available, thus repositioning science parks as one of the cornerstones of an innovation policy. Science parks should act as a platform that converge different organizations, interconnecting agents and thus enhancing interactions. The links to research institutions must not confine itself to the leading university since a science park must look forward to tap into other relevant knowledge reservoirs. It must convey the role of promoting regional technological diffusion, interlinking with business parks and thus upgrading the latter tenants' innovative potential.

The creation of a regional system of interconnected technological infrastructures will boost follower regions performance and allow minimizing the structural deficiencies these regions usually face. One of the main goals of a science park is to stimulate knowledge transfer from Universities to firms which is particularly relevant in follower regions. In fact, usually these regions present a divorce between the entrepreneurial sector and Universities. This disconnection is amplified by the specialization patterns frequently based on supplier-dominated industries, suffering from severe lock in problems and low technological absorptive capacity. Thus regional innovation policies must address the need of structural change as well as promote the technological upgrading and knowledge incorporation of existing industries. Under this perspective, a science park can be a central structuring element, increasing the return on public R&D and innovation output. The contributions of a science park in terms of structural change can be accounted on three levels: promotion of start-ups, technology transfer and clustering of external R&D initiatives.

Traditionally, a science park is perceived as a larger scale incubator that should stimulate university spin-offs and other technological start-ups by providing a comprehensive business

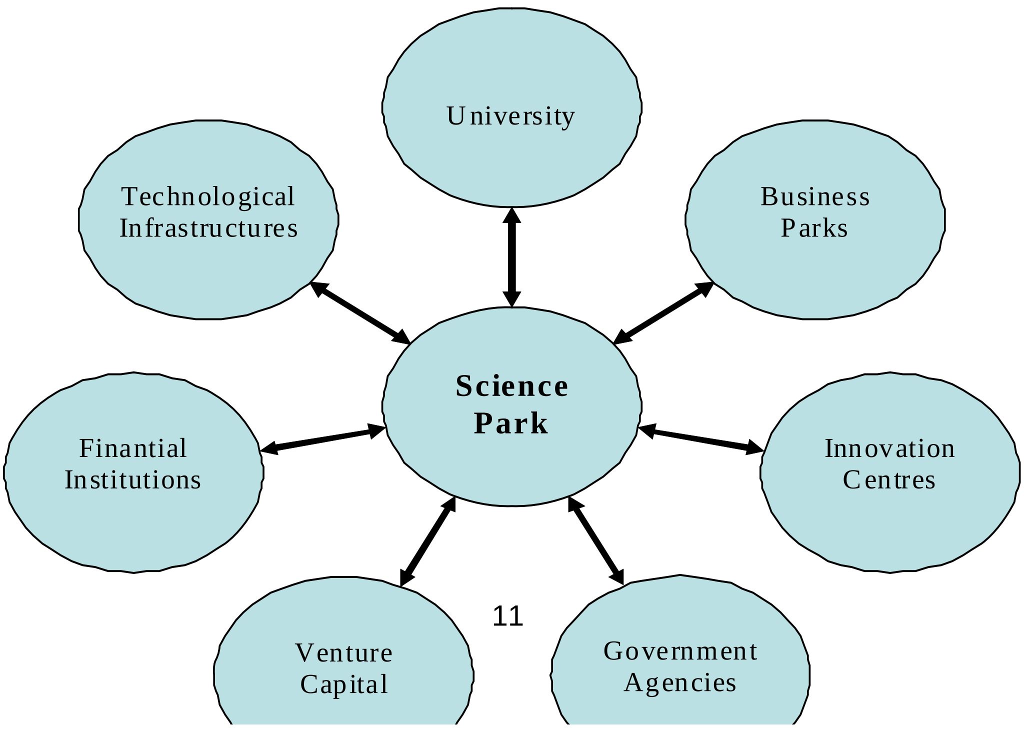

Figure 2: A systemic and open approach to the Science Park's role in a RIS

support. The fostering of NBTFs would contribute to the a transformation of the regional economic specialization profile, accelerating striuctural change. Nevertheless, we argue that this science push perspective must be integrated in a regional policy that also comprises a demand pull focus. In particular, for follower regions where often there is a reduced technological market given the supplier dominated economic profile, creating demand for these NBTFs development and growth is very important. This can be achieved by directing public demand to these firms, for instance, by widening e-government platform.

We further argue against the narrow and closed perception of the boundaries of a science park. The science park’s potential over regional economy does not end on the parks walls. We propose an integrated innovation strategy that articulates science parks with other laboratories and also with firms’ located off-park. Hence, this infrastructure should promote transfer and commercialization of knowledge beyond the park’s boundaries and contribute to the intensification of the knowledge incorporation across the regional economy.

Science parks may also carry an important role in the clustering of external initiatives which can be a major scope for RIS implementation in follower regions. Frontier regions have built RIS in a international context in which locations of R&D activities largely relied on endogenous initiatives. Since the 90s, foreign direct investment flows in R&D have increased significantly and changed their scope (e.g. Serapio and Dalton, 1999, Meyer-Krahmer and Reger, 1999, Kuemmerle, 1999, Gerybadze and Reger, 1999 and Hedge and Hicks, 2008). Even though multinationals global R&D investments are still mostly focused on developed countries (Meyer-Krahmer and Reger, 1999), these flows are now being extended to less developed regions (e.g. Indian ICT cluster in Bangalore - Kumar, 1996). The role of science parks in attracting these initiatives is a signaling one. Public driven R&D and the investment in higher education as allowed some follower regions to develop important human capital stocks. Follower regions thus may possess excellence in some fields and also a significant cost advantage, creating the perfect scenario for attracting multinationals R&D laboratories. The demonstrating research excellence may be accomplished through science parks NBTFs success, signaling the scientific regional capacity and the economic potential of the knowledge base. This is the insight we derive from the Cambridge science park evolution. According to Druille and Garnsey (2000) both the Cambridge Science Park and the Grenoble infrastructure first succeeded in creating an innovative milieu, providing incentives to entrepreneurs to stay in the region and there develop their NBTFs. After the success of these

NBTFs and of their solid scientific capabilities, multinationals perceived the excellence of regional research centers and further established high tech industries' R&D corporate centers (e.g. Xerox, Oracle, Toshiba, Microsoft, AT&T), in order to augment their knowledge base and capabilities (Druille and Garnsey, 2000). In a more moderate way, even public or non-profit R&D institutions are beginning to exploit the advantages of outward locations, following the same principle of home base augmenting and exploiting opportunities generated by high skilled human capital reservoirs in follower countries and regions.

Thus science parks role may actually comprise different dimensions than the usually assessed and be an important instrument in the core of a follower region innovation strategy.

Additionally, science parks may also contribute to the building up of social capital that will facilitate future cooperation between agents.

In sum, some of these aspects are common to both frontier and follower regions. However, follower regions structural deficiencies imply that the success of science parks in creating NBTFs is dependent upon demand pull policies creating the technological market for them. Furthermore, science parks may in follower regions convey a larger role in interlinking and articulating regional infrastructures, promoting the technological transfer from universities to the regional economy as a whole. Finally, besides signaling competences and attracting FDI R&D, science parks may constitute the bridge to join universities, firms and enhance social capital in terms of cooperation and interactions density, a deficitary aspect of more fragile Regional innovation systems.

CONCLUDING REMARKS

The follower regions structural deficiencies have to be overcome through an integrated policy approach, balancing science push and demand pull elements. Science parks constitute an important instrument in the diffusions of technology and in maximizing social return on public R&D. However, the narrow and closed approach underlying science parks implementation restrains its potential in contributing to the upgrading of the regions economy's technological specialization pattern. In follower facing a process of structural change, science parks may account as a catalytic device bridging science to economy, fostering interaction and the emergence of new knowledge intensive sectors. In a modern and integrated conception of innovation policies, we proposed that science parks be articulated with a range of other organizations, creating synergies and enhancing the returns on R&D. Furthermore, the success of a science park may carry a demonstrative role, signaling competences in follower regions. This signal can attract FDI R&D, accelerating the knowledge building and the structural change process in follower regions, which add to its attractiveness considerable cost advantages. In the future, we are to extend this analysis through a comprehensive study of European science parks, assessing different positioning in the core of regional innovation policies and results.

REFERENCES

Asheim, B. and Coenen, L. (2005), "Knowledge bases and regional innovation systems: Comparing Nordic clusters", Research Policy, 34, 1173–1190.

Bakouros, Y.L., Mardas, D. C. and Varsakelis, N. C. (2002), "Science park, a high tech fantasy?: an analysis of the science parks of Greece", Technovation, 22, 123–128.

Castells, P., Hall, P.(1994), Technopoles of the World: The Making of the 21th Century Industrial Complexes. Routhedge, London.

Chan, K.F. and Lau, T. (2005), "Assessing technology incubator programs in the science park: the good, the bad and the ugly", Technovation, 25, 1215–1228.

Chou, T. L. and Lin, Y. C. (2007), "Industrial Park Development across the Taiwan Strait", Urban Studies, 44 (8), 1405–1425, July.

Chyi, Y.-L. (2008), "Cluster Development and Global Competitiveness: Prospects of the Nano Sector in Hsinchu Science Park", The Journal of Interdisciplinar Economics, 19, 101–126.

Druilhe, C. and Garnsey, E. (2000), "Emergence and growth of high-tech in Cambridge and Grenoble", Entrepreneurship and Regional Development, 12, 163-177.

Felsenstein, D., (1994), "University-related science parks—"seedbeds" or "enclaves" of innovation?", Technovation, 14 (2), 93–110.

Ferguson, R. and Olofsson, C (2004). "Science Parks and the Development of NTBFs—Location, Survival and Growth". Journal of Technology Transfer, 29, 5–17.

Fukugawa, N. (2006), "Science parks in Japan and their value-added contributions to new technology-based firms", International Journal of Industrial Organization, 24, 381–400.

Gerybadze, A. and Reger, G., (1999), "Globalization of R&D: recent changes in the management of innovation in transnational corporations", Research Policy, 28, 251–274.

Hansson,F., Husted,K. and Vestergaard, J. (2005), "Second generation science parks: from structural holes jockeys to social capital catalysts of the knowledge society", Technovation, 25, 1039–1049.

Harper, J. C. and Georghiou, L. (2005), "Foresight in Innovation Policy: Shared Visions for a Science Park and Business–University Links in a City Region", Technology Analysis & Strategic Management,17 (2), 147–160, June.

Hegde, D. and Hicks, D.(2008), "The maturation of global corporate R&D: Evidence from the activity of U.S. foreign subsidiaries", Research Policy, 37, 390–406.

Koh, F. C. C., Winston T.H. Koh, W. T. H., and Tschang, F. T. (2005), "An analytical framework for science parks and technology districts with an application to Singapore", Journal of Business Venturing, 20, 217–239.

Kuemmerle, Walter (1999), "Foreign direct investment in industrial research in the pharmaceutical and electronics industries—results from a survey of multinational firms", Research Policy, 28,179–193.

Kumar, N. (1996),"Intellectual property protection, market orientation and location of overseas R&D activities by multinational enterprises", World Development, 24, 673-688.

Lee, Wen-Hsiung and Yang,Wei-Tzen (2000), "The cradle of Taiwan high technology industry development — Hsinchu Science Park (HSP)", Technovation, 20, 55–59.

Link, A. N, John T. Scott, J. T. and Donald S. Siegel, D. S. (2003), "The economics of intellectual property at universities: an overview of the special issue", International Journal of Industrial Organization, 21, 1217–1225.

Link, A. N. and Scott, J. T. (2006), "University research parks", J Prod Anal , 25, 43–55.

Löfsten, H and Lindelöf, P. (2002), “Science Parks and the growth of new technology-based firms—academic-industry links, innovation and markets”, Research Policy, 31, 859–876.

Löfsten, H and Lindelöf, P. (2003), “Determinants for an entrepreneurial milieu: Science Parks and business policy in growing firms”, Technovation, 23, 51–64.

Löfsten, H and Lindelöf, P. (2005), “R&D networks and product innovation patterns—academic and non-academic new technology-based firms on Science Parks”, Technovation, 25, 1025–1037.

Macdonald, S. and Deng, Y. (2004), “Science parks in China: a cautionary exploration”, International Journal Technology, Intelligence and Planning, 1 (1), 1–14.

Massey, D., Quintas, P. and Wield, D. (1992), High-tech Fantasies. Science Parks in Society, Science and Space, London: Routledge.

Maura McAdam, M. and McAdam, R. (2008), “High tech start-ups in University Science Park incubators: The relationship between the start-up’s lifecycle progression and use of the incubator’s resources”, Technovation, 28, 277–290.

Meyer-Krahmer, F. and Reger, G. (1999), “New perspectives on the innovation strategies of multinational enterprises: lessons for technology policy in Europe”, Research Policy, 28,751–776.

Monck, C.S.P., Porter, R.B., Quintas, P., Storey, D.J., Wynarczyk, P., (1988), Science Parks and the Growth of High Technology Firms, Croom Helm, London.

Motohashi, K. (2005), “University–industry collaborations in Japan: The role of new technology-based firms in transforming the National Innovation System”, Research Policy, 34, 583–594.

Oh, Deog-Seong (2005), “High-Technology and Regional Development Policy: An Evaluation of Korea's Technopolis Programme”, High-Technology and Regional Development Policy, 19, 3, 253-267.

Phillips, Su-Ann, S and Yeung, H. (2003),“A Place for R&D? The Singapore Science Park, Urban Studies”, 40(4), 707–732.

Phan, P. H., Siegel, D. S. and Wright, M. (2005), “Science parks and incubators: observations, synthesis and future research”, Journal of Business Venturing, 20, 165–182.

Quintas, P., Wield, D., Massey, D., (1992), “Academic-industry links and innovation: questioning the science park model”, Technovation, 12 (3), 161–175.

Serapio, Jr. and Dalton, D. H. (1999), Globalization of industrial R&D: an examination of foreign direct investments in R&D in the United States, Research Policy, 28, 303–316.

Squicciarini, M. (2008), “Science Parks` Tenants versus Out-of-Parks: Who Innovates More? A Duration Model”, Journal of Technology Transfer, 33 (1), 45-71, February.

Shin, Dong-Ho (2001), “An alternative approach to developing science parks: a case study from Korea, Papers Regional Science, 80, 103-11.

Siegel, D.S., Paul Westhead, P. and Wright, M. (2003), “Assessing the impact of university science parks on research productivity: exploratory firm-level evidence from the United Kingdom”, International Journal of Industrial Organization, 21, 1357–1369.

Stockport, G. (1989), “Defining a science park”, SWP 11/ 89, Cranfield School of Management.

Storey, D. J., Tether, B.S., (1998), “Public policy measures to support new technology based firms in the European Union”, Research Policy, 26, 1037–1057.

UKSPA, 1996, UKSPA 96: The United Kingdom Science park Association Annual Report 1996, Birmingham: The United Kingdom Science Park Association.

Vedovello, C. (1997), “Science parks and university industry interaction: geographical proximity between the agents as a driving force”, Technovation, 17(9), 491-502.

WESTHEAD, P. (1997), “R&D `inputs’ and `outputs’ of technology-based firms located on and off science parks”, R&D Management, 27, 45-61.

Westhead, P. and Batstone, S. (1998), “Independent technology-based firms: the perceived benefits of a Science Park location”, Urban Studies, 35(12), 2197- 2219.

Watkins-Mathys, L. and Foster, J. M. (2006), “Entrepreneurship: the missing ingredient in China’s STIPs?”, Entrepreneurship & Regional Development, 18, 249–274, May.

Zhu, D. and Tann, J. (2005), “A Regional Innovation System in a Small-sized Region: A Clustering Model in Zhongguancun Science Park”, Technology Analysis & Strategic Management, 17 (3), 375–390, September.

Recent FEP Working Papers

Nº 301	Alexandre Almeida, António Figueiredo and Mário Rui Silva "*From Concept to Policy: Building Regional Innovation Systems in Follower Regions"*, November 2008
Nº 300	Pedro Quelhas Brito, "*Conceptualizing and illustrating the digital lifestyle of youth"*, October 2008
Nº 299	Argentino Pessoa, "*Tourism and Regional Competitiveness: the Case of the Portuguese Douro Valley"*, October 2008
Nº 298	Aurora A.C. Teixeira and Todd Davey "*Attitudes of Higher Education students to new venture creation: a preliminary approach to the Portuguese case"*, October 2008
Nº 297	Carlos Brito "*Uma Abordagem Relacional ao Valor da Marca"*, October 2008
Nº 296	Pedro Rui M. Gil, Paulo Brito and Óscar Afonso "*A Model of Quality Ladders with Horizontal Entry"*, October 2008
Nº 295	Maria Manuel Pinho, "*The political economy of public spending composition: evidence from a panel of OECD countries"*, October 2008
Nº 294	Pedro Cosme da Costa Vieira, "*O Subsídio de Desemprego e a Relação Negativa entre Salário e Risco de Falência: Uma Teoria em Equilíbrio Parcial"*, October 2008
Nº 293	Cristina Santos, Alexandre Almeida and Aurora A.C. Teixeira, "*Searching for clusters in tourism. A quantitative methodological proposal"*, September 2008
Nº 292	Alexandre Almeida and Aurora A.C. Teixeira, "*One size does not fit all... An economic development perspective on the asymmetric impact of Patents on R&D"*, September 2008
Nº 291	Paula Neto, António Brandão and António Cerqueira, "*The Impact of FDI, Cross Border Mergers and Acquisitions and Greenfield Investments on Economic Growth"*, September 2008
Nº 290	Cosme, P., "*Integrating fire risk into the management of forests"*, September 2008
Nº 289	Cosme, P., "*A comment on efficiency gains and myopic antitrust authority in a dynamic merger game"*, September 2008
Nº 288	Moreira, R., "*Workart – A Gestão e a Arte"* (1st Prize of the 2nd Edition of FEP/AEFEP- Applied Research in Economics and Management), August 2008
Nº 287	Vasco Leite, Sofia B.S.D. Castro and João Correia-da-Silva, "*The core periphery model with asymmetric inter-regional and intra-regional trade costs"*, August 2008
Nº 286	Jorge M. S. Valente and Maria R. A. Moreira, "*Greedy randomized dispatching heuristics for the single machine scheduling problem with quadratic earliness and tardiness penalties"*, August 2008
Nº 285	Patricia Teixeira Lopes and Rui Couto Viana, "*The transition to IFRS: disclosures by Portuguese listed companies"*, August 2008
Nº 284	Argentino Pessoa, "*Educational Reform in Developing Countries: Private Involvement and Partnerships"*, July 2008
Nº 283	Pedro Rui Mazeda Gil and Óscar Afonso, "*Technological-Knowledge Dynamics in Lab-Equipment Models of Quality Ladders"*, July 2008
Nº 282	Filipe J. Sousa and Luís M. de Castro, "*How is the relationship significance brought about? A critical realist approach"*, July 2008
Nº 281	Paula Neto; António Brandão and António Cerqueira, "*The Macroeconomic Determinants of Cross Border Mergers and Acquisitions and Greenfield Investments"*, June 2008
Nº 280	Octávio Figueiredo, Paulo Guimarães and Douglas Woodward, "*Vertical Disintegration in Marshallian Industrial Districts"*, June 2008
Nº 279	Jorge M. S. Valente, "*Beam search heuristics for quadratic earliness and tardiness scheduling"*, June 2008
Nº 278	Nuno Torres and Óscar Afonso, "*Re-evaluating the impact of natural resources on economic growth"*, June 2008
Nº 277	Inês Drumond, "*Bank Capital Requirements, Business Cycle Fluctuations and the Basel Accords: A Synthesis"*, June 2008
Nº 276	Pedro Rui Mazeda Gil, "*Stylized Facts and Other Empirical Evidence on Firm*

	Dynamics, Business Cycle and Growth", May 2008
Nº 275	Teresa Dieguez and Aurora A.C. Teixeira, "*ICTs and Family Physicians Human Capital Upgrading. Delightful Chimera or Harsh Reality?"*, May 2008
Nº 274	Teresa M. Fernandes, João F. Proença and P.K. Kannan, "*The Relationships in Marketing: Contribution of a Historical Perspective"*, May 2008
Nº 273	Paulo Guimarães, Octávio Figueiredo and Douglas Woodward, "*Dartboard Tests for the Location Quotient"*, April 2008
Nº 272	Rui Leite and Óscar Afonso, "*Effects of learning-by-doing, technology-adoption costs and wage inequality"*, April 2008
Nº 271	Aurora A.C. Teixeira, "*National Systems of Innovation: a bibliometric appraisal"*, April 2008
Nº 270	Tiago Mata, "*An uncertain dollar: The Wall Street Journal, the New York Times and the monetary crisis of 1971 to 1973"*, April 2008
Nº 269	João Correia-da-Silva and Carlos Hervés-Beloso, "*General equilibrium with private state verification"*, March 2008
Nº 268	Carlos Brito, "*Relationship Marketing: From Its Origins to the Current Streams of Research"*, March 2008
Nº 267	Argentino Pessoa, "*Kuznets's Hypothesis And The Data Constraint"*, February 2008
Nº 266	Argentino Pessoa, "*Public-Private Sector Partnerships In Developing Countries: Are Infrastructures Responding To The New Oda Strategy"*, February 2008
Nº 265	Álvaro Aguiar and Ana Paula Ribeiro, "*Why Do Central Banks Push for Structural Reforms? The Case of a Reform in the Labor Market"*, February 2008
Nº 264	Jorge M. S. Valente and José Fernando Gonçalves, "*A genetic algorithm approach for the single machine scheduling problem with linear earliness and quadratic tardiness penalties"*, January 2008
Nº 263	Ana Oliveira-Brochado and Francisco Vitorino Martins, *"Determining the Number of Market Segments Using an Experimental Design"*, January 2008
Nº 262	Ana Oliveira-Brochado and Francisco Vitorino Martins, *"Segmentação de mercado e modelos mistura de regressão para variáveis normais"*, January 2008
Nº 261	Ana Oliveira-Brochado and Francisco Vitorino Martins, *"Aspectos Metodológicos da Segmentação de Mercado: Base de Segmentação e Métodos de Classificação"*, January 2008
Nº 260	João Correia-da-Silva, *"Agreeing to disagree in a countable space of equiprobable states"*, January 2008
Nº 259	Rui Cunha Marques and Ana Oliveira-Brochado, *"Comparing Airport regulation in Europe: Is there need for a European Regulator?"*, December 2007
Nº 258	Ana Oliveira-Brochado and Rui Cunha Marques, *"Comparing alternative instruments to measure service quality in higher education"*, December 2007
Nº 257	Sara C. Santos Cruz and Aurora A.C. Teixeira, *"A new look into the evolution of clusters literature. A bibliometric exercise"*, December 2007
Nº 256	Aurora A.C. Teixeira, *"Entrepreneurial potential in Business and Engineering courses … why worry now?"*, December 2007
Nº 255	Alexandre Almeida and Aurora A.C. Teixeira, *"Does Patenting negatively impact on R&D investment?An international panel data assessment"*, December 2007
Nº 254	Argentino Pessoa, *"Innovation and Economic Growth: What is the actual importance of R&D?"*, November 2007

Editor: Sandra Silva (sandras@fep.up.pt)
Download available at:
http://www.fep.up.pt/investigacao/workingpapers/workingpapers.htm
also in http://ideas.repec.org/PaperSeries.html

www.fep.up.pt

Faculdade de Economia da Universidade do Porto
Rua Dr. Roberto Frias, 4200-464 Porto | Tel. 225 571 100
Tel. 225571100 | www.fep.up.pt