Cooperation in Innovation Practices among Portuguese Firms: Do Universities Interface Innovative Advances?

Silva, Maria José and Leitão, João

15 October 2007

Cooperation in Innovation Practices among Portuguese Firms: Do Universities Interface Innovative Advances?

Maria José Aguilar Madeira Silva
Assistant Professor, University of Beira Interior
NECE, Management and Economics Department, Pólo IV, 6200-209 Covilhã, Portugal,
Phone: +351 275 319 651, E-mail: msilva@ubi.pt, URL: http://www.dge.ubi.pt/msilva

João Carlos Correia Leitão
Assistant Professor, University of Beira Interior
NECE, Management and Economics Department, Pólo IV, 6200-209 Covilhã, Portugal,
Phone: +351 275 319 653, E-mail: jleitao@ubi.pt URL: http://www.dge.ubi.pt/jleitao

Abstract

This paper aims to identify the nature of the relationships that are established amongst agents who co-operate in terms of innovation practices. It analyses whether the entrepreneurial innovation capability of firms is stimulated through the relationships developed with external partners. The data of 2nd Community Innovation Survey of EUROSTAT is used in a logistic model. In the estimation process of the Logit function, the entrepreneurial innovation capability is considered as the answer variable. The scientific agents who cooperate in terms of innovation activities impact, positively, on the propensity to engage in innovative advances revealed by the firms, at the level of product innovation. The paper presents policy implications, which may be used in the design of public policies for fostering open innovation networks between scientific agents and firms.

Keywords: Innovation, Networks, Entrepreneurial Innovation Capability.

1 - INTRODUCTION

Due to the challenges enterprises are facing, innovation is assumed as a key factor for competitiveness. Several theoretical approaches developed in the last few years, support the idea that innovation results from a non linear, evolutionary, complex and interactive process between the firm and its agents; where external contacts in the scope of innovation influence the firm'sinnovation capacity. This paper aims to analyse the nature of the relationships that are established among agents who co-operate in terms of innovation practices. Furthermore, it aims to determine if the entrepreneurial innovation capacity of firms is stimulated through the relationship established with the external partners.

Thus, it is intended with this essay to develop a theoretical support based on current reference approaches, corroborated by an empirical support which allows identifying if the innovative advances undertaken by Portuguese Industrial firms are stimulated by the relationship with business and science partners.

To empirically test the formulated hypotheses authorized by OCT - Observatório da Ciência e da Tecnologia *observatory of Science and Technology* which belong to the Second Community innovation survey for – CIS II (*Community Innovation Survey II*). The generalized model of linear regression is applied to the obtained data, namely the model of logistic regression.

The article is structured in the following way: point two presents relevant literature on the relationship regarding innovation; the conceptual model is proposed and the hypotheses which are to be empirically tested in the statistical model are formulated. In point three the sample is defined and later the description and characterization of variables used in the empirical study. Point four states the model of logistic regression for innovative advances. In point five the results are discussed and the main conclusions are presented.

2 – PROPOSAL FOR CONCEPTUAL MODEL AND HYPOTHESES

In this research, innovation is neither seen as something periodical that happened by accident nor something that results from the action of an individual agent. Innovation is seen as the result of an interactive and non linear process between the firm and its environment. (Kline and Rosenberg, 1986, Dosi *et al.*, 1988, Lundvall, 1988, 1992, Nelson, 1993, Edquist, 1997, Maskell and Malmberg, 1999, Lundvall, Johnson, Andersen and Dalum 2002). The results of this same process are designated as entrepreneurial innovation capacity. The term entrepreneurial innovation capacity was adopted to integrate the components that result from the innovative process of a firm, namely: product innovation, process innovation and organizational innovation. This paper is focused on the study of entrepreneurial innovation capacity regarding the innovative advances undertaken by the firm in what concerns the product innovation.

Considering the dimension of entrepreneurial innovation capacity: product innovation and having as its base the pioneer factor, two different types of innovation are distinguished: "new for the firm versus new for the market". The category of innovation "new for the firm" includes modifications and improvements of the firms existing products, as well as the products that are new for the firm, extending or substituting certain items (Kaufmann e Tödtling, 2000). The innovation of these products comprise changes regarding variety of the products, small design improvements or technical changes of one or several products, as well as the introduction of new ones. It is generally known as incremental innovation, with small technical changes that result from the global available knowledge.
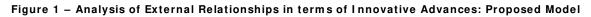
The category innovation "new for the market" includes products which are new to the firm and the market (Kaufmann and Tödtling, 2001). Such kind of product offer new qualities, services or functions that up to that moment are not available in another market place. Therefore, such products do not have other competing products, which lead towards a temporary monopoly; often addressed to very specialised markets (Kaufmann and Tödtling, 2001). These innovations often require more than just incremental development, contributing towards the development of innovative advances. This way, it is considered that the firm produced innovative advances when it introduced a new product not only to the firm but also to the market that is supplied by the firm, during 1995 to 1997 (CIS II, 1999, Kaufmann and Tödtling, 2001).
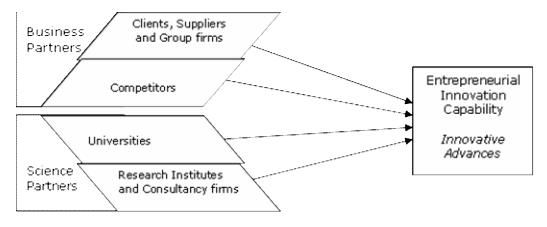
While analysing the resources on this matter, it was verified in the past few years that there is a growing interest in the study of external partnership in the scope of innovation. The reference approaches on this theme, suggest that external partnerships may stimulate the innovative process of firms; for the following reasons, according to the network and the inter organisational associations, the external partnerships established among associates are characterised by relatively open information exchange and such information flow may stimulate innovative activities (Porter, 1990; Furman, Porter and Stern, 2002; Pyke and Sengenberger, 1992; Hakansson, 1987; Hakansson and Johanson, 1992, Cohen and Levinthal, 1989, 1990). Despite deriving from several theoretical approaches, this research has demonstrated a considerable convergence in what concerns the fact that established partnership with external associates influence the innovation process.

Therefore the systemic perspective of innovation enriched its analysis, by considering organisational and environmental factors that influence the innovative performance and the entrepreneurial competitiveness. According to this approach, innovation is originated from a collective learning process where institutions have a determinant role. Since theinnovation capacity is the result of an interactive process, which embraces firms and environment, by enhancing the inherent synergies of learning that belong to the economic system and by stimulating the institutions that support innovation (Lundvall, 1985, 1988, 1992; Nelson, 1993; Cooke, Uranga and Etxebarria, 1997; and Braczyk *et al.*, 1998; Cooke et al. 2000; Kaufmann e Tödtling, 2001). The systematic approach enhances that these institutions, when connecting several agents, may play a crucial role in the creation and transmission of innovation (Godinho, 2003). This approach provided a better understanding about the connections established between firms and external partners, as well as it allowed the acknowledgement of several agents that are crucial for disseminating innovation within the system.

In several countries, many studies show the importance of external partnerships regarding improvements of the firm'sinnovation capacity (Fritsch and Lukas, 1999, 2001; Kaufmann and Tödtling, 2000, 2001; Bayona *et al.*, 2001; Romijn and Albaladejo, 2002, Hagedoorn, 2002, Silva, 2003, Silva, *et al.*, 2005, Veugelers and Cassiman, 2005, Leitão, 2006, Schmidt, 2007). Also in Portugal, the results obtained by the CISEP/GEPE (1992) study, and the research elaborated by Simões (1997), show the importance of external partnerships as factors influencing the performance of Portuguese firms.

However, the literature has not covered so far several issues concerning innovation. As a result, besides knowing who the main partners are, in the scope of innovation, in order to understand innovation process, it is fundamental to study: what the importance of the various external partners is, regarding the development of innovative activities and its contribution to the innovative advances. Thus, a model is proposed to analyse if the relation established with external partnerships, in the scope of innovation, stimulates firms to adopt innovative advances. The proposed model is presented in the following Figure 1.

Figure 1 – Analysis of External Relationships in terms of Innovative Advances: Proposed Model

Within the various partners of innovation, and taking into consideration the data obtained by the innovation enquiry to firms – CIS II (1999), four external partnership groups have been identified. Regarding business partners, two groups are pointed out. One group associated to business partners that promote cooperation, namely: clients, suppliers and other group firms. Another partnership group refers to the competitors; these partnerships are distinguished from the other business partners, since it is a complex alliance and can lead towards anti-competitive behaviours. In terms of science partners, we distinguish two groups. The first is related to the entities that supply knowledge and training, such as: universities and higher education institutions. The second is related to the remainder partners contemplated in the CIS II enquiry, namely Institutes of public research, private non profitable organizations and consultancy firms. Having these four partnership groups as a base, the following hypotheses are formulated.

Several studies point out that the innovation capability of firms is influenced by the established partnerships with business partners, namely: client suppliers and group firms (Simões, 1997, Fritsch and Lukas, 1999, 2001; Kaufmann and Tödtling 2000, 2001). Therefore it is intended to find out if the relationships established with clients, suppliers and group firms stimulate the firm to develop innovative advances. This way, the following hypothesis is formulated:

H1: The partnership regarding innovation established with clients, suppliers and groups firms are positively related to the propensity of the firm to undertake innovative advances.

Given that firms establish partnerships with competitors regarding innovation, this research intends to empirically test if such partnerships help enterprises create new products that are new not only to the firm but also to the market. In this sense, the following hypothesis is formulated:

H2: The partnership regarding innovation established with competitors positively related to the propensity of firm to undertake innovative advances.

According to the existing literature, universities assume a special role in stimulating innovative advances. For Kaufmann and Tödtling (2001), universities produce technological developments of long range, because they focus primarily on the creation of new knowledge regardless of economic considerations. Fritsch and Schwirten (1999) also refer that universities and other institutions of higher education supply inputs for the private sector's innovative activities. According to the former considerations, the following hypothesis is formulated:

H3: Firms that establish a partnership regarding innovation with universities and other institutions of higher education are more able to undertake innovative advances.

The partnership with consultancy firms, institutions for private and public research, focus essentially on the production of a scientific and technological knowledge promptly commercialized (Kaufmann e Töldtling, 2001). The relation with this type of institutions is based on the demand for alternative sources of information and knowledge for innovation. This way, these institutions supply scientific and technological knowledge however, it is more common to supply applied knowledge, specific skills and information (Tether, 2002; Bruce and Morris, 1998; and Becker and Dietz, 2004). In order to find out if the partnership with these partners stimulate the innovative advances, the following hypothesis is formulated:

H4: The partnerships regarding innovation established with consultancy firms, governmental and private institutions are positively related to the propensity of firm to undertake innovative advances.

The fourth hypothesis aims to determine if the partnerships established with partners regarding innovation, influence significantly the innovation capacity of industrial Portuguese firms, at a level of innovative advances undertaken by firms and in terms of product innovation.

3 – RESEARCH METHODOLOGY

After proposing the model of analysis and the hypotheses to be empirically testes, the research methodology is developed through the presentation of the population, the sample and of the variables to be used in the estimation of logistic regression.

3.1 – Population and Sample

The data used in this study was collected by the "OCT – Observatório das Ciências e das Tecnologias" (Sciences and Technologies Observatory), in Portugal. The data was collected during the second semester of 1998, through a survey that consisted in a questionnaire named as Community Innovation Survey II. The surveyed year was 1997 and there is a great deal of indicators that concern the period of 1995 to 1997. This questionnaire was applied in Europe, under the supervision of Eurostat and following the guidelines in the Oslo Manual (OCDE, 2005).

The population includes all the industrial firms with less than 20 employees. The economic activity classes belonging to the population, more specifically to the industry, are the ones that follow: 15 to 37 and 40 to 41. The sample was built by the "INE – Instituto Nacional de Estatística" (National Institute of Statistics), according to the methodological specifications of Eurostat. The INE has selected an initial sample of industrial firms, selected from the 9289 firms that are registered at the "FGUE – Ficheiro Geral de Unidades Estatísticas do INE" (Global File of INE's Statistical Units). According to Conceição and Ávila (2001), the sample was built through a mixed method that combines the census approach with the stratified random sampling.
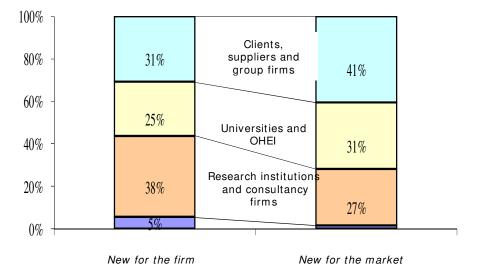
Thus, an initial sample of 1556 industrial firms was extracted from the population. Some adjustments that resulted from the survey were made to the initial sample, due to file mistakes or activity changes. Consequently, the activities and/or the dimension classes of some firms were reclassified. After being corrected by the survey results, the obtained sample comprised
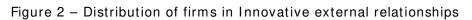
1429 firms, being named as corrected sample. The firms that answered the questionnaire in a valid way, following the guidelines defined by Eurostat, came to a total of 819 firms, thus constituting the final sample. Considering the number of firms that comprised the corrected theoretical sample, it was verified that the 819 answers which were obtained by the industrial firms represented a global answer rate of 57, 3%.

Since this study is centred on the entrepreneurial innovation capacity of the firm, regarding its innovative advances in product innovation, all 193 firms that undertook product innovation from 1995 to 1997 were considered.

3.2 – Data

The firms were classified as "innovative to the market" if they answered affirmatively to the question in the 5th point of the questionnaire, and were classified as "innovative to the firm" if they answered negatively. This question asked if "from 1995 to 1997, the company introduced technologically new or improved products which were new both to the firm and to the market served by that firm" (CIS, 1999: 4). The sample has 193 product innovative industrial firms, which were classified according to their innovativeness degree. Ninety of these firms, representing 47%, stated that they had introduced new products into the market from 1995 to 1997. The remaining firms, namely 103 (53%), introduced innovations in products that were new to the firm, but not to the market.

Figure 2 – Distribution of firms in Innovative external relationships

The two innovation types present several differences that should be mentioned (Figure 2). The firms that have attained incremental innovations (new to the firm) present, as main partners, research institutions and consultancy firms (38, 2 %), followed by the business partners: clients, suppliers and group firms (30, 9%). Regarding the firms that have developed products, which constitute radical innovations that are new to the firm and to the market, the main relationships are established with clients, suppliers and group firms (40,6%), followed by universities and other higher education institutions (31,2%).

In Table 1 the dichotomic variables of the model for testing the formulated hypotheses, are presented.

Table 1 – Variables of the Model and Hypotheses

Model I		Code	Measures	Hyp.
Dependent variable: Innovative advances		INA	Binary 1= New to the market 0 = New to the firm	
Independent variables	Relationships established with clients, suppliers and group firms	RE1	1= Firm has established at least one relationship with clients or suppliers or group firms 0 = Firm has not established any relationship	H₁
	Relationships established with competitors	RE2	1= Firm has established at least one relationship with competitors 0 = Firm has not established any relationship	H₂
	Relationships established with universities and OHEI	RE3	1= Firm has established at least one relationship with universities or OHEI 0 = Firm has not established any relationship	H₃
	Relationships established with research institutions and consultancy firms	RE4	1= Firm has established at least one relationship with state or private research institutions or with consultancy firms 0 = Firm has not established any relationship	H₄

4. LOGISTIC REGRESSION FOR INNOVATIVE ADVANCES

According to what has been previously defined, the *Innovative Advances* (*INA*) variable is binary, with values equal to 1, if the firm has developed product innovations that are new to the market, or equal to 0, if the firm has developed product innovations that are new only to the firm. The binary data are very common among the several types of categorical data and their modelling is part of the linear regression models category (McCullagh and Nelder, 1989). The logistic regression model is the most common one (Agresti, 1996, Ferrão, 2003), regarding the way it facilitates the substantive interpretation of parameters. This way, a logistic regression model for innovative advances is proposed, by using dichotomic independent variables, in which ε_i represents the residual term.

$$INA_i = \beta_0 + \beta_1 \operatorname{Re}_1 + \beta_2 \operatorname{Re}_2 + \beta_3 \operatorname{Re}_3 + \beta_4 \operatorname{Re}_4 + \varepsilon_i \qquad (1)$$

The estimation process is based on the maximum likelihood procedure.

5 – RESULTS: PRESENTATION AND DISCUSSION

The estimators of the final model are presented in Table 2. According to the Wald statistics, we detect that all the estimators of the regression parameters are statistically significant up to 5%, except for the relationships established with competitors.

Table 2 – Logit Regression Model Results for Innovation Advances

Model	Parameter Estimator	S.E.	Wald	Sig.	EXP (B)
Relationships established with:					
Clients, suppliers and group firms	0,797	0,405	3,865	0,049*	2,219
Competitors	-1,485	1,248	1,415	0,234	0,226
Universities and OHEI	1,243	0,575	4,669	0,031*	3,467
Research institutions and consultancy firms	-1,112	0,554	4,034	0,045*	0,329
Constant	-0,281	0,173	2,638	0,104	0,755
Model summary					
Correct Predict (%)	60,1%				
Chi-square	11,318			0,023	
Log likelihood	255,361				
Number of cases (n)	193				

Significance level: 5%

The first hypothesis is concerned with the relation between the capacity of the firm to develop innovation advances and the variable that is relative to business partners relationships, as follows, H_1: *The relationships regarding innovation established with clients, suppliers and group firms are positively related to the propensity of the firm to undertake innovative advances.* The results suggest that the relationships established with these partners have positive and significant effects on the innovative advances made by the firm, as it is indicated by the positive estimator of the parameter (0,797). As we analyse the marginal effects associated with the variable here at study, it is verified that the firms which establish relationships have an advantage of 2,219 when it comes to developing innovative advances, comparing to the firms that do not establish these relationships. Therefore, the firms that connect with clients, suppliers and/or group firms are more able to innovate than firms that have not established such kind of relationships. This ratifies the results obtained by other authors, such as, Fritsch and Lukas (1999, 2001), and Kaufmann and Tödtling (2000, 2001).

Concerning the second hypothesis, H_2: *The relationships regarding innovation established with competitors are positively related to the propensity of the firm to undertake innovative advances.* According to the obtained results, nothing can be concluded about this relationship, since the variable associated with these relationships is not statistically significant. Hence, the null hypothesis stating that there is not a connection between the established relationships with the competitors and the tendency of the firm to undertake innovative advances is neither rejected nor accepted. These facts are possibly due to the reduced number of cases associated with the variable.

With reference to the third hypothesis, H_3: *The firms that establish relationships regarding innovation with universities and other higher education institutions are more able to undertake innovative advances.* According to the results, the relationships with universities and other higher education institutions have positive and significant effects on the tendency of the firm to make innovative advances. These results follow the empirical investigations led by Fritsch and Schwirten (1999), Kaufmann and Töldtling (2001) and Tether (2002). It should be mentioned that the success advantage of the firm to develop innovative advances comprises 3,467. In other words, the advantage of the firm to develop innovative advances is 3,467 bigger in firms that establish relationships with universities and other higher education institutions, comparing with those that do not establish such relationships. As the marginal effects values of the several variables are analysed, it is noticed that the variable associated with the relationships established with universities and other higher education institutions has the highest value. Thus, it can be stated that the innovative advances undertaken by the firms are also a product of the relationships that they establish with universities and other higher education institutions.

As far as concern the last hypothesis, H_4: *The relationships regarding innovation established with consultancy firms, governmental and private institutions are positively related to the propensity of the firm to undertake innovative advances.* The obtained results are quite significant, meaning that the null hypothesis stating that there is not a connection between the established relationships and the tendency of the firm to undertake innovative advances may be rejected. Thus, there is a connection, but this connection has a negative sign, as the coefficient estimation (-1,112) indicates. Consequently, the propensity of the firm to develop innovative advances is negatively correlated with the establishment of such relationships; these results suggest that establishing relationships with consultancy firms, governmental and private research institutions maximizes the tendency of the firm to develop incremental innovations rather than innovative advances.

The predictive capacity of the model is 60,1%, which results from the comparison between the predicted and the observed values of the variable answer. The chi-square test statistics comprises 11,318 with a proof value inferior to the significance level of 0,005. The log-likelihood statistics, comprising 255,361, also corroborates the global significance of the model, when compared with the null model.

6 – CONCLUSIONS

Regarding the challenges that firms have to face, innovation is a key factor in what concerns entrepreneurial competitiveness. Nowadays, the word innovation is on the spotlight, but talking about innovation is not enough, it is necessary to do something about it. According to Conceição (2002: 20) "maybe it is now, more than ever, that it really matters to decisively move forward with concrete actions. Therefore, it matters to collect as much information as possible about what is known to determine and condition the innovation process."

The current study aimed to analyse if the entrepreneurial innovation capacity concerning innovative advances is stimulated by the relationships established with business and science partners. To reach this aim, a conceptual model was presented, a model supported by empirical evidences that allowed the formulated hypotheses to be tested. Throughout the study, the main deductions from the factors included in the proposed conceptual model were presented and empirically contrasted, according to the Community Innovation Survey II data.

The results indicate that the firms which establish relationships with business partners: client, suppliers and group firms, are more prone to develop innovative advances than firms that do not establish such relationships. As to relationships with competitors regarding innovation, there is nothing to be concluded in a statistically significant way. This is possibly due to the reduced number of firms that establish relationships with this type of external partners. Therefore, it can be concluded that the vertical relationships established with business partners stimulate the development of the innovation capacity, as far as innovative advances are concerned.

Regarding science partners, the results reveal that the development of innovative advances made by the firms is more stimulated by the cooperation with universities than with the remaining science partners. This is probably due to the fact that universities generate a new type of knowledge, regardless of economical factors. This exact same knowledge might have a wide range of business applications, allowing it to be used to create additional innovations, whereas the study made by research institutions depends more on economical factors, focusing on R&D that is rapidly commercialized.

As we analyse each type of relationship, we notice that the external relationships established with business partners and with universities influence the firm to undertake innovative advances. This positive influence assumes a greater importance when it comes to establish relationships with universities and other higher education institutions. For its turn, the relationships that are established with research institutions and consultancy firms do not motivate the firms to undertake innovative advances. Instead, it is verified that there is a statistically significant and negative connection between these two variables. Therefore, the relationships with this type of entities promote the introduction of incremental innovations, namely innovations that are new to the firm but not to the market. Overall, it is possible to conclude that establishing relationships regarding innovation with external partners influences the entrepreneurial innovation capacity, not only its innovative advances, but also its incremental innovations.

The present study has a main limitation that lies on the lack of data about innovative firms, especially in what concerns the CIS. This way, several innovative firms may not be included in the present study. This limitation doesn't make possible to develop comparison analyses about the nature of the relationships established among these firms and their private and public partners. Furthermore, it only uses data from a sample of Portuguese innovative firms, which should be expanded in future research.

Further future research should be developed about the motivations of firms to engage in cooperative open innovation projects. The firms' characteristics, both general and with respect to innovation activities, which influence the motivations for firms to cooperate, should be analysed. Similarly, new research could examine whether public funding leads firms to cooperate in order to access external knowledge and R&D.

References

AGRESTI, A. (1996). An introduction to categorical data analysis, New York: John Wiley & Sons.

BAYONA,C. GARCIA-MARCO, T. and HUERTA, E. (2001): "Firm's motivations for cooperative R&D: an empirical analysis of Spanish firms", *Research Policy*, Amsterdam; Vol. 30; pp. 1289-1307.

BECKER, W. and DIETZ J. (2004): "R&D cooperation and innovation activities of firms–evidence for the German manufacturing industry" *Research Policy*, Vol. 33, pp. 209–223.

BRACZYK, H., COOKE, P. and HEIDENREICH R. (eds.), (1998): *Regional Innovation Systems,* UCL, Press, London.

BRUCE, M. and MORRIS, B. (1998): "In house, Out-sourced or a Mixed Approach to Design", in Management of Design Alliances: Sustaining Competitive Advantage, Bruce, M. e Jevnaker, B. (Eds), Wiley, Chichester.

CIS II (1999): "Segundo Inquérito Comunitário às Actividades de Inovação", Observatório das Ciências e Tecnologias, Ministério da Ciência e da Tecnologia, Lisboa.

CISEP/GEPE (1992): *Inovação da Indústria Portuguesa* – Observatório MIE, GEPE, Lisboa.

COHEN, W. and LEVINTHAL, D.A. (1989): "Innovation and Learning: the Two Faces of R&D – Implications for the Analysis of R&D Investment", *Economic Journal*, 99, Set, pp. 569-596.

COHEN, W.M. and LEVINTHAL, D.A. (1990): "Absorptive Capacity: A New Perspective on Learning and Innovation", *Administrative Science Quarterly*, Vol. 35, March, pp.128-152.

CONCEIÇÃO, P. (2002): "O Processo de Inovação visto por dentro", *Jornal Público, Caderno de Economia,* 28 de Setembro, pp.20.

CONCEIÇÃO, P. and ÁVILA, P. (2001): *Inovação em Portugal: II Inquérito Comunitário às Actividades de Inovação*, Celta Editora, Oeiras.

COOKE, P., BOEKHOLT, P. and TÖDTLING, F. (2000): "*The governance of innovation in Europe: regional perspectives on global competitiveness* ", Printer, London.

COOKE, P.; URANGA, M.G. and ETXEBARRIA, G. (1997): "Regional Innovation Systems: Institutional and Organizational Dimensions", *Research Policy*, 26 (4-5), December, pp. 475-491.

DOSI, G.; FREEMAN, C.; NELSON, R.; SILVERBERG, G. and SOETE, L. (Eds), (1988): *Technical Change and Economic Theory*, Printer, London.

EDQUIST, C. (1997): "Systems of Innovation Approaches - Their Emergence and Characteristics" in Edquist (Ed.) *Systems of Innovation: Technologies, Institutions and Organizations*, Chapter One, London, Printer, pp. 1-35.

FERRÃO, M.E. (2003). *Introdução aos modelos de regressão multinível em educação,* Campinas: Komedi.

FRITSCH, M. and LUKAS R., (1999): "Innovation, Cooperation, and the Region", in: David B. Audretsch e Roy Thurik (eds.), *Innovation, Industry Evolution and Employment*, Cambridge (UK): Cambridge University Press, pp. 157-181.

FRITSCH, M. and LUKAS R., (2001): "Co-operation in Regional Innovation Systems", *Regional Studies,* 35 (4), pp. 297-307.

FRITSCH, M. and SCHWIRTEN, C., (1999): "Enterprise-University Co-operation and the Role of Public Research Institutions in Regional Innovation Systems", *Industry and Innovation*, 6 (1), June, pp. 69-83.

FURMAN, J.L.; PORTER, M.E. and STERN, S. (2002): "The Determinants of National Innovative Capacity", *Research Policy*, 31, pp. 899-933.

GODINHO, M.M. (2003): "Inovação: Conceitos e Perspectivas Fundamentais", M.J. Rodrigues, A. Neves, M.M. Godinho (orgs.), *Para uma Política de Inovação em Portugal*, Biblioteca de Economia & Empresa, Dom Quixote, Lisboa, pp. 29–51.

HAGEDOORN, J. (2002) "Inter-firm R&D partnerships: an overview of major trends and patterns since 1960," Research Policy, Vol. 31; pp. 477-492.

HAKANSSON, H., (1987): *Industrial Technology Development – A Network Approach*, London: Croom Helm.

HAKANSSON, H., and JOHANSON, J. (1992): "A Model of Industrial Networks", in *Industrial Networks – A New View of Reality*, Axelsson, B. e Easton, G. (eds), Routledge, London, pp. 28-36.

KAUFMANN, A. and TÖDTLING, F. (2000): "Systems of Innovation in Traditional Industrial Regions: the Case of Styria in a Comparative Perspective", *Regional Studies*, 34 (1), pp. 29-40.

KAUFMANN, A. and TÖDTLING, F. (2001): "Science-industry Interaction in the Process of Innovation: the Importance of Boundary-crossing Between Systems", *Research Policy,* 30, pp. 791-804.

KLINE, S.J., and ROSENBERG, N. (1986): "An Overview of Innovation", in *The Positive Sum Strategy: Harnessing Technology for Economic Growth*, Laudau, R. and Rosenberg, N. (Eds), National Academy Press, Washington, pp. 275-306.

LEITÃO, J., (2006), "Open Innovation Clusters: The Case of Cova da Beira Region (Portugal)", *Conference Proceedings of ISBE 2006*, Cardiff.

LUNDVALL, B. A. (1985): "Product Innovation and User-Producer Interaction", *Industrial Research*, Series Nº 31 Aalborg: Aalborg University Press.

LUNDVALL, B. A. (1988): "Innovation as an Interactive Process: From User-Producer Interaction to the National System of Innovation", in *Technical Change and Economic Theory,* Dosi, G.; Freeman, C.; Nelson, R.; Silverberg, G. and Soete, L. (Eds),Chapter 17, Printer, London, pp. 349-269

LUNDVALL, B. A. (Ed.) (1992): *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, Printer, London.

LUNDVALL, B. A., JOHNSON, B., ANDERSEN, ES. and DALUM B. (2002) "National systems of production, innovation and competence building", Research Policy, Vol. 31, pp. 213–231.

MASKELL, P. and MALMBERG, A., (1999). "Localised Learning and Industrial Competitiveness," Cambridge Journal of Economics, Oxford University Press, Vol. 23(2), pp. 167-185

McCULLAGH, P. and NELDER, J.A. (1989). *Generalised Linear models,*2ª Ed., Londres: Chapman & Hall.

NELSON, R. R (1993): *National Systems Of Innovation: A Comparative Analysis*, Oxford University Press, Oxford, pp. 3-21.

OCDE (2005): OSLO Manual: *Proposed Guidelines for Collecting and Interpreting Technological Innovation Data*, 3ª Ed., Paris, OCDE.

PORTER, M. E., (1990): *The Competitive Advantage of Nations*, New York, Macmillan.

PYKE, Frank and SENGENBERGER, Werner (1992): *Industrial Districts and Local Economic Regeneration*, International Institute for Labour Studies, Geneva.

ROMIJN H. and ALBALADEJO, M. (2002): "Determinants of Innovation Capability in Small Electronics and Software Firms in Southeast England", *Research Policy*, Amsterdam; Sep; Vol. 31 (7); pp. 1053-1067.

SCHMIDT, T. (2007), "Motives for Innovation Co-operation - Evidence from the Canadian Survey of Innovation", ZEW Discussion Paper No. 07-018, Mannheim.

SILVA, M. J. RAPOSO, M., FERRÃO, M. and JIMÉNEZ, J (2005):"Relacionamentos externos no âmbito da Inovação Empresarial: Modelo Aplicado aos Avanços Inovadores", Estudos de Gestão, *Portuguese Journal of Management Studies,* Volume X, nº 1, p.5-19.

SILVA, M.J. (2003):"Capacidade Inovadora Empresarial – Estudos dos Factores Impulsionadores e Limitadores nas Empresas Industriais Portuguesas", Doutoramento em Gestão pela Universidade da Beira Interior, não publicada

SIMÕES, Vítor Corado (1997): *"Inovação e Gestão em PME"*, Gabinete de Estudos e Prospectiva Económica (GEPE), Ministério de Economia, Lisboa.

TETHER, B. (2002): **"**Who co-operates for innovation, and why. An empirical analysis", *Research Policy*, Amsterdam; Vol. 31; pp. 947-967.

VEUGELERS R, and CASSIMAN B. (2005): "R&D cooperation between firms and universities: some empirical evidence from Belgian manufacturing", *International Journal of Industrial Organization*, vol. 23, Nº 5-6, pp. 355 - 379.