



INNOVATION AND ECONOMIC AND FINANCIAL PERFORMANCE: AN ANALYSIS AT THE FIRM

Carla MARQUES¹, Susana COVELO², Alexandra BRAGA³, Vitor BRAGA⁴

¹⁻² UTAD, CETRAD, Vila Real, ³⁻⁴ ESTGF – IPP, CIICESI, CETRAD, PORTUGAL

ABSTRACT:

It is widely accepted that innovation plays a major role as far as economic and financial performance is concerned. However, very often, one gets the impression that this statement comprises indiscriminately many different aspects such as economic growth in general, national economic competitiveness, competition, profitability as well as individual business firms' survival and growth. Therefore it is important to develop an empirical research to help clarifying *how*, *when*, *in what sense* and *how much* innovation may affect the firms' economic and financial performance. With this study, the authors wish to give a contribution to a better knowledge of these issues aiming mainly at analysing innovation's positive impact on the Portuguese firms' economic and financial performance for the period between 1998 and 2004. Bearing in mind the complexity of the phenomenon, the hypotheses under study were tested empirically with recourse to statistic econometric analysis. The results obtained show that innovation has a positive impact on Portuguese firms' economic and financial performance and vice-versa.

Key-words: Innovation, economic and financial performance, innovation's determining factors, Community Innovation Survey

1. INTRODUCTION

Innovation capacity is, nowadays, recognized as one of the main factors on the firms' competitive advantage. Therefore, it is important to learn on the nature of innovation, how it influences both economic and financial results and the mechanisms through which social and economic agents get involved in the whole innovation process, always bearing in mind that innovation management is intrinsically difficult and risky.

Innovation can thus be a critical element in improving the economic and financial results of firms and the performance of national economies. Recent research confirms that an increased economic and financial performance is observed among firms capable of using innovation to improve their processes or differentiate their products and services in relation to their competitors. This performance is measured in terms of market quota, profitability, growth, and market capitalization (e.g. [1], [2], [3], [4], [5], [6], [7])

In light with this perspective, the study of the relationship between innovation dynamics and the economic and financial performance is very relevant, in the context of academic and business research. A revision of the existing literature has shown that there are few studies addressing the impact of innovation on the firms' economic and financial performance and that most of them are, to some extent, incomplete due to a partial analysis of the subject, i.e. the analysis is not based on a complete list of all the relevant factors influencing innovation (see [8], [9], [10], [11]). Nonetheless, these show the relevance of these factors in different stages of the innovation process with different impacts on the firms' economic and financial performance.

Recently there has been a growing amount of research related to new ways of defining and measuring innovation. Innovation variables can, on the one hand, be organised into macro, meso and micro variables and, on the other hand, into input, throughput (the process of transforming inputs into outputs) and output variables (e.g. [12], [13]). This paper focuses on the micro level and distinguishes innovation input, the transformation of input into output (throughput) and innovation output. The present analysis uses the latest reference approaches on innovation and its impact on economic and financial performance as the conceptual framework, while developing a theoretical support based on empirical findings which allow identifying innovation's determining factors on Portuguese firms' performance for the period between 1998 and 2004.

The paper is structured as follows. Following an introductory section, there is a theoretical discussion of the approaches on innovation processes and its impact on economic and financial

performance; the paper then proceeds in the conventional manner: method, results, discussion and conclusions. The research's main limitations and some avenues for future investigation, as well as implications for management practice, are also explored.

2. THEORETICAL BACKGROUND AND HYPOTHESES

Despite the risk and uncertainty, innovation, when well succeed, may produce a relevant impact on the firms' economical and financial results. Innovation is, thus, a key element for the improvement of firms' performance in particular, and of economies, in general. Recent research confirms that firms are able to use innovation to improve their processes or to differentiate their products and services, presenting a better economic and financial performance than its competitors, measured both by the market share and profitability (e.g. [14], [15]); or by growth and market capitalization (e.g. [16], [17], [18], [19]). The literature review has shown that few studies were devoted to the impact of innovation in the economical and financial performance of firms, showing, also, that some were, to a certain extent, incomplete because they approached this topic in a partial manner.

In this context, the study of the relationship between innovation and the economical and financial performance of firms has become fundamental, allowing us to set up the main research hypothesis:

H₀⁽⁰⁾: *Innovation has a positive impact on the Portuguese firms' performance and vice-versa, i.e. there is a circular relationship between the different stages of the productive process (performance, input, and output).*

The conclusions of the studies referred to so far suggest a number of determinants in each of the stages of the innovation stages (input, output e throughput) and in the impact that these can have in the economical and financial performance of firms. In what regards the input stage, the most commonly used variable is the R&D investment (e.g. [20], [21], [22], [23]). However, [28] points out several disadvantages associated to the use of this variable as input, such as the fact that these studies only consider firms with previous R&D investment. In this perspective, some authors (e.g. [24], [25], [26], [27]) use the total investment in innovation as the variable that better represents the effort in innovation (input).

Taking into account the advantages and disadvantages of input variables, it seems that the variable that best represents the innovation effort is the total investment in innovation which is influenced by variables of innovation transformation, output, and economical and financial performance. Thus, one can argue that:

H₀^(1a): *The output stage is influenced by factors associated to the process of transformation input-output, and for the firm performance.*

Taking into account that the several studies that test the relationship between innovation output and the firm performance (e.g. [28],[29], [30], [31]) we are led to conclude that the variable percentage of new product sales is the most commonly used in these studies. However, having in mind the characteristics of the data of these studies, the variable innovation output is the one that better reflects is total innovation (product / processes / marketing /markets /organizational innovation) and thus one can argue that:

H₀^(1b): *The output stage is influenced by input determinants, transformation processes and the firm performance.*

The academic studies used in this research (e.g. [32], [33], [34], [35]) show that firms that innovate have an increased growth of sales and profits. This explains why firms that co-operate and invest in innovation on a permanent basis are expected to verify increased sales. Therefore we propose as a hypothesis that the growth of sales is the best variable to characterise our sample in terms firms' performance and:

H₀^(1c): *The variable growth of sales is influenced by the output and by other performance related variables.*

Based on these hypotheses we aim at developing our research. In a different way, we will seek to investigate if innovation has a positive impact on the Portuguese firms' performance. For that purpose, we have developed a research model based, in broad terms, on the models proposed by [36], [37] and [38], the literature defines models which include at least four stages:

1st Stage: The decision presents itself as to whether or not to innovate and is likely to be influenced by several factors;

- 2nd Stage: The firm decides to innovate, and this decision then influences the innovation input level and the level of investment in innovation;
- 3rd Stage: The innovation output, which is often determined by the innovation input, comes under analysis. The transformation of the innovation input into innovation output (throughput) occurs between the 2nd and 3rd stages.
- 4th Stage: Finally, the relationship between innovation output and the economic and financial performance of firms is analysed.

The research model mentioned above and the expected mathematical signs for the relationships established between the different stages of the innovation processes are shown in Figure 1.

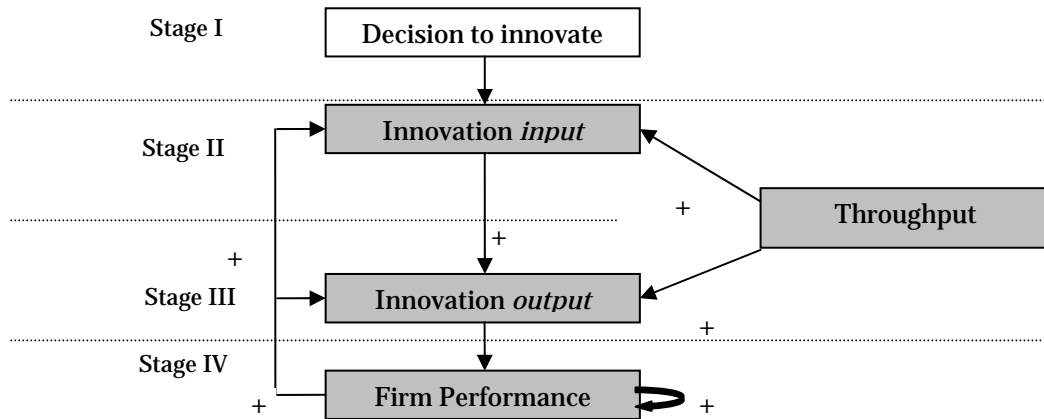


Figure 1. Global Research Model [Source: Marques & Monteiro-Barata (2006), pag. 118.]

3. DATA AND EMPIRICAL METHODOLOGY

3.1 Dataset

For the aims of this study, it has been decided to use secondary data provided by the Portuguese component of the Community Innovation Survey, referring to the time period between 1998 and 2000 (CIS III) and between 2002 and 2004 (CIS IV). This survey was coordinated by EUROSTAT and carried out by GPEARI / MCTES¹. Based on this database, we constructed our sample, composed by 508 observations in the three sectors: primary, secondary, and tertiary, located in rural and urban areas, with and without innovation activities, as shown in table 1.

Table 1. Sample overview (508 Obs.)

	CIS III			CIS IV		
	Rural	Urban	Total	Rural	Urban	Total
Total firms(n ^o)	178	330	508	178	330	508
Primary Sector (%)	2,8	2,7	2,8	2,8	2,7	2,8
Secondary Sector (%)	73,6	66,4	68,7	73,6	66,4	68,7
Tertiary sector (%)	24,2	30,9	28,5	24,2	30,9	28,5
Micro firms (%)	0	0	0	0	0,9	0,6
Small firms (%)	32,6	29,1	30,3	33,1	29,4	30,7
Medium Firms (%)	33,1	30,9	31,7	23,6	29,7	27,6
Large Firms (%)	34,3	40,0	38,0	43,3	40,0	41,1
SME (%)	65,7	60,0	62,0	56,7	59,1	58,3
Innovative firms: Yes (%)	74,7	80,0	78,1	70,8	74,8	73,4
Product Innovation (%)	36,0	40,9	39,2	38,2	48,8	42,5
Process Innovation (%)	44,9	43,6	44,1	47,8	51,2	50,0
Other Innovations (%)	62,9	70,9	68,1	47,2	60,0	55,5
Innovation in products and processes (%)	4,5	1,8	2,7	7,3	5,8	6,3
Innovation strategy: Innovation in the market (%)	27,5	33,6	31,5	24,2	28,8	27,2
Job creation: yes (%)	39,9	32,7	35,2	39,9	32,7	35,2

¹ Gabinete de Planeamento, Estratégia, Avaliação e Relações Internacionais / Ministério da Ciência, Tecnologia e Ensino Superior.

3.2 Empirical method

The proposed research model was used to identify the determinants that influence each of the stages of the innovation process and the possible existence of feedback relationships between these stages.

Presently, in innovation studies, the linear model and the neoclassical vision are neglected in favour of more complex systems, with entrepreneurial investment and the creation of knowledge at the core of research. The image of the company based on profit maximisation is substituted by a view in which the firm is seen as an organisation based on learning and with limited rationality, developing external networks and internal capabilities in a given geographical space ([39]). In the analysis of the interactive process of innovation, it is recommended to use more complex econometric models, such as the probit, tobit, or Heckman models and the models of simultaneous equations.

In feedback studies, it is common to use the two-stage and three-stage models ([40] e [41], respectively), both models based on the least squares for estimating the previously defined equations of the simultaneous equation models. [42] estimated the simultaneous equation model through the Seemingly Unrelated Regression Equation Model (SURE), in order to evaluate the existence of feedback between input, output, and firms' performance for the Portuguese industrial firms.

Having in mind the points made so far, the studies undertaken and the characteristics of the available data, we have used the Seemingly Unrelated Regressions – SURE for the estimation of a simultaneous equation model, in order to evaluate the existence of feedbacks between the different stages of the innovation process (input, output, and performance). The variables of the innovation process are presented in table 2, as much as their characteristics:

Table 2. Innovation process variables and their characteristics

Variables	Description	Scale
INPUT Innovation Effort Training for innovation	Total Investment in Innovation % of investment in training for innovation	Interval Interval
Throughput Innovation strategy Market Customer Cooperation	innovation as part of the strategy dummy variable - performance in the market dummy variable - customer satisfaction dummy variable – cooperation with research institutions and other firms	Dichotomous Dichotomous Dichotomous Dichotomous
OUTPUT Innovation	Process/product/market/organizational innovation	Dichotomous
Performance Growth sales Growth in employment	Evolution sales growth between 1998-2004 Evolution of job creation rate between 1998-2004	Interval Interval
Location Size Sector Funding	Rural vs urban Small, Medium, and Large firms Primary, Secondary, and Tertiary The existence of external funding (supporting programmes and other sources of funding)	

4. SIMULTANEOUS EQUATION MODEL: INNOVATION-PERFORMANCE RELATIONSHIP

In this section the existence of feedbacks between the different stages of the innovation process will be shown. In order to do this, we have used a model with three simultaneous equations, using the SURE as the method for estimating the parameters of the regression. The results of the estimation are shown in table 3.

Using Zellner's SURE method to analyse the three equations estimated we can see that: (1) the total investment in innovation equation is influenced by innovation output (innovation in process/product/market/organizational) and firm performance (growth in sales); (2) the innovation output equation is influenced by innovation input (total investment in innovation and training for innovation), by the innovation process (cooperation) and firm performance (growth in sales); (3) the firm performance equation is influenced by innovation output (innovation in process/product/market/organizational) and by one of the performance variables (job creation).

Table 3. Results of the estimation of the Simultaneous Equation Model

	Innovation Input	Innovation Output	Growth in Sales
Total investment in innovation	---	3069,814*** (1,83)	---
Training for innovation	0,0610** (2,82)	0,243* (4,12)	---
Cooperation	---	0,197* (3,43)	---
Innovation Output	---	---	0,632* (5,65)
Growth in Sales	0,0382* (3,46)	0,167* (5,65)	---
Employment growth	---	---	0,212*** (1,84)
Size	0,098** (2,86)	0,313* (3,31)	---
Funding	---	0,134** (2,24)	---
constant	0,0174* (2,56)	---	0,180*** (0,72)
χ^2	76,54	26,31	28,72
Prob> χ^2	0,0003	0,0049	0,0071
Adjusted R2	0,7510	0,6540	0,7180

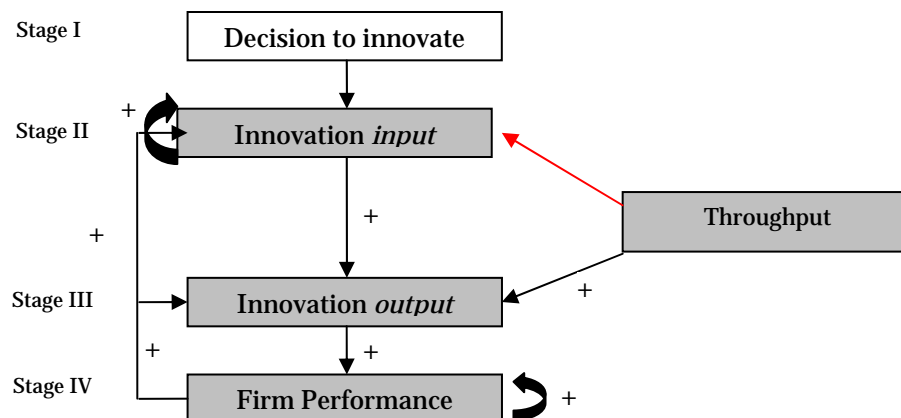
- t-statistics always appear between round brackets
- Significance level from which the null hypothesis is rejected* 1%; ** 5%, *** 10%.
- Only statistically significant results are presented in this table
- Model estimated by the seemingly unrelated regressions equation method (SURE)

From the conclusions stated above, it is possible to establish that there are feedback relationships between the different stages of the innovation process, which confirm the links defined in our research model: innovation has a positive impact on the performance of Portuguese firms and vice-versa, i.e. there are feedback relationships between the different stages of the innovation process (input, output and performance) ($H_0^{(i)}$).

We would like to highlight that the introduction of the variable firm size in the regression equations has shown to be statistically significant, contrary to what has been reported in a number of studies referred previously. In fact, according to the literature review, studies on the importance of the firm size in innovation show contradictory conclusions because a large amount of this literature suggests the existence of a positive relationship between the firm size and innovation (see, for example, [43], [44], [45]); other empirical studies conclude that there is a negative relationship between the firm size and innovation (for example, [46], [47]); and according to [48] there is no relationship between innovation and the firm size. There is a clear ambiguity in what concerns the role of size in innovation.

5. CONCLUSION, IMPLICATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

The results obtained show that innovation had a positive impact on the economic and financial performance of Portuguese business firms and *vice-versa* – in other words, there is a feedback relationship between the different stages of the innovation process (input, output, and performance), as we see in Figure 2.



It should also be stressed that the study of the relationship between innovation and economic and financial performance is currently a much discussed subject and extremely important for most firms and national economies. Nevertheless, it remains much to be discovered in this specific research area. As far as the dynamic component of the innovation process is concerned, identification of the factors that influence each of its different phases can never be considered complete.

The conclusions reached in this empirical research allow suggesting some corporate practices that are part of innovation systems and that can become responsible for fostering innovation at an entrepreneurial level:

Firms and other private agents should:

1. Recognise innovation as the primary source of competitive advantage, since innovation as a continuous entrepreneurial strategy is an innovation factor. In this perspective, one can use innovative firms as examples for other firms to innovate (demonstration effect).
2. Find the basis for strong co-operation, given that our research has demonstrated co-operation as a determinant factor, associating initiative of applied research (consortium) to the creation of new products and new productive processes, though the consolidation and support of innovation networks. These networks allow accessing to information, knowledge and to the supporting mechanisms that firms need and, on the other hand, to promote interaction between the various service providers in order to gain the knowledge on the specifics and necessities of firms. This interaction, combined with the co-ordination of the various actors of the innovation system, allows the compatibility of supporting measures provided by institutions and the real needs of firms regarding innovation. Thus, these networks may become a privileged vehicle of innovation diffusion and learning.

In this regards, government should:

1. Promote initiatives of information sharing with several actors (part of the innovation system) in order to facilitate knowledge exchange, the use and valuation of institutions, and of programmes and services to support entrepreneurial innovation.
2. Create measures to stimulate innovation, since the Portuguese entrepreneurial fabric is made of, mainly, small and medium sized firms (the creation and implementation of public policies to stimulate innovation in these firms should be a concern of policy makers); these measures should also embody the development of long term relationships and fostering co-operation projects between firms with little R&D experience; support R&D centres and universities to establish a 'bridge' between firms and R&D institutions, seeking, simultaneously to focus these institutions' practices and strategies on the necessities of SME's.
3. Support, through the use of risk capital mechanisms, the initial commercial development of new entrepreneurial initiatives, and to support entrepreneurship (two forms of overcoming the innovation barrier, such as the lack of funding sources)
4. Reduce the costs of patents and create a legal protection system favourable to the commercial exploitation of innovation;
5. Introduce supporting measures to the creation or development of service activities to firms with a strategic character (the supply side), as much as the acquisition of these services by firms (demand side).

The adequate interpretation of the results requires that the main limitations of this research are made explicit: (1) a longer time period for the data would allow dealing with further issues in regards to innovation, namely profitability and growth; (2) the fact that the number of observations of the sample did not allow us to control all the relevant variables is a problem mainly felt by analysts who study a small economy like the Portuguese, where the universe of firms is relatively small; (3) case studies have not been undertaken in order to deepen the knowledge about the relationships between innovation and performance and to identify other factors related to the innovation process and the firms' performance.

In a competitive and globalised world is difficult to imagine a firm that continuously 'wins' without innovation. Innovation as a demanding practice is a strategic imperative for increasing competitiveness of firms, and of countries. In this perspective, several actors and institutions (with responsibilities in this matter) should be co-ordinate in order to stimulate innovation and to create a real innovation system that allows an innovative environment.

REFERENCES

- [1.] GEROSKI P, VAN REENEN J. *The Profitability of Innovating Firms, RAND Journal of Economics*, 24 (2) (Summer), 1993: 198-211.

- [2.] HUSSO K, LEPPÄLAHTI A, NIININEN P. *R&D, Innovation and Firm Performance. Studies on the Panel Data of Finnish Manufacturing Firms. Statistics Finland, Science and Technology, 3, Helsinki, 1996.*
- [3.] KLOMP L, VAN LEEUWEN G. *The Importance of Innovation for Company Performance, Netherlands Official Statistics, 14, Winter, 1999: 26-35.*
- [4.] KLEINKNECHT A, OOSTENDORP R. *R&D and Export Performance: Taking Account of Simultaneity, in Kleinknecht A, Mohnen P. (eds.), 2002: 310-320.*
- [5.] KEMP RGM, FOLKERINGA M, JONG JPL, WUBBEN E.F.M. *Innovation and Firm Performance, Research Report H200207, SCALES - Scientific Analysis of Entrepreneurship and SMEs, Zoetermeer, 2003.*
- [6.] MARQUES CS, MONTEIRO-BARATA J. *Determinants of the Innovation Process: An Empirical Test for the Portuguese Manufacturing Industry. Management Research, vol.4 (2) (Spring 2006), 2006: 111-124.*
- [7.] KOELLINGER P. *The Relationship between Technology, Innovation, and Firm Performance: Empirical Evidence on E-Business in Europe. 2008, in <http://publishing.eur.nl/ir/repub/asset/12469/ERS-2008-031-ORG.pdf>, accessed December 12, 2009.*
- [8.] NÅS SO, LEPPÄLAHTI A. *Innovation, Firm Profitability and Growth, STEP Report 1/97, May, STEP GROUP, Oslo.*
- [9.] *Op. cit. Ref. 3.*
- [10.] SANDVEN T, SMITH K. *Innovation and Economic Performance at the Enterprise Level, Conference innovation and enterprise creation: Statistics and indicators, France, 23-24/11/2000.*
- [11.] *Op. cit. Ref. 5.*
- [12.] BROERSMA L. *The Innovative Process in Commercial Services and its Proper Climate, mimeograph, University of Groningen, 2001: 30.*
- [13.] *Op. cit. Ref. 6.*
- [14.] *Op. cit. Ref. 6.*
- [15.] *Op. cit. Ref. 7.*
- [16.] KLOMP L, VAN LEEUWEN G. *Linking Innovation and Firm Performance: A New Approach. International Journal of the Economics of Business, 2001, 8 (3): 343-364.*
- [17.] *Op. cit. Ref. 4.*
- [18.] *Op. cit. Ref. 5.*
- [19.] *Op. cit. Ref. 7.*
- [20.] *Op. cit. Ref. 16.*
- [21.] LÖÖF H, HESHMATI A, ASPLUND R, Naas SO. *Innovation and Performance in Manufacturing Industries: A Comparison of the Nordic Countries, SSE/EFI working paper series in economics and finance no. 457, 2001: 38 pp.*
- [22.] MASSO J, VAHTER P. *Innovation and Firm Performance in a Catching-up Economy. 2007, in http://www.merit.unu.edu/MEIDE/papers/2007/MASSO_VAHTER_Innovation%20and%20firm%20performance%20in%20a%20catching-up%20economy.pdf, accessed January 24, 2010.*
- [23.] COAD A, RAO R. *Innovation and Firm Growth in High Tech Sectors: A Quantile Regression Approach, Laboratory of economics and management; Sant'Anna School of Advanced Studies, Pisa (Italy), 2007.*
- [24.] *Op. cit. Ref. 6.*
- [25.] *Op. cit. Ref. 22.*
- [26.] *Op. Cit. Ref. 23.*
- [27.] SANTOS D. *A influência da Inovação no desempenho das firmas no Brasil. Universidade presbiteriana Mackenzie, programa de pós-graduação em Administração de empresas, São Paulo, 2009.*
- [28.] BÓIA M. *Determinants of Innovation in Portugal: Designing, Implementing and Analyzing Evidence from the Third Community Innovation Survey. Dissertação para a obtenção do Grau de Mestre em Engenharia e Gestão de Tecnologia, Instituto Superior Técnico, Lisboa, 2003.*
- [29.] *Op. cit. Ref. 6.*
- [30.] *Op. cit. Ref. 7.*
- [31.] BARTOLONI E. *Profitability and Innovation: New Empirical Findings Based on Italian Data 1996-2003. 2009, in <http://www2.druid.dk/conferences/viewpaper.php?id=5421&cf=32>, accessed January 22, 2010.*

- [32.] LÖÖF H. *Outsourcing, Innovation and Performance in Service and Manufacturing Industries, Conference innovation and enterprise creation: Statistics and indicators, France, 23-24/11/2000.*
- [33.] KLEINKNECHT A, MOHNEN P. (eds.), *Innovation and Firm performance. Econometric Explorations of Survey Data, Basingstoke, UK: Palgrave, 2002.*
- [34.] *Op. cit. Ref. 5.*
- [35.] *Op. cit. Ref. 32.*
- [36.] KLINE S, ROSENBERG N. *An Overview of Innovation, in Landau R, Rosenberg N. (eds.), The Positive Sum Strategy: Harnessing Technology for Economic Growth, Washington, DC: National Academic Press, 1986: 275-305.*
- [37.] CRÉPON B, DUGUET E, MAIRESSE J. *Research, Innovation and Productivity: An Econometric Analysis at the Firm Level, NBER Working Paper no. 6696, 1998.*
- [38.] *Op. cit. Ref. 6.*
- [39.] ARNOLD E, THURIAUX B. *Overview, Technopolis, proceedings of the conference Innovation and enterprise creation: statistics and indicators, session C: Innovation and Firm Performance, disponibil em www.technopolis-group.com/innocnf, 2000: 9-14.*
- [40.] *Op. cit. Ref. 21.*
- [41.] *Op. cit. Ref. 3.*
- [42.] *Op. cit. Ref. 6.*
- [43.] CONCEIÇÃO P, HEITOR M. V, VELOSO F. *Infrastructures, Incentives and Institutions: Fostering Distributed Knowledge Bases for the Learning Society, Technological Forecasting and Social Change, 2003: 70, 583-617.*
- [44.] *Op. cit. Ref. 29.*
- [45.] BARATA JMM. *Innovation in the Portuguese Manufacturing Industry: Analysis of a Longitudinal Company Panel, 57th International Atlantic Economic Conference, Lisboa, 2004.*
- [46.] ROTHWELL R, DODGSON M. (eds.). *The Handbook of Industrial Innovation, UK: Edward Elgar Publishing Company, 1994.*
- [47.] VECIANA JM. *La Innovación como Reto para la Gestión e la Investigación, Comunicação Apresentada na Sessão de Abertura das XII Jornadas Luso-Espanholas de Gestão Científica, 10-12 Abril, UBI, Covilhã, 2002.*
- [48.] SIMÕES V. C. *Inovação e Gestão em PME, Gabinete de Estudos e Prospectiva Económica (GEPE), Lisboa: Ministério da Economia, 1997.*

