PRODUCT INNOVATION AND INNOVATION PERFORMANCE OF ENTERPRISES: THE CASE OF GREECE WITHIN E.U.

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Abstract

The aim of this paper is to examine the product innovation with regard to cooperation for innovative activities and innovative performance. Contemporary management and economic literature argues that product innovation is potentially related to firm performance (Kitsos, C. P, Hatzikian, Y., 2006). The innovative performance of Greek firms will be examined in terms of the potential relationship between the product innovation, cooperation and direct innovative output (sales) during the period 1994 to 2004. We study where innovations are developed, whether they are exclusively developed within the enterprise, whether they come from co-operation agreements or whether they are developed externally by other enterprises or organisations. In the economy of knowledge (OECD, 2001), theory and statistical data point out that innovation does not constitute an individual activity of enterprise. On the contrary the new technologies influence the total of operations and the organisation. (Kitsos, et. al., 2006). The analysis is based on the conceptual frame that developed by the EUROSTAT and the OECD (Handbooks Oslo and Frascati) and on the empirical data of CIS2, CIS3, CIS4. Therefore, we probe deep into considerations which influence the advancement of the innovation activity, through empirical evidence and statistical methodology.

Keywords : Innovation, performance, cooperation.

1. Introduction

In the context of this paper, we examine the Greek innovating enterprises in the manufacturing and services sectors in their efforts to develop innovating activities. Furthermore, we analyze the methods of cooperation for innovation activities by partner, as a percentage of innovative enterprises, concerning Greece in comparison to E.U. Member States. The statistical data are based on Eurostat : Community Innovation Survey – CIS. The innovative performance of Greek firms is compared to EU member states, based on CIS 2, 3, 4 results, in order to identify similarities and differences in that research topic. We study where innovations are developed, whether they are exclusively developed within the enterprise, whether they come from co-operation agreements or whether they are developed externally by other enterprises or organisations. In the knowledge-driven economy, European Commission. (2004), management should strive to develop and attain a variety of objectives in all the areas where activity is critical to the operation and success of the management system. Attempting to define the concepts of innovation and based on the "Oslo Manual", OECD (1997) and the "Innovation Results of CIS", the main terms used are the following (Kitsos and Hatzikian, 2008) :

I. *Innovation*. An innovation is a new or significantly improved product (good or service) introduced to the market or the introduction within an enterprise of a new or significantly improved process. Innovations are based on the results of new technological developments, new combinations of existing technology or the utilisation of other knowledge acquired by the enterprise.

II. *Product innovation*. A product innovation is a product (good or service) which is either new or significantly improved with respect to its fundamental characteristics, technical specifications, incorporated software or other immaterial components, intended uses, or user friendliness. Changes of a solely aesthetic nature are not included.

III. *Process innovation*. A process innovation includes new and significantly improved production technology, methods of supplying services and of delivering products. The outcome (of the process) should be significant with respect to the level of output, quality of products or costs of production and distribution.

IV. *Research and Development Activities* (R & D). Comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge of man, culture and society, and the use of this stock of Knowledge to devise new application.

V. *Invention*. It is an object, process or technique which displays an element of novelty. In certain circumstances, legal protection may be granted to an invention by way of a patent. By default, an (R & D)

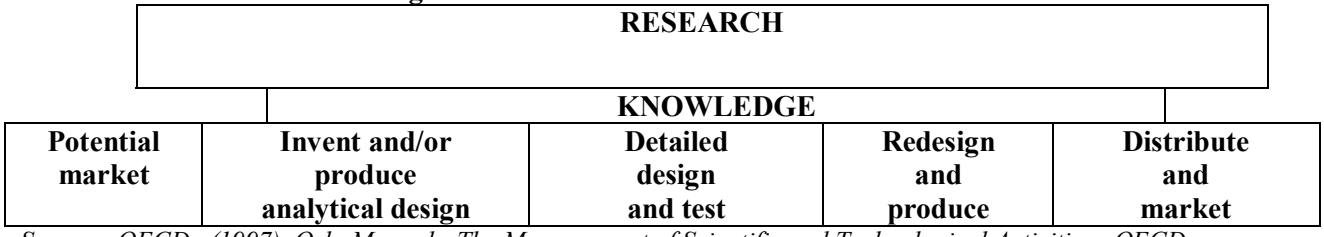
enterprise is an innovative firm. However, an innovative enterprise is not necessarily either an R&D performer or entrepreneur.
VI. Enterprises with innovation activity. Enterprises that have had any kind of innovation activity during the survey period, i.e. have introduced or implemented new products and/or processes, had abandoned innovation activity, or had on-going innovation activity.
VII. *Enterprises without innovation activity*. Those enterprises that had no innovation activity.

In the framework of this paper, the sources of information for innovation are classified as a result of a technological push from within the enterprise (internal sources) or a commercial push from suppliers and competitors or a commercial pull from customers (external sources). Thus, the precise sources of information studied in the context of this paper are the following (Kitsos and Hatzikian, 2006) :
In the framework of this paper, the different types of cooperation for innovation activities are classified as a result of a technological push from within the enterprise (internal sources) or a commercial push from suppliers and competitors or a commercial pull from customers (external sources). Thus, the precise types of partners of cooperation for innovation activities studied in the context of this paper are the following :
a. Internal partners : Other enterprises within the enterprise group.
b. Market partners : Suppliers of equipment, materials, components or software, Clients or customers and Competitors and other enterprises from the same industry.
c. Institutional partners : Universities or other higher education institutes, Government or public research institutes.
d. Other partners : Consultants, commercial labs or private R&D institutes.

2. The Theoretical Framework

Technological innovation is vital for firm's competitive advantage. One of the features of the New Economy is that in the transformation process, the major input is intellectual property: knowledge, research, information and design. These inputs have supplanted (in value) the material inputs required to build physical units. Therefore, there is no doubt that in 'knowledge-based economy' essential role plays the systematic application of the scientific knowledge to new product, process or service. The emphasis in the literature is clearly on an increasing relevance of knowledge and innovation as an input to production and innovative processes (OECD, 2001). As to innovation management, the first explicit theory is the "technology push theory or engineering theory of innovation". According to this theory, basic research and industrial R&D are the sources of new or improved products and processes. An alternative view, in the 1960s, gave birth to the "market pull theory of innovation". This theory still gives a central role to research as a source of knowledge to develop or improve products and processes. Moreover adopts the first recognition of organisational factors, as contributors in innovation theory; the technical feasibility was still considered as a necessary condition of innovation, but no longer sufficient in itself for successful innovation (Schmookler, 1996; Myers and Marquis, 1969).
A new generation called the "chain-link theories" of innovation then emerged to explain the fact that linkages between knowledge and market are not as automatic as assumed in the engineering and market pull theories of innovation (Von Hippel, 1994). At the end of the 1980s and during the 1990s, a technological networks theory of innovation management was developed by a new group of experts under the title of "systems of innovation". This view stressed the importance of sources of information that are external to the firm: clients, suppliers, consultants, government laboratories, government agencies, universities, etc (Nelson, 1993; OECD, 1999).

Figure 1. The chain-link model of innovation



Source : OECD, (1997), Oslo Manual : The Measurement of Scientific and Technological Activities , OECD-EUROSTAT, p.24.

The Chain Link model and the National Systems of Innovation (NSI) approach are the main streams on which the analysis regarding the sources of information for innovation is based, in the context of this paper.

The chain-link model conceptualises innovation in terms of interaction between market opportunities and the firm's knowledge base and capabilities. A key element in determining the success (or failure) of an innovation project is the extent to which firms manage to maintain effective links between phases of the innovation process: the model emphasizes, for instance, the central importance of continuous interaction between marketing and the invention/design stages (Freeman, C. 1982). Finally, "the social network theory" of innovation management states that knowledge plays a more crucial role in fostering innovation. The growing importance of knowledge as a production factor and as a determinant of innovation can be explained by the continuous accumulation of technical knowledge over time, and by the use of communications technologies that make that knowledge available very rapidly on a worldwide scale (Foray, 2000).

3. The innovation context and cooperation in Greece

In this section, we analyze the Greek innovating enterprises in the manufacturing and services sector in their efforts to develop innovating activities. The statistical data concerning innovation, R&D expenditure etc are based on Eurostat : Community Innovation Survey - CIS 2, 3, and 4. The innovation indexes are rather a new discipline in the Greek statistical system, when measuring industrial indexes. That is why only recent data can be provided and analyzed.
The results of the innovation context in Greece presented in Tables 1 and 2 are based on the Greek Community Innovation Survey (CIS 2, 3, 4). In Table 1 the size of companies included varies with smaller companies included in the survey for the period 1998-2000 and for 2002-2004.

Table 1 : Innovation Indicators: Manufacturing enterprises : Greece

Indicators	1994-96*	1996-98*	1998-00**	2002-2004**
	% Share in total population	% Share in total population	% Share in total population	% Share in total population
Enterprises with innovation activity	26,50	30,30	27,3	35,1
Product innovators	22,5	25,2	18,4	24,9
Process innovators	18,5	23,7	17,5	30,9
Intramural R&D	20,6	21,2	25,3	18,1
Research and experimental development - R&D	15,8	18,9	20,0	na
Continuous R&D	5,1	7,1	9,4	10,6
Occasional R&D	10,7	11,8	na	na
Enterprises with Cooperation arrangements on innovation activities	4,7	6,5	5,1	20,6
Product innovators that introduced new or improved products to the market	10,4	14,0	10,3	15,6

Sources : CIS 2, 3, 4, Eurostat
**>20 employees ; **> 10 employees*

The statistical data "enterprises with innovation activity", "product innovators", "process innovators", etc., show a decline. This decline is related to more small enterprises being included in the survey for the period 1998-2000. The small enterprises in Greece with more than 10 and less than 20 employees do not tend to innovate and, therefore, affects the percentage of the Greek firms with innovation activity. Each of the indicators is the percentage (share) of the total population of the CIS of each period. We present the main figures we collected concerning the Greek industry, as far as innovation concerns. The statistical analysis of innovation has been extensively discussed by Kitsos *et al.* (2006) and Kitsos and Hatzikian, (2005).
Table 1 indicates that there is a small improvement for the Greek industry, as far as competitiveness concern. The innovative manufacturing enterprises represent the 26,5% in the first period (1994-96), the 30,3% in the second period (1996-98), the 27,3% in the third period (1998-00) and the 35,1% in the fourth period (2002-2004). Product innovators represented the 22,5% in the first period, the 25,2% in the second period, the 18,4% in the third period, and the 24,9% in the fourth period. Process innovators represented the 18,5% in the first period, the 23,7% in the second period, the 17,5% in the third period and the 30,9% in the fourth period. These estimators might provide evidence for a contradiction to the above mentioned result. But when

new or improved products are entering to the market the innovation indexes are relatively low: 10,4% in the first period, the 14,0% in the second period and the 10,3% in the third period and the 15,6% in the fourth period.

Table 2 : Innovation Indicators : Service enterprises with 10 or more employees : Greece

Indicators	1994-96	1996-98	1998-00	2002-2004
	% Share in total population	% Share in total population	% Share in total population	% Share in total population
Enterprises with innovation activity	11,1	15,50	31,9	36,7
Intramural R&D	4,2	6,2	6,6	19,2
Research and experimental development - R&D	8,3	13,0	16,1	na
Continuous R&D	5,6	5,6	10,5	10,1
Occasional R&D	2,8	7,5	na	na
Enterprises with Cooperation arrangements on innovation activities	6,3	5,6	12,8	9,5

Sources : CIS 2, 3, 4, Eurostat

Only a small number of Greek private companies (from the collected data 16 in number!) are adopting innovation for products and processes successfully commercially and technically. The public funds improved innovation, without successful consequences, see Table 1. This might be called as a "Greek innovation paradox", and it extensively discussed by Kitsos *et al.* (2006) and Kitsos and Hatzikian, (2006).
In Table 2 the share of innovative enterprises in the Greek service industry increased significantly. It was 11,1% the first period and increased to 15,5% in the second period and there is a sharp increase to 31,9% the third period and keeps on increasing to the 36,7% in the fourth period of the enterprises with 10 or more employees. The service industry shows the low increase of 15% from 1994-1996 to 2002-2004 while the industry performs a 28% increase for the same period. Still it is worth mentioning that from 1994-1996 to 2002-2004 the total increase is better for services than manufacturing (see Tables 1 and 2). Greece is lagging behind comparing to all 15 member states for 2000 and for 2004 (Table 3). The position of Greece was drastically improved exceeding only Spain (34,7%), France (32,5%), and the Netherlands (34,3%). This is evident that the Greek industry improves its competitiveness and tries to reduce the gap with the European industry.

Table 3: **Percentage (%) of enterprises with innovation activity in total. E.U. member states : 1998-2004**

E.U. member states	1998-2000	2002-2004	Change (%)
Country *-15*	*44,0*	*45,1*	2,5
Austria	49,0	52,5	7,1
Belgium	50,0	51,3	2,6
Denmark	40,0	52,0	30,0
Finland	45,0	43,3	-3,8
France	41,0	32,5	-20,7
Germany	61,0	65,1	6,7
Greece	27,3	35,8	31,1
Ireland	65,0	52,5	-19,2
Italy	36,0	36,3	0,8

E.U. member states	1998-2000	2002-2004	Change (%)
Luxembourg	48,0	52,2	8,8
The Netherlands	45,0	34,3	-23,8
Portugal	46,0	40,9	-11,1
Spain	33,0	34,7	5,2
Sweden	47,0	50,0	6,4
The United Kingdom	36,0	43,0	19,4
Sources : EUROSTAT -CIS 3 & 4.			

Nevertheless, the gap with the other European countries remains (and is more probable that will remain) statistically significant. The average of European Union is at 44,0% for 2000 and 45,1% for 2004. Ireland holds the maximum percentage (65,0%) and Greece the minimum one (27,3%) for 2000. In 2004, Germany holds the maximum percentage (65,1%) and France the minimum one (32,5%).
In total, from table 3, although Greece is still well behind, it shows an improvement of its innovation performance, while other countries reduce the innovation activity.

4. Empirical results of cooperation for innovation activities

In this section, we analyze the methods of cooperation for innovation activities by partner, as a percentage of innovative enterprises, concerning Greece in comparison to E.U. Member States. The statistical data are based on Eurostat : Community Innovation Survey – CIS. One very efficient form of knowledge transfer is cooperation. "Innovation cooperation" means active participation with other enterprises or non-commercial institutions on innovation activities. There is no need for both partners to benefit commercially, but pure contracting-out of work with no active cooperation is excluded.
The CIS 4 questionnaire draws a distinction between seven different partners for cooperation:

- Other enterprises in your enterprise group;
- Competitors or other enterprises in the same sector;
- Clients or customers;
- Suppliers of equipment, materials, components or software;
- Universities or other higher education institutions;
- Government or public research institutes;
- Consultants, commercial labs or private R&D institutes.

Table 4 show the percentages of innovative enterprises by country for each category of partner.
The proportion of innovative enterprises that cooperate with other enterprises in the same group varies between 23% in Finland and 3% in Italy. In Greece, only the 3,5% of the innovative enterprises cooperate with other enterprises in the same group. In Finland more than one out of every three enterprises (34%) cooperate with competitors or other enterprises in the same sector. Behind Finland, the highest scores for this kind of cooperation were recorded in Denmark (15,0%) and in France (14,0%). The proportion of the Greek innovative enterprises that cooperate with competitors or other enterprises in the same sector is 12,0%.The smallest score for this category of partner was found in Spain with 2,5%.

Table 4: Methods of cooperation by partner, as a percentage of innovative enterprises, by country, EU-15, 2002- 2004

	Other enterprises within group	Competitors	Clients	Suppliers	Universities	Government	Consultants
E.U. average	11,7	10,8	14,9	19,9	11,1	6,8	12,4
Austria	7,0	4,0	7,5	7,5	10,0	5,0	7,5
Belgium	17,0	10,0	10,0	26,0	17,0	8,0	15,0

	Other enterprises within group	Competitors	Clients	Suppliers	Universities	Government	Consultants
Cyprus	6,0	12,5	4,0	25,0	2,5	2,0	16,0
Denmark	18,0	15,0	7,5	27,0	18,0	6,5	18,0
France	17,0	14,0	20,0	20,0	10,0	7,5	12,5
Germany	5,0	4,0	7,5	7,0	8,0	4,0	2,5
Greece	3,5	12,0	7,5	11,0	6,5	2,5	6,5
Ireland	17,0	6,0	25,0	23,0	10,0	6,0	10,0
Italy	3,0	5,0	5,0	7,5	5,0	1,5	6,5
Netherlands	17,5	12,5	22,0	30,0	12,5	9,0	15,0
Portugal	6,0	7,0	12,0	14,0	7,5	5,0	8,0
Spain	4,0	2,5	4,0	10,0	5,0	5,0	4,0
Sweden	17	11,0	27,5	32,0	17,5	6,0	20
Finland	23,0	34,0	41,0	40,0	37,0	26,0	32,5
Un. Kingd	15,0	12,0	23,0	22,5	10,0	7,5	12,5

Sources : EUROSTAT -CIS 4.

Whereas in Spain only 4% of the enterprises with innovative activities cooperate with their clients or customers, in Finland 41% do so. In Greece, only the 7,5% of the innovative enterprises cooperate with suppliers of equipment, materials, components or software. The most successful form of cooperation seems to be with suppliers of equipment, materials, components or software. Finland is in the lead with 40%, followed by Sweden (32%), Netherlands (30%), Denmark (27,0%), Belgium (26,0%) and Cyprus (25,0%). In Greece, only the 11,0% of the innovative enterprises cooperate with suppliers of equipment, materials, components or software. By contrast, the lowest figures for cooperation with suppliers was recorded in Italy (7,5%), Austria (7,5%) and Germany (7%). Compared with suppliers, universities or other higher education institutions are in less demand as cooperation partners.

Finland's innovative enterprises – which are very active in all types of cooperation and recorded the highest scores for all categories of cooperation partner – were also in the lead for cooperation with higher education on 37,0%. Behind Finland, the highest scores for this kind of cooperation were recorded in Denmark (18,0%), Sweden (17,5%), and in Belgium (17,0%). This form of cooperation is almost non-existent in Cyprus, where it is practised by just 2% of the innovative enterprises. In Greece, only the 6,5% of the innovative enterprises cooperate with higher education.

Worse still are the results for cooperation with government or public research institutes. 26% of Finnish innovative enterprises use this type of cooperation, but in most other countries the percentages are very low. In Italy the share of this category of partner does not even reach 2%. In Greece, only the 2,5% of the innovative enterprises cooperate with government or public research institutes.

Table 4 demonstrates the weak cooperation between the public and private sectors on innovation. Nevertheless this kind of cooperation is very important for knowledge transfer, a key component of innovation. It seems necessary to strengthen cooperation between the business enterprise sector and both the government and the higher education sectors.

Inside the private sector cooperation seems to be easier because more enterprises choose consultants, commercial labs or private R&D institutes as partners. In Finland nearly one third of the innovative enterprises do so (32,5%). Behind Finland, the highest scores for this kind of cooperation were recorded in Sewden (20,0%), and in Denmark (18,0%). In Greece, only the 6,5% of the innovative enterprises cooperate with consultants, commercial labs or private R&D institutes. By contrast, only 2,5% of German innovative enterprises and 4,0% of Spain innovative enterprises are involved in this form of cooperation.

To summarise the results on cooperation and the different methods, it should be said that the innovative enterprises do cooperate but could do to a much greater degree. As the situation with cooperation varies

along with the methods and across countries, it needs to be studied in detail. It is important to identify the barriers to cooperation in order to introduce the necessary reforms and other action to encourage cooperation (Kitsos and Hatzikian, 2005).

5. Conclusions

Knowledge transfer must improve in order to accelerate the exploitation of research and the development of new products and services. To that end, European universities and other public research institutions should be given incentives to develop skills and resources to collaborate effectively with business and other stakeholders, both within and across borders. A major hindrance is the inconsistent, and often inadequate, rules and approaches for managing intellectual property rights (IPR) resulting from public funding. The Commission has identified good practice and models of knowledge-sharing between the public research base and industry which will serve to inspire further action at both EU and national levels. Besides and closely linked to information, another key topic has emerged in the ongoing discussion on innovation: knowledge transfer. There is no doubt that knowledge creation, the main business of higher education, is essential. However, if this knowledge is to be useful it has to be applied to the walks of life where it can make a difference. Knowledge needs to be transferred. The main way in which knowledge is transferred from higher education to the wider world is via the expertise and experience built up by graduates. However, small companies which could benefit from the knowledge of a highly skilled graduate but have a small workforce are reluctant to take on graduates. Knowledge is transferred whenever the findings or works of academics are disseminated more widely (Hatzikian, 2007).

There are many ways in which this can be done. One key way that knowledge can be spread is via the training that higher education offers to industry. Creating stronger links between universities and businesses is a major aim of Europe's innovation policy. One step in this direction is commercialisation of research. This is the process of getting ideas which have a commercial application out of the laboratories and into the marketplace. Commercialisation does not exclusively concern technology. Creative arts and social sciences also have the potential to generate profitable commercial activity.

Interactions between the public research base and industry have been gradually increasing over the past decade. These can vary from contractual research to collaborative research or even to structured partnerships. Most of these interactions involve the transfer of knowledge between the stakeholders concerned and enhance the socio-economic impact of publicly funded research, e.g. by creating new useful products, new jobs and sometimes new companies (Bouris J. and Chatzikian Y., 2006). The analysis set out in this paper constitute a starting point for discussions on a common framework for knowledge transfer in order to create a level playing field and a more coherent landscape for knowledge transfer. Furthermore, the results presented in this paper are intended to help research institutions identify shared interests with industry and facilitate mutually beneficial knowledge transfer arrangements. Major policy initiatives in this area should taken by Greece and other Member States and should be reflected in the planning and the implementation in action reform plans, promoting the exchange of good practice in the innovation an cooperation subject area.

The knowledge economy represents new opportunities and requires some design actions to support and take advantage of this economy and the Greek firms have to realize this. It is the firm that organizes the creation of value (Kitsos and Hatzikian 2006). In principle, the shortening of product cycles, firms face the need for more capital-intensive investment and must put more emphasis on the ability to react quickly. For the Greek firms, innovation is a crucial means to create competitive advantage and superior customer value. Except for certain types of technology-based firms, the focus is not on the technological aspects of new product development, but on innovative ways to improve their position in the market. Innovation takes many forms (Hatzikian, 2007). There is technological innovation, but also innovation through new business models and new ways of organizing work, innovation in design and in marketing. Innovation can also consist of finding new uses and new markets for existing products and services.

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