Factors affecting innovation revisited

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Resumen

El propósito de este trabajo es contribuir a un mejor conocimiento de los factores que afectan a la innovación mediante el análisis de los microdatos de la encuesta de innovación de las empresas españolas de 2003. El estudio se aborda desde la elaboración de una taxonomía de sectores combinando las Ventajas Tecnológicas Reveladas de la industria española con el dinamismo tecnológico mundial; además se introduce una clasificación de las empresas en función de la pertenencia o no a un grupo de empresas y de si esos grupos son de nacionalidad española o extranjera.

Se utilizan técnicas de Análisis Factorial para reducir y organizar la abundante información disponible en Factores con significado económico que después son empleados como variables explicativas de la innovación de producto y de proceso. Se encuentran diferencias entre ambos tipos de innovación tanto por el número de factores significativos como en la intensidad de su capacidad explicativa. La taxonomía elaborada muestra su importancia al mostrar patrones de comportamiento distintos entre los cuatro tipos de casos construidos.

Abstract

The aim of this paper is to contribute to a better understanding of factors affecting innovation by analysing the Spanish manufacturing sector using microdata of the 2003 Spanish Innovation Survey. To enrich the analysis a self developed sectoral taxonomy is used coming from the combination of both of the sectoral Revealed Technological Advantages (RTA) and worldwide technological dynamism of the sectors; moreover firms are classified according to the type of capital ownership: independent companies, companies belonging to a national group and subsidiaries of multinational enterprises. The abundance and heterogeneity of variables advised us to use Factor analysis to reduce and organise the original variables into a number of consistent and theoretically significant factors. We found differences between product and process innovation, both in number of explicative variables (significant independent variables) and in relative effect of independent variables (even, in some cases, a sign change from product to process innovation). Taxonomy matters because of some differences in explanatory (independent) variables for each sector and model explanatory power differences between sectors, and, on the other hand, because of the "non significance" of some significant variables once we control by sectoral taxonomy.

Key words: Innovation, Factors affecting innovation, Multinational enterprises, Sectoral taxonomies, Spain.

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Índice

Índice

1. Introducción

Innovation has experienced a remarkable change in recent years as a consequence of a number of factors including the advance of science and technology and the increasing globalisation of a number of markets and activities. The growing heterogeneity of sources affecting the process of firms' innovation has led to the knowledge created out of the companies themselves achieving greater importance, and therefore to the central role to be played by the capacity of integrating inner and outer sources of technological capabilities with other competitive forces. Similarly, the acceleration of internationalisation at most economic and social levels has increased the necessity for exploiting firms' advantages at international (sometimes world) level and seeking new competitive (technological) assets in a multinational framework. Moreover, the specialised research has reached a common conclusion that sectoral features have a remarkable influence on the possibilities and organisational modes of innovatory activity.

From Pavit's seminal sectoral taxonomy on innovation, there is a long tradition of using several taxonomies or "classificatory list" of productive sectors according to their innovative characteristic or intensity. Both academic and institutional taxonomies can be described as "closed aprioristic lists" of sectors, built on rigorous studies but without flexibility to allow country differences on sector characteristics. A main contribution of this paper consists of grouping companies in different categories of sectors in a non-aprioristic way: each sector is "self-classified" in a specific type and not in any other according to particular characteristics and "innovative behaviour" in a given country (in our case, Spain). To this end we have developed a taxonomy from the combination of (RTA[1]) of each sector of activity and the evolution of its world weight between 1993-1998 and 1999-2003. Original sectoral data come from patents granted by the USPTO by priority year at the national level by sector of economic activity (NACE class derived through concordance with International Patent Classification).

Using microdata from the Spanish Innovation Survey[2], we had the advantage of their quality and statistical significance. These data are of a great statistical validity insofar as an expert group coordinated by the Spanish National Statistics Institute has, on the one hand, drawn up a permanent sample of firms with the intention of creating a stable panel of data and, on the other, has controlled the statistical significance of the anonymous data vis-à-vis the original micro data. In addition, this information allows us to separate firms according to their independent feature or belonging to a group, including the country of origin of the mother house of MNCs.

Our topic to explain is the innovative activity (product and process innovation) of Spanish manufacturing firms (both national and multinational ownership), using as explanatory variables those included in the Innovation Survey. The abundance and heterogeneity of variables advised us to use Factor analysis to reduce and organise the number of original variables in a number of consistent and theoretically significant factors. We have made a series of sectoral analyses in an iterative way using both PITEC original variables and its transformations. Non-included variables have been rejected on the basis of KMO and MSA values. Once relevant factors are retained, we have made two series of logistics regressions for both process and product innovation implementation, with factors and firms ownership as independent variables. In each series, firstly we regress once for the whole sample and secondly we regress four times more controlling by sectoral taxonomy.

In the next section, we present the main theoretical background, in the third section we discuss our data and methodological guidelines, in the fourth section we present some stylised facts of innovation activities in Spain for a better understanding of the context in which our empirical work is done, in the fifth section we show the empirical results and finally in the sixth section we enhance the main conclusion

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[1] RTAs for a sector of a country is calculated as follows: $RTA_{ij} = (P_{ij} / P_{wj}) / (P_{Ti} / P_{Tw})$ where i is the country, j the sector, w the world total for j sector, T is the total of the country and tw is the absolute world total. All referred to patents in a period of time.

2. Theoretical background

It is not our intention to develop a complete theory of factors affecting innovation. First of all this is because such a theory is not available, as demonstrated by both the attempts to gather the most relevant empirical investigations (Tidd, Bessant and Pavitt, 1997), and the list of issues included in seminal books as "issues affecting innovation" (Rothwell and Dodgson, 1995; Fagerber et al, 2006). On the contrary, our aim is to briefly review the most significant contributions to find some theoretical guidelines for our empirical research. In this regard, to briefly summarise the panorama of theoretical visions of the conditions which promote successful innovative activities of firms, we can cluster them together in two fundamental groups. On the one hand are those belonging to the long tradition of industrial organisation theory which basically search for a few determining factors of the capacity of innovation and, on the other, those more representative of the relatively recent approach of the evolutionary theory which is based on the analysis of variety and diversity of innovative modes and frequently uses the classification of cases as a basic theoretical tool.

Starting from the tradition of industrial organisation studies, one must remember their central methodological characteristics consisting of the combination of the three classical steps of structure-conduct-performance (Scherer and Ross, 1990). As formerly for other economic issues, the analytical work is oriented to finding out one or a few factors (never a large number) which can explain the innovatory activity of the firms in a satisfactory way[3]. Without a doubt these two are the most frequently researched elements: the size of the firm and the concentration level of the markets in which firms carry out their innovative activities.

In spite of the huge number of studies made about both of theses issues, the current situation is that there are no conclusive results allowing us to assert the sign and intensity of the impact those factors have to induce innovation. In fact, as far as the size of the firm is concerned, we can share the argument of

Freeman and Soete (1997, page 193) that the size "certainly influences what kind of projects can be attempted in terms of technology, complexity and costs but does not in itself determine the outcome".

This inconclusive conclusion is the result of a large amount of empirical research relating to the size of the firms and innovative activities of the firms. Perhaps the most classic one is the association of size with R&D expenditure. In this case, the available research shows there is a concentration of R&D expenditure in large companies, basically determined by the size of R&D programmes instead of the size of the firm (Freeman and Soete, 1997). Nevertheless, it is more difficult to find a clear association between the increase of the size and the intensity of R&D expenditure. In fact, mainly after controlling by sector, the association seems to follow a growing trend (the larger the size the more intense is R&D effort) but just to a certain extent; from this point onward the dominant relation is a proportional one (Cohen, 1995). With regard to small firms, the evidence points to a twofold situation: whereas a vast majority of small firms do not perform any specialised R&D programme, in several countries those small firms that do perform R&D have above average R&D intensities (Freeman and Soete, 1997, p. 232).

The situation is even less clear if innovation replaces R&D activities; more qualifications have to be incorporated, such as, for example, the possible advantage of small companies in early stages of innovative work and the less expensive but more radical innovation, whereas large firms have advantages in the later stages and improvement and scaling up of early breakthroughs (Freeman and Soete, 1997, 234). More generally, Rothwell and Dodgson (1995, 323) arrive at the following conclusions:

I. Innovatory advantage is unequivocally associated neither with large nor small companies. Small firm advantages are mainly behavioural while those of large firms are mainly material.

II. Available data suggests that the firm size/innovation share relationship is U-shaped.

III. Small firms´ innovatory contribution varies significantly from sector to sector.

[3] Orsenigo (1989) suggests they use a dichotomous perspective: large versus small size, concentrated versus non-concentrated markets, etc. Cohen (1995) calls them studies in the Schumpeterian tradition.

IV. Small and large firms do not operate in isolation from each other and they enjoy a variety of complementary relationships in their technological activities".

V. Any study of the roles of small and large firms in innovation should be dynamic: their relative roles vary considerably over the industry cycle (Shepherd, 1991; Utterback, 1994).

The situation is more confusing if the aim is to associate levels of concentration (or monopolistic power) with a superior innovative performance. The reason is that there are two different angles to approach that relationship: one is the passive and direct association of higher levels of concentration with more intensive behaviour and the second the more dynamic and complex one that postulates the need for a monopolistic reward to encourage innovative activities (Orsenigo, 1989; Cohen, 1995). In the first case no strong conclusive result can be shown and the second is very difficult to test; therefore, some idea of a simultaneous determination of concentration and innovation can be proposed (Cohen, 1995).

To complete that uneven perspective we can conclude that to generalise about size of the firms, scale of R&D, inventive output and innovation needs to be heavily qualified. Industry, technology and history matter[4] (Freeman, 1982; Freeman and Soete, 1997). There are not many other features so deeply investigated. In general, progress has been poor in topics such as the influence of cash flows or diversification (Cohen, 1995). Nevertheless, it is important to highlight the importance given to some organisational characteristics in the seminal SAPPHO project (Rothwell et al, 1974) and the renaissance of those elements in the literature and policy practices (Nelson&Sampat, 2001; Nelson, 2008; OECD, 2005).

Following a methodology of comparing success and failure of innovation, the SAPPHO project spotlighted a number of organisational variables, mainly "marketing related", "external communication" and "firm management".

Freeman cleverly summarised it by saying: "the fact that the measures which discriminated between success and failure include some which reflected mainly on the competence on R&D, others which reflected mainly on efficient marketing and some which measured characteristics of the business innovator with good communications, confirms that view of industrial innovation as essentially a coupling process" (Freeman, 1982, 125).

The former notwithstanding, the innovation theory reoriented the approach to investigate the role of the firms. Precisely the cited book of Freeman, together with seminal works such as Rosenberg 1976, Nelson and Winter, 1982, Dosi, 1984 and Pavitt, 1984 made claims for a better understanding of technology and innovation that enables to create a more accurate theoretical approach. Apart from other general considerations (Orsenigo, 1979; Dosi, 1984) as far as this paper is concerned, the central change has to do with the introduction of variety and diversity as opposed to the main stream perspective of general determinants of firms' innovation; furthermore, the notion of "learning" occupied a central position as a consequence of considering technology and innovation as specific kinds of knowledge (Pavitt, 2006).

As a consequence of this new orientation the approach to firms' innovatory behaviour incorporates a number of remarkable modifycations. Four of them are particularly significant for the objectives of this investigation: the role of systems of innovation, the importance of non-technological innovation, the relevance of the sector of activity and the introduction of taxonomies to map the heterogeneity of conducts.

The concept of systems of innovation (Freeman, 1987; Lundvall, 1992) basically reinforced the idea of systemic interaction among firms and a large amount of institutions. Thus, in the context of this paper, the relevant issue is the necessity of incorporating internally and externally sources of knowledge to the firm, either on a collaborative mode or through market mechanisms. In other words, the isolated consideration of firms´ characteristics is not enough to fully understand the innovative practice of enterprises (Rothwell, 1995; Tidd, Bessant and Pavitt, 1997); hence variables measuring such an interaction must be incorporated.

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[4] It is important to remember a number of empirical limits which seriously make it difficult to arrive at general conclusions. According to Cohen (1995), we can mention the fact that samples are mostly not random, in many cases there are other firms variables out of control and the multisectoral character of most large firms.

Regarding non technological innovation, the first consideration is what aroused in the SAPPHO project: organisational factors – considered form a broad perspective- play a crucial role for the overall innovative strategy of the firms. More recently, Nelson and others (Nelson&Sampat,2001, Nelson, 2008) have insisted on the necessity of fully integrating "social" and "physical" technologies at micro and macro level. Furthermore, Teece´s contribution to firms' innovatory attitudes put a great demand on the necessity of including the "complementary assets" into the theoretical and empirical explanation of innovation (Teece, 1986). As for the case of systems of innovations, the incorporation of variables referring to those non technological factors is absolutely needed.

The issue of sector of activity is not new in industrial economics. To a great extent it is the need to consider competitive conditions in the analysis; perhaps the most developed version in the industrial organization tradition is the model of "competitive forces" by Porter in which he combines five elements driving industry competition. 1.- Relations with clients; 2.- Relations with buyers; 3.- New entrants; 4.- Substitute products and 5.- Rivalry among established firms (Porter, 1980)[5].

The former notwithstanding, recent developments within the general approach of the evolutionary theory spread the concept in the direction of incorporating other sectoral conditions (Malerba, 2002, 2006) and/or the conditions for a sectoral model of accumulative technological change based on different Technological Regimes or Innovation Patterns (Nelson and Winter, 1992, Malerba and Orsenigo, 1995, 1997; Pavitt, 1984). In other words, as sectoral conditions for innovation are different, any efforts to understand that process ought to incorporate sectoral differences as a central analytical element; in Pavitt's words: "increasing specialisation in the production of artifacts, and their underlying knowledge bases, has made innovative processes increasingly path-dependent. As a consequence, several aspects of innovation are contingent on sector, firms and technology field" (Pavitt, 2006).

The latter drives us to the fourth point: the taxonomic exercise. As a general expression of most theoretical revisions, the concepts of variety and diversity came to substitute the previous search for uniformity and universal determinisms. On the contrary, the evolutionary theory postulates the existence of a heterogeneous cluster of sources of knowledge, competing technologies, organisation models, ways of profiting from innovation and so on (Orsenigo, 1989; Pavitt, 1984; Dosi, 1984; Dosi et al, 1988, etc). However, the scientific approach to the diversity requires further theoretical efforts and it is here where the creation of taxonomies emerges[6]. In fact, there have been many of them insofar as any taxonomy is deduced from some particular aspect the researcher wants to illuminate; albeit in this work we wish to underline two which have influenced our empirical investigation: Pavitt taxonomy and Technological Regimens.

Pavitt taxonomy starts from the notion of technological trajectories as expression of the sectoral patterns of technological change. The aim is to supply an empirical method to organise the manifested variety of innovative activities into a group of trajectories on the basis of 1) the sectoral sources of technology used , differentiating between those internally generated from others coming from different sectors. 2) Institutional sources and the nature of the technology 3) Characteristics of the innovative firms.

The result is the establishment of several categories of technological trajectories to build in which Pavitt combines some elements of the firms themselves with others concerning the sources of knowledge and its diffusion through products or process innovations; depending on whether the innovation is used in a different sector than the one in which they have been produced or if they are used in the same sector in which they have been created (Pavitt, 1984). The lesson for us is the need to consider those kinds of factors in any explanation of a firms´ innovation and that the distribution between product and process innovation can shed light on substantial aspects of the innovation process. As a complementary consi-

[5] The strength of this model is the "deep understanding of the competitive environment in which the business firms operates, and in which it must consciously try to position itself in its technology strategy, as well as in other dimensions of corporate policy" (Tidd, Bessant and Pavitt, 1997, 67) although its main weakness is that it underestimates the power of technical change to transform industrial structures and overestimates the power of managers to decide and implement innovation strategies (idem, 68).

[6] Another significant effort has to do with the concept of "routines" which organises the otherwise random behaviour of the firms and interactions markets and institutional forces to give sense to the complex activity of technology creation. See among others, Dosi et al, 1988.

deration we wish to quote Edquist et al, (2001) when they prefer to include organisational innovation as part of the process innovation. We shall see how in our research the possibility of comparing product and process innovations upgrades the understanding of the role of institutional aspects.

With regard to Technological Regimes, its most worthy contribution in this analysis is to enrich the approach to firms´ activity by allowing us to classify different strategies. Classic and recent works (Malerba and Orsenigo, 1996; Corocher, Malerba and Montobbio, 2007) insist on the necessity of elaborating measures which enable the analysis to discern the underlying characteristics of the different patterns of innovating, according to the level of opportunity, cumulativeness and appropriability of the different technological regimens. The dichotomy of two main Regimes, following the Schumpeter analysis (Schumpeter I and II) allows us to distinguish how in each of them we have a number of intra-firm characteristics as well as others related to the interaction with the surrounding system: high technological opportunities, low appropriability and a low degree of cumulativeness (at the firm level) for Schumpeter I, and high appropriabiliy and cumulativeness (at the firm level) for Schumpeter II.

According to the previous argumentation our empirical research on the patterns of innovation of Spanish companies will be organised under the following guidelines:

1. Factors influencing innovation are varied and partly belong to the development of innovative projects, part to the firm as a whole and part to the environment (Rothwell, 1995)

2. It is absolutely necessary to base the study on a statistical source which can provide information about economic features of the firms, their internal innovative strategy and the interaction with the system in order to capture the importance of inner and outer sources (Cantwell, 2006[7]).

3. The fundamental role of organizational aspects both for the general implementation of innovation and as part of the general innovative activities of firms and institutions (Lazonik, 2006)

4. It is also crucial to take into consideration the role of the sector of activity. In spite of the existence of quite frequently used categories (e.g. the OECD classification according to the technological content of the sectors) we have chosen another option consisting of the elaboration of a sectoral typology according to their own international technological position. In other words, we prefer a self contained classification.

5. The distinction between product and process innovation to assess to what extent the factors are common for both types; particularly when in both cases the sectoral typology is applied.

6. Finally, the consideration of different types of firms´ ownership, especially as far as the internationalisation process is concerned. The issue of the reciprocal "invasion" of innovation systems demands a necessity of understanding of the innovatory modes employed by domestic and international companies and to what extent the increasing internationalisation is homogenising (or not) the innovation activity.

In section 3 we shall develop the way in which we have made operative those guidelines.

3. Methodology and data analysis.

To carry out the investigation, we count on two important mainstays. On the one hand, we have developed a "self-classificatory" taxonomy of manufacturing sectors in terms of innovative dynamics and performance; on the other, the recent availability of anonymous micro-data of the Spanish Innovation Survey[8]

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[7] Interestingly enough are the arguments Cantwell provides to explain the lesser independence of firms and their deeper dependency on background knowledge: 1) The increase of inter-company flows. 2) The increasing role for government and other non-corporate institutions in knowledge creation. 3) The growing importance of science for technology and 4) the tendency towards a more rapid codification and the formation or spreading of professional and scientific communities (Cantwell, 2006, 561).

[8] It is called the PITEC panel (Panel de Innovacion Tecnologica), and is designed and built as a statistical instrument for monitoring technological innovation activities of Spanish firms. See: http://sise.fecyt.es/Estudios/PITEC.asp.

with a great statistic validity endorsed by the Spanish National Statistics Institute, the Spanish Foundation for Science and Technology (FECYT), and COTEC Foundation.

To build our taxonomy we have systematically compared the percentage evolution rate between two periods (1993-1998 and 1999-2003) both of patents granted for each sector of activity and their Revealed Technological Advantages (RTA[9]) using data from patents granted by the USPTO by priority year at the national level by the sector of economic activity (NACE class derived through concordance with International Patent Classification).

With two classification axes, we are able to classify each NACE sector in one of four categories. Presented vertically we find technological advantage (upper) or disadvantage (lower) while horizontally we see worldwide evolution (positive on the right hand side and negative on the left one); for technical details, see Annexe A)[10]. As a result, we define the following four categories: "*Dynamic specialisation*" if there are RTA advantages in dynamic sectors; it is the best of the cases insofar as the specialisation of the Spanish economy fits perfectly with the international technological dynamic. "*Retreat*", with RTA disadvantages in sectors in retreat; it is a residual case also with positive aspects. "*Lost opportunity*", with RTA disadvantages in dynamic sectors; it is the worst possibility because the Spanish economy has not been able to adapt to the international dynamism. Finally "*Stationary specialisation*", includes RTA advantages in sectors in retreat; this also reflects a less favourable position insofar as it shows the Spanish specialisation is produced in internationally less dynamic sectors. Classification of PITEC sectoral definition is shown in Table 3 of Annexe B[11].

This taxonomy has the main advantage derived from its "self-classificatory" to put each NACE sector into one of our four categories. Thus, we can avoid "a-prioristic" and rigid classifications (following OECD technological content classification, Pavit's taxonomy or others) that could not be appropriated to analyze the characteristics of intermediate countries, as is the Spanish case. In opposition, our taxonomy is flexible because classification results from sectoral characteristics on each country; so it can be adapted from one country to another and each sector moved from one category to another, if necessary, but the criteria to construct categories remain unchanged.

Furthermore, this taxonomy allows us to evaluate overall sectoral specialisation of a country as a whole in terms of innovative and technological performance. If most of the sectors (in number and in GDP percentage) are placed in "main diagonal" (Dynamic and Retreat) this country is well adapted to international innovative and technological dynamics; in the contrary case, if most of the sectors are placed on the "inverse diagonal" (Stationary and Lost Opportunities), country specialisation is contrary to international one.

The great statistical validity of anonymous micro-data is derived from the fact that an expert group coordinated by the Spanish National Statistics Institute has, on the one hand, drawn up a permanent sample of firms with the intention of creating a stable panel of data and, on the other, has controlled the statistical significance of the anonymous data vis-à-vis the original micro data. This information allows us to separate firms according to their independent feature (Independent companies, ICs) or belonging to a group, including the country of origin of the mother house of the cluster. If the headquarters is located in Spain, we can assume most of them can be expected to behave as Spanish multinationals, following some international literature (Evangelista, 2005). Nevertheless, as it is not possible to confirm this multinational character of the group we shall call them "National groups (NGs)" versus "Multinational Groups (MNGs)[12]". Using the original variables of the panel we have calculated some additional ones that are listed in Table 1 of Annexe A. After these calculi, we work with variables listed in Table 2 of Annexe B.

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[9] RTAs for a sector of a country are calculated as follows: $RTA_{ij} = (P_{ij} / P_{wj})/(P_{Ti} / P_{Tw})$ where i is the country, j the sector, w the world total for j sector, T is the total of the country and tw is the absolute world total. All refer to a period of time.

[10] A note of caution has to be introduced in these types of classifications because it is not the same to be far from the crossing point of the two axes than to be near it. However, we understand it is valid for a first approach, irrespective of the possibility of further qualifications.

[11] Although it is not the central issue of this paper, it is important to highlight the not very favourable position of Spain in considering two aspects. First, the weak specialisation of Spain in most ICT technologies and second the abundance of cases of advantages in sectors which in the last decade have had a relative stagnation with regard to World dynamism.

[12] Here we introduce an MNG definition to enhance the fact of belonging to a group of enterprises versus individual companies in our empirical analysis. Nevertheless, both MNG and MNE must be interpreted similarly.

The method proposed has two steps. In the first step, we use factor analysis to see how different variables behave relative to others and to reduce the information to be used in the explanatory phase. Once factors have been obtained, the next step is to include them as explanatory variables in different Logit models[13] in order to estimate which of them (and to what extent) affect any observed firms implementation process or product innovation.

Using extracted factors as explanatory variables, it is possible to show the most significant variables or factors explaining the differences between innovative and non-innovative firms. Including dummies to control the fact of belonging to a multinational group or to be an individual firm, we can detect the different-tiated impact MNGs have upon the Spanish Innovation System. In the final stage, the analysis will be made introducing the sectoral typology of the sectors as a factor to be controlled.

To tackle this task we have carried out a series of alternative Logits. Firstly, we have studied the model in which the dependent variable is INNPROD (1 for companies which have successfully introduced a product innovation; 0 for the opposite), without distinguishing independent or national group firms, or splitting the survey by type of sector; typology of firms' ownership is introduced as a potentially explanatory variable. Afterwards, we have repeated the analysis by splitting the survey by sectors. The same analysis is made for a model in which the dependent variable is INPROCC (1 for firms having successfully introduced a process innovation; 0 for the opposite), initially without sectoral cuts in the sample and after controlling by sectoral taxonomy; in both cases with firms' ownership types as potentially explanatory variables.

# 4. Some stylised facts of the innovation in the Spanish economy.

In order to provide a minimum framework to contextualise our empirical work, we understand it is worth summarising some stylised fact which characterises the situation of the innovation in the Spanish economy, with particular attention paid to firms.

The first aspect to consider is the relatively reduced level of innovation in Spain, clearly below the potential level offered by its economic development offers. According to the last Innovation Scoreboard (see figure nº 1) Spain occupies the 25th position of 37 OECD countries analysed: the Summary Innovation Index (SII) of Spain is 0.31, while the EU average is 0.45 and the leading countries are around 0.7. The cluster analysis carried out with all those countries includes Spain in the last position of "Modest Innovators", the third of four clusters.

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[13] The choice of this regression technique responds to twofold criteria, On the one hand, the comparison of pairs of groups and on the other, to detect the relative effect of each factor to explain differences between groups of firms. See Wooldridge (2000) for a detailed exposition of logit and probit models.

FIGURE 1: THE 2007 SUMMARY INNOVATION INDEX (SII)
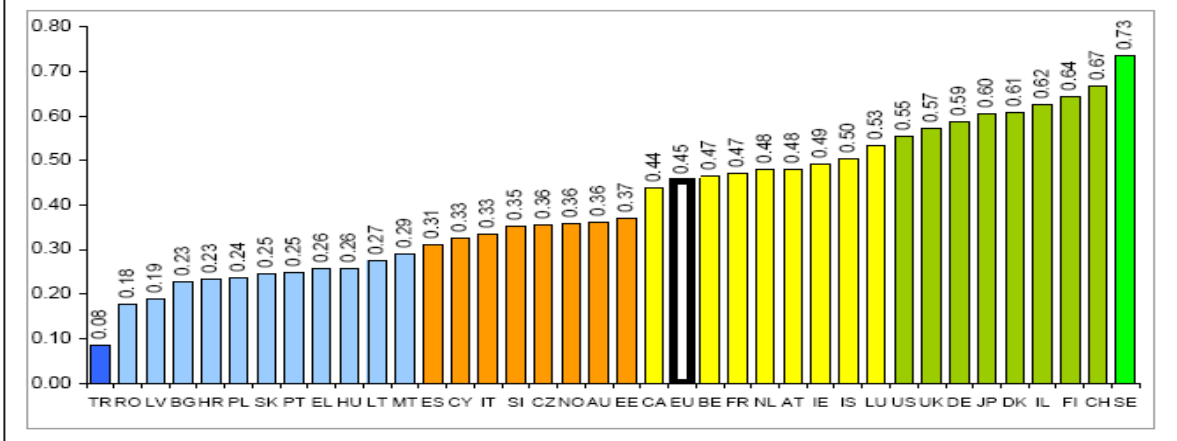
Source: Innovation Scoreboard 2007

On splitting the SII into its main components – see figure nº 2- we arrive to a second determining feature of the Spanish situation: the worse performance shown by aspects related to entrepreneurship and creation and application of knowledge. From another perspective we can complete it by underlining the fact that the participation of private companies in the overall financial effort and R&D execution is significantly below the average of countries which lead the innovation dynamism internationally.

Figure nº 2: The Main Components of SII in Spain and the EU (Spain is the black line)
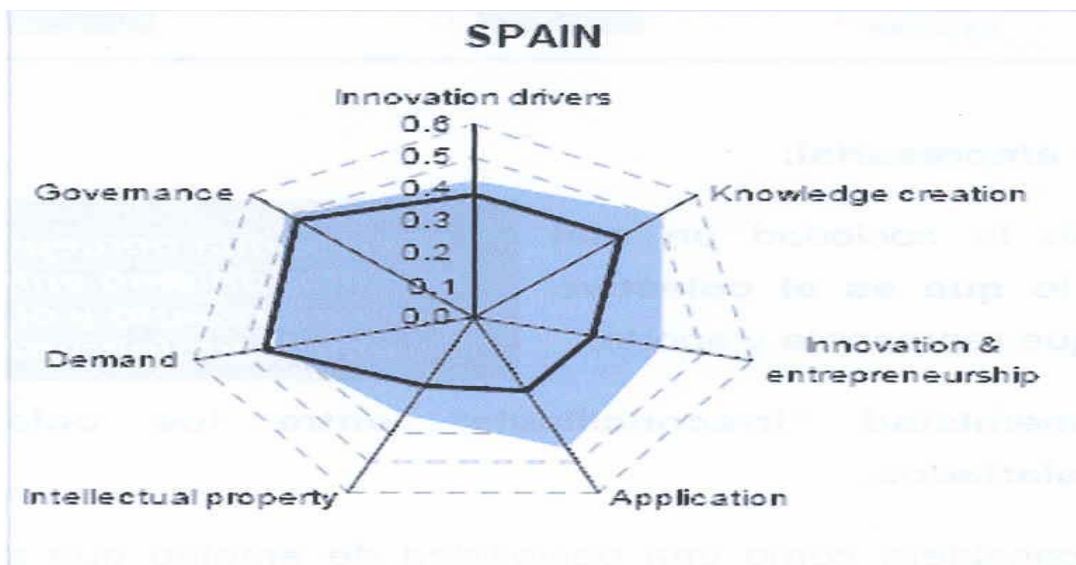
Source: Innovation Scoreboard, 2005.

Another significant aspect to mention refers to the combination of internal and external sources of information for the innovative tasks. Data of the last Spanish Innovation Survey (2006) show that only 9.10% of firms consider their own internal sources to be very important against versus 8.87% which give that importance to market sources, 1.29% of firms to Institutional sources (mainly Universities and Research centres) and 2.64% to Other sources. If we focus only on the Industrial sector the corresponding figures are: 16.35 % for internal sources, 15.07% for market, 2.63 for Institutions and 4.78% for others. Two main elements arise from those data: first the greater confidence of firms in outer sources of information and, second, the little importance given to non-entrepreneurial sources; the clearest example is just 1.24% of

14

manufacturing firms mention the University as an important source.

An outstanding feature concerns the type of innovation. Generally speaking, there is a clear predominance of process versus product innovation. Thus, the 2006 Innovation Survey shows that there are 25% more firms claiming to carry out process innovation rather than product one (33,767 versus 27,085); in industrial firms the proportion is even higher, 34% more process than product innovation (12,098 versus 9,007).

More complete is the information given by the 2005 edition of the Innovation Scoreboard. There they clustered innovative firms in four types. Strategic, Intermittent, Modifiers and Adopters. Figure nº 3 shows the result of comparing Spanish and EU situation: the outstanding majority presence of mere Adopters in Spain accurately qualifies the situation.

Figure nº 3: Spain Innovation Mode
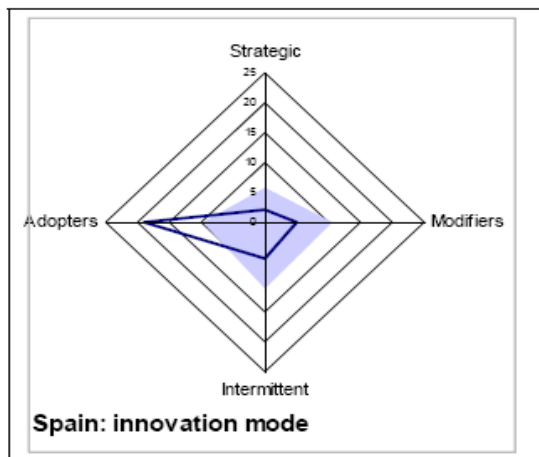
Source: Innovation Scoreboard 2005.

Lastly we want to mention the magnitude of the internationalisation of innovation. On the one hand we must say the weight of MNEs´R&D activity is relatively high, one of the heaviest in West Europe[14] (see figure nº 4). On the other, that presence is clearly asymmetric insofar as the R&D MNEs carry out in Spain is of relative importance for them (on rare occasions it is strategic) while for the Spanish economy it represents a great proportion of the overall private effort.

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[14] Nevertheless Spain is practically the only case in which that weight has decreased in the last years.

Figure nº 4: Multinational Corporation R&D expenditures over total national
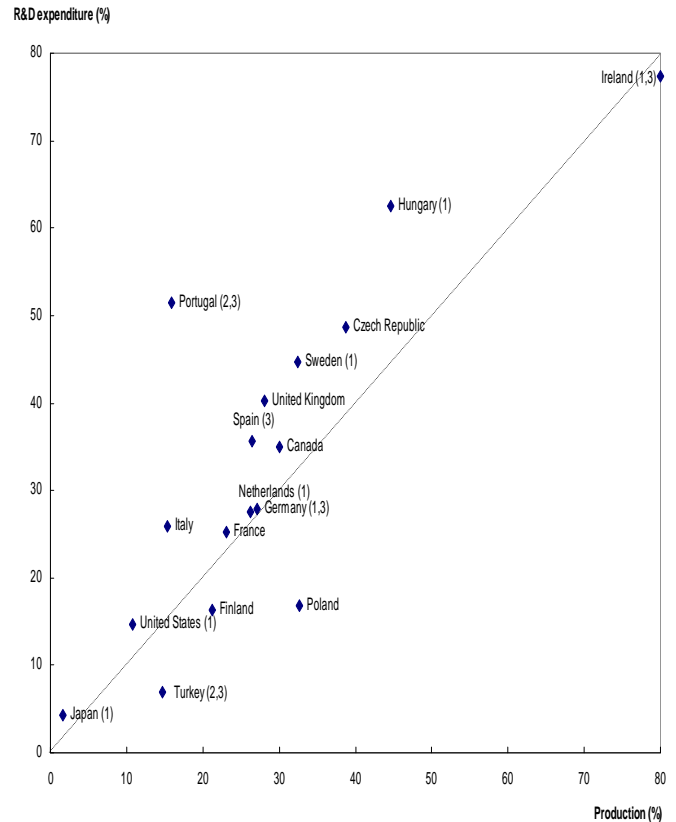
Source: OECD, 2007

5. Results.
5.1. Factor analysis.

As a first step in the explanatory phase we have made a series of trials in an iterative way with variables listed in table 2 of the annexe, and using the principal components method. Non-included variables have been rejected on the basis of KMO and MSA values. After several tests we have eliminated FUNIV, FIPSFL and FEXT (for those only 7 observations present values different from zero) and also FEMPEXT and FEMP (with 24 and 73 observations that present values different from zero). The KMO ratio rises at acceptable values (0.54) and explained variance goes as far as 63%. To continue eliminating variables gives us very low KMO improvements, does not improve explained variance, and distorts Factor results; we stopped the process at this point.

In those tests, Factor structure remains very stable with few changes: 9 factors (8 when we eliminate the last variables). Individual Factor explained variance has four levels (level I, 1 or

2 factors between 9.5% and 10.5%; level II, 3 or 2 factors between 7% and 8.5%; level III, 3 factors between 5.5% and 6,5%; level IV, 2 factors around 4,5%).

The more solid Factor structures are:

- NESTR, NGEST, NORG, NMARK, NESTE, always in the first level and usually the first factor.

- GMAQUI, GTECNO, GPREP, usually in the second level, we find a tendency to incorporate GFORM also.

- PATNUM, FPRO, usually in the second level. GINTID has a tendency to link this factor.

- INNOVEM, INNPROD, sometimes in the second level, others in the third.

- PIDTEJpw, FAP, sometimes in the second level, others in the third.

- TAMMED, GEXTID, GMARKET, usually in the third level.

- INNNOVET, INNPROC, always in the last level.

- INNOVEC, INFUN, always in the last level too.

Our selected Factor structure is shown in Table 1 and its quite reasonable possibility of being interpreted in economic and innovative terms must be underlined; each factor is accompanied by the variables that cluster together and the name we have assigned to make explicit its economic or innovative significance.

TABLE 1: extracted factors.

Factor	DESCRIPTION	EXPLAINED VAR (%)	
		Each factor	Accumulated
1	Organizational Innovation (ORGINNV)	10.53	10.53
2	Non-R&D innovative expenditures (NRDEXPEND)	10.42	20.95
3	Own R&D and results (RD&PAT)	7.5	28.45
4	Product innovation on inner effort (PRODINNER)	7.15	35.6
5	Human resources and Public funds (HUMCAP&FUNDS)	6.15	41.75
6	Size and external knowledge integration (SIZE&INTEGRATION)	6.05	47.8
7	EU funds attraction (UEFUNDS)	5.81	53.61
8	Basic research and cooperation (BASICR&COOP)	4.82	58.43
9	Process innovation on external sources (PROCEXTER)	4.81	63.24

Source: Own elaboration from PITEC; principal components method.

5.2 Regression analysis.

This phase of the analysis has been done through the estimation of regression models using the former factors as independent variables to explain the innovative activity of the firms. Following the research path proposed, we have estimated a number of logistic regressions with several characteristics:

- We have separated product and process innovation on the understanding that there can be significant differences between them. In both cases models try to explain the probability of any firm belonging to the innovative group or not.

- Apart from the factors we have included as independent variables two dummies trying to control the fix effect of firms belonging to any of the three groups in which we have divided the sample: independent Spanish companies (EIN), firms belonging to a national group (GN), and firms belonging to foreign multinational groups (GMN). The idea is to consider the importance of the growing interna-

tionalisation of the innovation in the Spain.

- In addition to the general regressions for products and processes we have estimated in each case four other regretssions corresponding to the types of sectors formerly explained.

The results are shown in tables 2 and 3 from which we can deduce as the main findings the following.

TABLE 2: Logit coefficients for "innprod" (product innovation)

Variable	GLOBAL	DYNAMIC	STATIC	LOST OPP.	RETREAT
ein	.226**				
gmn					
basicr_coop	.209***		.241***	.182*	
humcap_funds	.981***	.977**	.526***	1.29***	
nrdexpend	.406**	-5.26***		.804**	-6.13***
orginnv	.424***	.435***	.402***	.439***	.393***
rd_pat	.449***	1.57***		.65***	
Size_integr	.238**	2.06***	.324***	.146*	2.12***
uefunds	.195**	.46***		.437*	
constant	.677***	1.22***	.618***	.915***	.582***
N	3691	805	1362	1086	438
ll	-2213	-427	-852	-634	-250
ll_0	-2395	-500	-900	-695	-294
chi2	363	144	96.1	123	87
r2_p	.0758	.144	.0534	.0881	.148
aic	4445	869	1713	1284	509
bic	4500	902	1739	1324	525
legend: * p<0.05; ** p<0.01; *** p<0.001					

Source: Own elaboration from PITEC data.

TABLE 3: Logit coefficients for "innproc" (process innovation)

Variable	GLOBAL	DYNAMIC	STATIC	LOST OPP.	RETREAT
ein	.383***		.666***		
gmn					
basicr_coop	.886***	.973***	1.12***	.971***	.768***
humcap_funds	-.471***	-3.76***	-.969***	-.436***	-3.12***
Nrdexpend	.499***	-8.55***	-1.06***	.886***	-10.6***
orginnv	.597***	.475***	.65***	.532***	.43***
rd_pat	.128*	-1.75***	-.297**	.291**	
Size_integr			.502**		
Uefunds	1.89***		1.87***	1.09***	
constant	-.213***	-.803***	-.196*	-.0482	-.455***
N	3691	805	1362	1086	438
LI	-2033	-390	-726	-598	-225
ll_0	-2552	-551	-944	-752	-297
chi2	1037	322	436	309	145
r2_p	.203	.292	.231	.205	.244
aic	4083	791	1470	1210	459
bic	4132	820	1517	1245	480
legend: * p<0.05; ** p<0.01; *** p<0.001					

Source: Own-elaboration from PITEC data.

GENERAL FINDINGS.

1. Generally speaking we obtain a better explanation for process than for product innovation. It is reflected in the higher pseudo R2 values and in the higher homogeneity found across types of sectors. Nevertheless, significant factors are rather similar, although size & integration is more important in product innovation. From a more speculative point of view we ask if those differences are a reflection of the Spanish innovation characterised, among other elements, by a lesser presence of radical and strategic innovations and a heavier weight of adoptions and by a lesser dependence on foreign inputs in process technologies (Buesa& Molero, 1992; Molero, 2007).

2. The association between human capital (personnel) and the access to public funds changes its signs: positive for product innovation and negative for process. All the remaining factors maintain the same sign in both cases.

3. The kind of sector emerges as much more important than the type of firms´ ownership, confirming what was expected. Once we control for the first, we only find a case in which the type of firm is relevant: ICs in process innovation of Stationary Specialisation sectors. Importantly enough it must be said that this group gathers a non negligible number of so called traditional industries in which independent companies are still the bulk of the activity.

4. Organizational innovation arises as the most important factor explaining the behaviour of innovative firms. Its universal presence in both types of innovation and in all kinds of sectors, always with a positive sign, allows us to assert that this new evidence confirms and reinforces what theory and previous studies predicted.

5. After controlling for type of sector, a number of differences can be found. It is so both for the explanatory capacity of the models and for concrete factors which are significant in some cases but not in others (sometimes changing the sign). In our opinion this confirms and justifies the relevance of the taxonomy used. Moreover the level of adjustment varies significantly between the sectors better adapted to the international dynamism (Dynamic Specialisation and Retreat) and the other two more imbalanced sectors (Lost Opportunities and Stationary Specialisation).

PRODUCT INNOVATION

1. The type of firm is not significant in any of the cases. However the size & integration factor has a favourable effect in all cases.

2. Expenditures on non R&D innovative activities have a positive impact in Lost Opportunities, negative in Dynamic Specialisation and Retreat and are non- significant in Stationary Specialisation. This points out to a greater necessity of proper R&D activities in more dynamic sectors to follow the world evolution whereas in dynamic sectors in which Spain has technological disadvantages, non R&D activities can be considered as an alternative to build some capacities to be completed afterwards through R&D.

3. The already mentioned role of organisational innovation shows a higher effect in the two sectors with weaker adaptation to the world dynamic: Stationary Specialisation and Lost Opportunities. In other words, it is for those sectors that this non technological innovation seems to play its most important role.

4. The joint effect of R&D expenditure and Patents is a factor which positively influences product innovation in internationally dynamic sectors, regardless of having technological advantages or disadvantages. That is to say, in mature sectors the technological effort measured through R&D and patents is not a discriminating factor between innovative and non innovative firms; whereas it positively dis-

criminates in dynamic sectors. In these cases R&D and patents appear as a requirement to get technological advantages. A similar comment can be made with regard to UE funds; this factor can be understood as an index of innovative dynamism.

5. Basic research and Cooperation is only significant in the two sectors which reveal a bad international adaptation: Stationary Specialisation and Lost Opportunities. Therefore we can send a message for policy considerations: to strengthen those activities is essential to improve the situation of the firms in Lost Opportunities sectors.

PROCESS INNOVATION

1. Independent companies are more active in Stationary Specialisation sectors, together with Size & Integration factor. The weight of traditional sectors with independent companies –some of them of noticeable size- allows us to interpret this result as a situation in which foreign companies come to "follow" or "adapt" the behaviour of national companies with remarkable technological advantages.

2. Basic Research & Cooperation is favourable in the four cases, albeit its effect is relatively higher in sectors with bad international adjustment: Lost Opportunities and Stationary Specialisation. This result supports what was said in the analysis of product innovation: financing basic research and cooperative activities positively influences innovation in product and process.

3. Non R&D innovative expenditures have a negative impact in all sectors except in Lost Opportunities. Moreover, the size of the effect is much greater in sectors positively adapted to international evolution. Again, most dynamic sectors are much more dependent on R&D while in other cases non R&D activities can be a preliminary step to create R&D capabilities.

4. Organisational innovation, as always, favours innovation and its effect is greater in internationally dynamic sectors, particularly if it is a sector with technological disadvantages.

5. The positive sign of Human Capital and Funds suggests in processes with more systematic and incremental innovation, the stability of human resources is important and they seem to be strongly connected with the availability of public funds.

A complementary way of exploiting the findings can be made through the point of view of the kinds of sectors to highlight some relevant regularities. The starting point is the existence of more similarities between sectors with good fitness concerning international dynamism, on the one hand, and between those badly adapted, on the other.

As far as the first two are concerned we can point out that in the Dynamic Specialisation category two factors are common to product and process innovation: Organisational Innovation, with a positive impact, and non R&D expenditures, with a negative one. Another two show different signs in product and process: Human capital and Funds and R&D and Patents- both have a positive effect in product innovation and a negative effect in process.

Regarding Retreat Sectors, only two factors arise as common to product and process: The salient fact is that Organisational Innovation and Non R&D expenditures are common to both Dynamic and Retreat and both types of innovation, product and process. The first has a regular positive influence and the second a negative one.

In Dynamic sectors the role of human capital and funds and R&D and patents is also remarkable. The two are significant for both types of innovation, although with different signs; positive for product and negative for process.

Coming to sectors with negative international adjustment, it is noticeable that there is less regularity than in the former cases. The most outstanding are the following.

Apart from the systematic presence of organisational innovation, there also arises the

regular presence of Basic Research and Co-operation. This, on the one hand, explains the insufficient role played insofar as it has not been enough to guarantee a better international adjustment. This is why we insisted on the idea that policy has to foster those activities in order to upgrade the situation.

A second regularity has to do with Human Capital and Funds. This factor is common to the two sectors and types on innovation, although for the last one, the sign changes from positive in product to negative in process.

6. Concluding remarks.

As on many occasions, the distance between the theoretical debate and empirical findings has been non-negligible in this research exercise. In fact, the theory about factors affecting firms´ innovation has still a long way to go because the analytical object is complex and difficult to set limits for, as our review of the literature has shown. In spite of those difficulties we have tried to cast some light on the bases of the study of the Spanish case with some noticeable features: first, the importance given to the category of sector by constructing a new taxonomy through the combination of sectoral technological RTAs and the international dynamism; second, the utilisation of a very reliable database, which, based on the CIS has been statistically improved and ready to be used prepared by a group of specialists; third, the combination of a very large number of variables in order to capture the richness and complexity of the innovatory process; fourth, the inclusion of a separate study of product and process innovation; and fifth, the incorporation of the type of company by differentiating between national independent enterprises from either national or multinational groups.
The results obtained allow us to make explicit the following remarks:

1. First of all, the methodology has demonstrated its usefulness because both the sectoral taxonomy and the separation of product and process innovation show significant differences. We should like to underline the importance of typological analysis in the overall theoretical effort.

2. Particularly important are some findings about differences across categories of sectors. If in a preliminary ap-proach we differentiate between the positive diagonal (dynamic and retreat sectors) and the negative one (lost opportunities and stationary specialisation), we arrive at the conclusion that our estimations are stronger for the positive one, both for product and process innovation. In other words, the influence of the variables grouped in factors, allows us to assert that there is a better integration and functioning in the cases in which the Spanish specialisation coincides with the world dynamic.

3. Similarly, although less clearly, the separation of product and process has shown its usefulness. In general terms the better adjustment of the model for explaining process innovation is adequate to Spanish innovative specialisation which is more process oriented. Even though with the necessary caution, we can remember the demonstrated bias of the Spanish pattern towards less intensive and more adoption based kinds of innovations. Furthermore, the extraordinary importance of machinery and equipment purchases as sources of innovation for a majority of firms fits well into our findings.

4. On the contrary, the type of firms according to the distinction between national and foreigners does not shed much light. Very much in accordance with previous works (Molero & Garcia, 2008), our results do not find extraordinary differences between companies belonging to national or multinational groups. Although a number of qualifications must be introduced regarding the organisation of innovative process, our study finds more similarities than differences regarding the innovatory efficiency. Thus notwithstanding, we find out some differences for companies which are not members of a group (regardless of its nationality) particularly in sectors named as "traditional" or of low to medium technological intensity.

5. To explain differences sectoral taxonomy is clearly more relevant than firm ownership typology. This fact

20

point to, both, on the relevance of taxonomy and on the adaptive strategies of MNCs.

6. Public grants enhance product innovation, perhaps because they help to solve problems with human resources expenditures on concrete project development. But, on the other hand, they hamper process innovation, revealing weakness in human resources expenditure financing while for process innovation stability and temporal continuity they are urgently required.

ANNEXE A: SECTORAL CLASSIFICATION

Two criteria have been combined: the position of the sector in the Spanish economy according to its Revealed Technological Advantage (RTA) and the international dynamism of the sector in terms of its percentage in world total patents. The source has been the US patent office and the period selected 1993-2003, divided into two sub periods. 1993-1998 and 1999-2003. Patents have been obtained at two digit level of NACE classification as provided by Eurostat. RTA has been calculated for the sub period 1999-2003 while the technological dynamism of the sectors has been estimated through the difference between the percentages each sector has in total patents in the second period compared with the same percentage in the first one.

Combining the two criteria we arrive at a typology with four cases: 1: sectors with RTA > 1 and an increase of its percentage in world patents between the two periods (*Dynamic Specialisation*). 2: sectors with RTA<1 and a decreasing participation in total patenting (*Retreat*). 3: sectors with RTA > 1 and a decreasing participation in world technological dynamism (*Stationary Specialisation*) and 4: sectors with RTA < 1 and an increasing participation in total patents (*Lost Opportunities*).

SECTORAL CLASSIFICATION

Lost Opportunities Sectors	*Dynamic Specialisation Sectors*
Tanning, dressing of leather; manufacture of luggage	**Manufacture of textiles**
Manufacture of fabricated metal products, except machinery and equipment	**Manufacture of wearing apparel; dressing; dyeing of fur**
Manufacture of office machinery and computers	**Manufacture of basic metals**
Manufacture of electric motors, generators and transformers	**Manufacture of machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines**
Manufacture of accumulators, primary cells and primary batteries	**Manufacture of other general purpose machinery**
Manufacture of lighting equipment and electric lamps	**Manufacture of agricultural and forestry machinery**
Manufacture of electrical equipment n.e.c.	**Manufacture of machine-tools (split into DK2941, DK2942 and DK2943 in NACE Rev.1.1)**
Manufacture of electronic valves and tubes and other electronic components	**Manufacture of other special purpose machinery**
Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy	**Manufacture of domestic appliances n.e.c.**
Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	**Manufacture of electricity distribution and control apparatus, manufacture of insulated wire and cable**
Manufacture of industrial process control equipment	
Manufacture of optical instruments, photographic equipment	
Manufacture of watches and clocks	
Manufacture of motor vehicles, trailers and semi-trailers	
Manufacture of other transport equipment	

21

Manufacture of furniture; manufacturing n.e.c.	
Retreat Sectors	*Stationary Specialisation Sectors*
Manufacture of tobacco products	**Manufacture of food products and beverages**
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	**Manufacture of pulp, paper and paper products**
Manufacture of other non-metallic mineral products	**Publishing, printing, reproduction of recorded media**
Manufacture of medical and surgical equipment and orthopaedic appliances	**Manufacture of coke, refined petroleum products and nuclear fuel**
Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment	**Manufacture of basic chemicals**
	Manufacture of pesticides and other agro-chemical products
	Manufacture of paints, varnishes and similar coatings, printing ink and mastics
	Manufacture of pharmaceuticals, medicinal chemicals and botanical products
	Manufacture of soap, detergents, cleaning, polishing
	Manufacture of other chemical products
	Manufacture of man-made fibres
	Manufacture of rubber and plastic products
	Manufacture of weapons and ammunition

Source: Own elaboration

ANNEXE B

TABLE B1: Calculated Variables.

VARIABLE	CALCULUS FROM PITEC VARIABLES AND DESCRIPTIÓN
EGTINN	(GTINN/CIFMED*100) Innovation effort
GTINNpw	(GTINN/TAMMED) Expenditure in innovation per worker
PIDTEJCpw	(PIDTEJ/TAMMED*100) R&D staff per 100 workers.
PGINTID	(GINTID/GTINN*100) % Internal R&D expenditure
PGEXTID	(GEXTID/GTINN*100) % External R&D expenditure
PGID	(PGINTID+PGEXTID) % R&D expenditure
PGMAQUI	(GMAQUI/GTINN*100) % Expenditure in acquisition of machines, equipment and software
PGTECNO	(GTECNO/GTINN*100) % Expenditure in acquisition of external know-how
PGPREP	(GPREP/GTINN*100) % Expenditure in preparation for production/distribution.
PGFORM	(GFORM/GTINN*100) % Expenditure in training
PGMARKET	(GMARKET/GTINN*100) % Expenditure in introduction of innovations
FPRO	(F1) Own funds
FEMP	(F2+F3+F4) Funds from other firms
FEMPEXT	(F11+F12) Funds from other foreign firms
FAP	(F5+F6+F7+F8) Funds from AAPPs
FUNI	(F9+F15) University funds
FIPSFL	(F10+F16) Funds from IPSFLs

Source: Own elaboration from PITEC.

TABLE B2: Variables.

NAME	DESCRIPTIÓN
TAMMED	Average number of workers in the sphere of activity to which the firm belongs.
CIFMED	Average figure of businesses in the sphere of activity to which the firm belongs
EXPMED	Average export volume in the sphere of activity to which the firm belongs.
INVMED	Average gross investment in material goods in sphere of activity it belongs to.
INNOVE	Carries out innovation activities.
INNOVEM	Innovation developed by firm or group.
INNOVEC	Innovation developer in cooperation with other firms or institutions.
INNOVET	Innovation developer by other firms or institutions.
INNPROD	Innovation products from (t-2) to t
INNPROC	Innovation process from (t-2) to t
GINTID	Figure for internal R&D expenditure.
GEXTID	Figure for external R&D expenditure.
GMAQUI	Figure for expenditure on acquisition of machinery, equipment and software.
GTECNO	Figure for expenditure on acquisition of external know-how.
GPREP	Figure for expenditure on product/distribution preparation..
GFORM	Figure for expenditure on training.
GMARKET	Figure for expenditure on introduction of innovations.
EGTINN	Innovation effort
PIDTEJpw	EJC staff in R&D per 100 workers.
INFUN	Basic or fundamental research
INAPL	Applied research
DESTEC	Technological development.
FPRO	Own funds
FEMP	Other firms' funds
FEMPEXT	Funds from other foreign firms.
FAP	AAPP funds
FUNI	University funds
FIPSFL	IPSFL funds
FUE	EU program funds
FEXT	Other funds from abroad
COOPERA	Cooperated from (t-2) a t with other firms
PAT	Request for patents
PATNUM	Number of requests for patents
PATOEPM	OEPM Patents
PATEPO	EPO Patents
PATUSPTO	USPTO Patents
PATPCT	PCT Patents
PATINT	International Patents (outside OEPM)
NESTR	Non-technological innovation strategy
NGEST	Non-technological innovation management
NORG	Non-technological innovation organization
NMARK	Non-technological innovation : marketing
NESTE	Non-technological innovation: aesthetic or subjective change

Source: Own elaboration from PITEC.

23

TABLE B3: Correspondences of PITEC sectoral classification and RTA-Dynamism sectoral typology.

RAMAID	DESCRIPTION	NACE_REV_1	SECTORAL TYPOLOGY
	PITEC SECTOR		
02	Manufacture of food products and beverages	DA_15	3 (lost opportunities)
03	Manufacture of tobacco products	DA_16	2 (retreat)
04	Manufacture of textiles	DB_17	1 (dynamic specialisation)
05	Manufacture of clothing / dressing and dyeing of fur	DB_18	1 (dynamic specialisation)
06	Tanning and dressing of leather/ manufacture of luggage, handbags, saddlery, harness and footwear	DC_19	4 (stationary specialisation)
07	Manufacture of wood and of products of wood and cork, except furniture/ manufacture of articles of straw and plaiting material	DD_20	2 (retreat)
08	Manufacture of pulp, paper and paper products	DE_21	3 (lost opportunities)
09	Publishing, printing and reproduction of recorded media	DE_22	3 (lost opportunities)
10	Manufacture of coke, refined petroleum products and nuclear fuel	DF_23	3 (lost opportunities)
11	Manufacture of chemicals and chemical products (except Manufacture of pharmaceuticals, medicinal chemicals and botanical products)	DG_24 except 24.4	3 (lost opportunities)
12	Manufacture of pharmaceuticals, medicinal chemicals and botanical products	DG_24.4	3 (lost opportunities)
13	Manufacture of rubber and plastic products	DH_25	3 (lost opportunities)
14	Manufacture of ceramic tiles and flags	DI_26.3	2 (retreat)
15	Manufacture of other non-metallic mineral products (except Manufacture of ceramic tiles and flags)	DI_26 except 26.3	2 (retreat)
16	Manufacture of basic iron and steel and of ferrous alloys and ferrous products	DJ_27.1, 27.2, 27.3, 27.51, 27.52	1 (dynamic specialisation)
17	Manufacture of basic precious and non-ferrous metals and non-ferrous products	DJ_27.4, 27.53, 27.54	1 (dynamic specialisation)
18	Manufacture of fabricated metal products (except machinery and equipment)	DJ_28	4 (stationary specialisation)
19	Manufacture of machinery and equipment n.e.c	DK_29	1 (dynamic specialisation)
20	Manufacture of office machinery and computers	DL_30	4 (stationary specialisation)
21	Manufacture of electrical machinery and apparatus n.e.c.	DL_31	4 (stationary specialisation)
22	Manufacture of electronic valves and tubes and other electronic components	DL_32.1	4 (stationary specialisation)
23	Manufacture of radio, television and communication equipment and apparatus	DL_32 except 321	4 (stationary specialisation)
24	Manufacture of medical, precision and optical instruments, watches and clocks	DL_33	2 (retreat)
25	Manufacture of motor vehicles, trailers and semi-trailers	DM_34	4 (stationary specialisation)
26	Building and repairing of ships and boats	DM_35.1	4 (stationary specialisation)
27	Manufacture of aircraft and spacecraft	DM_35.3	4 (stationary specia-

			lisation)
28	Manufacture of other transport equipment	DM_35, except 35.1, 35.3	4 (stationary specialisation)
29	Manufacture of furniture	DN_36.1	4 (stationary specialisation)
30	Manufacture of games and toys	DN_36.5	4 (stationary specialisation)
31	Manufacture of games and toys	DN_36, except 36.1,36.5	4 (stationary specialisation)

Source: Own elaboration from PITEC and OECD patent d

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