Outputs of innovation systems: accounting what comes out of the system

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Abstract:

This paper focuses upon the performance of innovation systems from an output perspective. Innovation performance measurement is considered as increasingly interesting by several scholars during last years. It is also important as basis for the design and implementation of innovation policies. Different methodologies dealing with innovation performance are found not only in the literature but also in more official organizations such as the European Commission, articulated by the Community Innovation Surveys and the European Innovation Scoreboard. One of the main concerns in these methodologies is how to deal with the outputs of an innovation system. Many difficulties arise in the use of science and technology statistics, as there are several phenomena that are hard to measure. In addition, it may be important to distinguish between: (i) innovations in a proper sense (product and process innovations), (ii) determinants of innovations (learning, interactions), and (iii) consequences of innovations (growth, employment). In this paper we try to characterize some European countries according to seven innovation output indicators - in the manufacturing and service sectors. The approach followed in this paper could also provide insights when applied to developing countries, which are already concerned with the collection of science and technology indicators.

Keywords: innovation systems, output indicators, community innovation survey, manufacturing sector, service sector.

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1. Introduction

The aim of this paper is to contribute to the literature on innovation system performance, by focusing upon the outputs of several Innovation Systems (IS). During the last decades there has been an increasing stream of literature dealing with the development, use and exploitation of indicators in order to improve the measurement and characterization of IS (Oslo Manual, 1992 and 2005; Frascati Manual, 1994 and 2002). It is possible to find several studies proposing methodologies/composite indicators for the measurement of the innovative capacity (Zabala-Iturriagagoitia et al., 2007a). In Europe, the European Commission has been one of the most active agents in this sense, with the development of the European Innovation Scoreboard (EIS) and the implementation of the Community Innovation Surveys (CIS), which include many indicators designed to determine innovative capacity (European Innovation Scoreboard, various years). However, innovation capacity is not the same as realization of actual innovations.

In spite of the increasing efforts carried out, much work remains to be done in order to capture all the complexities involved in the development of innovation processes at different levels (micro, local, regional, sectoral, local, etc.) (Katz, 2005). In the literature thee is a great debate on which the most appropriate indicators are in the depiction and analysis of an IS (Godinho et al., 2005). However not many contributions are to be found on the output perspective. This is our major target.

In order to develop our output perspective, we will use seven indicators collected from the CIS II, CIS III, CIS IV and CIS 2006, for various European countries both in the manufacturing and service sectors. With this analysis we cover a 10 year time period, from 1996 (CIS II) to 2006 (CIS 2006). We acknowledge that the identification of indicators to measure outputs of ISs is not an easy task. We merely centre on the *outputs* of innovation processes, or innovations that come "out of" the IS. With it, we aim at offering alternative indicators to those commonly used[1] when the performance of different countries is being benchmarked (Dou, 2004; Huggins, 2009).

The paper is organized as follows. The second section provides a brief introduction to the IS framework and the relevance of developing comparative benchmarking investigations in order to characterize (and thus learn by comparing) the innovation processes in different innovation systems in the most comprehensive manner. The third part describes the methodology followed during the research and the seven indicators selected for this output performance measurement. Then the fourth section presents the main results of the analysis, offering an explicit depiction for each of the seven indicators considered. The paper concludes by highlighting the most relevant findings and pointing at the further research to be developed in this context.

2. Conceptual framework: the performance of innovation systems

2.1.- Innovations and innovation systems

[1] A detailed list of indicators commonly used in the literature in order to characterize innovation systems´ outputs will be offered in the next section (see also appendix 2).

The main purpose of an IS is to pursue innovation processes, that is, to develop and diffuse innovations. In this sense, the literature discerns a series of functions accomplished within the frame of IS (Galli and Teubal, 1997; McKelvey, 1997). Johnson (2001) then relates the functions of an IS with the activities developed within them, and Hekkert et al., (2007) propose a set of seven functions to be applied when mapping the key activities in innovation systems. According to the literature then, it could be stated that the main functions of an IS are the development, diffusion and use of innovations (Edquist, 2005).

Innovations are new creations of economic significance, primarily carried out by firms (but not in isolation). They include product innovations as well as process innovations. *Product innovations* are on the one hand, new/improved material goods and intangible services, while on the other hand, *process innovations* are new ways of producing goods and services, being technological, organizational, managerial, marketing oriented, etc. (Edquist and Hommen, 2008b).

During last years, and as matter of increasing interests from the policy-makers concerning public accountability (Majone, 1989; Arnold, 2004; Diez-López and Izquierdo-Ramírez, 2005; Batterbury, 2006) a large stream of literature has emerged in relation to the measurement, management, or evaluation of IS performance (Godin, 2002; Lovell, 2002: Bogetoft et al., 2006; Brenner and Broekel, 2009). In this sense, several related concepts have come out regarding the propensity of territories to innovate, such as innovative capacity, innovation potential, innovation capabilities or innovativeness among others (Mairesse and Mohnen, 2002; Zabala-Iturriagagoitia et al., 2007a). The performance of an IS can be regarded as the outputs of the system, i.e. what 'comes out' of it, that is, innovations (Edquist and Hommen, 2008b; Brenner and Broekel, 2009). Therefore, the question arises as to what are the inputs of an IS and what is the contribution of a particular spatial units towards the achievement of certain outputs. In this particular paper, our focus is on the outputs of an IS.

There are different ways in which innovation performance can be defined and measured[2] In this sense, it might be expected that the different methodologies and proposals raised concerning the measurement of performance should address the issue of IS outputs. However, some scepticism can be found in the literature as to the adequacy of some of the indicators provided in order to characterize the performance of an IS (Grupp and Mogee, 2004). From our point of view, the performance of an IS should not be measured as economic growth, military strength or by the number of intermediary factors, such as patents or publications (Arundel et al., 2008)[3], and which might (or not) play a role in the accomplishment of innovative products and processes (Grupp. 1998: 143). The IS should

[2] According to Arundel et al., (2008) two methods of analysing innovation statistics can be highlighted: (i) descriptive analyses; (ii) multivariate models of the determinants of innovations.

[3] Patents are often considered to be innovation indicators. From our point of view they are rather an indicator of invention, but not of innovation, as they reflect that something is technologically new, but not necessarily that it is economically useful (Coombs et al., 1996). This point is also highlighted by Brenner and Broekel who consider that "patents are a limited measure of innovation activities because many innovation activities are not patents and many inventions are patented but never reach the market" (2009:6).

not be considered as being the same as the whole economy or the whole society. It is much more sensible to limit the notion of IS to be constituted by innovations of various kinds and the activities that influence their development and diffusion.

This then brings us to talk about the determinants of innovation, the inputs of innovation and the impact of innovation outputs. These are different things, even if they are interrelated (Brown and Svenson, 1999), and it is important to distinguish among these categories, so some clarification is needed. As Wagner-Döbler states "input indicators capture what is used to produce knowledge" (2005:147), that is, what it comes into the system, while "output indicators deal with the outcome of knowledge production" (ibid), i.e. what it comes out of it. Then the outcomes, or impact of innovation, concern the possible consequences that innovations may have in economic growth, employment, labour productivity, environmental balance, military strength, etc. as these are the main focal points for innovation policy-makers and the targets of their innovation policies[4]. Growth is not an output measure of the IS, but innovations are very important for economic growth. Hence innovation policy is an important part of growth policy, but they are not the same. However, these consequences are different from innovations as such or the determinants of innovations (Rondé and Hussler, 2005). Edquist (2005: 190-191) and Hommen (2008b: 10) (see Appendix 1) use a list of ten activities, structured into four thematic categories, as equivalent to the determinants of the innovation process[5], that is, those factors that influence, support, ease and promote the development of innovation processes within the IS.

One of the main rationales for pursuing comparative studies regarding the performance of particular IS rests is to foster learning and improve performance of some concrete units – territories, research groups, countries, policy makers, etc. - by comparing the results of different units among them (Main, 1992; Niosi, 2002; Dou, 2004). In this sense, the main purpose of developing comparative (benchmarking) studies based on indicators "is to assist policy by summarizing a range of innovation indicators at the national, regional or sector level, by permitting a comparison of the relative success or failure of the innovation system, or through the identification of specific aspects of the innovation system which perform well or poorly" (Arundel and Hollanders, 2008: 30). Thus, the main aim of these studies is to assist the policy-making sphere in the identification of systemic problems to be solved by innovation policy (Hommen and Edquist, 2008; Huggins, 2009). Indeed, it is in fact very difficult to improve, what cannot be measured. As stated, in order to be useful for policy purposes, these measurements and descriptions must be comparative between systems, as it is not possible to say whether innovation intensity is high or low in a certain system if there is no comparison with innovation intensities in other systems. This has to do with the fact that we cannot identify 'optimal or ideal' innovation intensities (just as we can not specify an optimal IS). Such

[4] Indeed, the study of consequences of innovations is a very complicated issue itself and will not be addressed in this paper.

[5] These four categories of activities (determinants) are: (i) provision of knowledge inputs to the innovation process; (ii) demand-side activities; (iii) provision of constituents of IS; (iv) support services for innovating firms. It is necessary to state that public innovation policy is an element of all the ten activities. A similar contribution of the factors influencing innovation output can also be found in Brenner and Broekel (2009).

comparisons can be made between the same systems over time, or between different existing systems. Following Arundel et al, who state that "policy relevant results need to be replicated across several countries and over time" (2008: 16), we will try to cover both aspects, comparing the performance of different European countries at different points in time, offering thus a dynamic approach to the analysis of the performance of IS.

The performance of an IS can be measured by means of the propensity to innovate, also referred to in the literature as innovation intensity as illustrated above. Ideally, propensities should be known for many specific categories of innovations. If these propensities are unknown it would not be possible to improve the performance of the various IS (national, regional, sectoral, local, etc.). Hence the measurement of propensities to innovate with regard to specific categories of innovations is of utmost importance for policy purposes.

This begs the question of how innovation intensities in "other systems" are determined. Can the innovation intensity for a certain category of innovations be too high? The answer to this question is related to the fact that we talk about innovation intensities for different categories of innovations. In a system with limited resources, a high innovation intensity for one category of innovations might imply a low innovation intensity for others, which is unlikely to be pursued. So, some kind of balance among different categories of innovations may be preferred (Edquist, 2008). There are certainly no generally accepted criteria for achieving these kinds of balances, as it also depends on the specific targets (goals) defined by innovation policy in various systems (national regional, sectoral, etc.) (Frenken et al., 2007). They will have to be discussed in a pragmatic way from case to case (Borrás, 2009; Pennisi and Scandizzo, 2006). However, it should be taken into consideration that "more innovation is not always better". So, we cannot take for granted that innovation is always good and that more is better (Zabala-Iturriagagoitia et al., 2007b). Accordingly, the output perspective followed in this paper needs to be complemented with an input view. It should also be supplemented with the measurement of determinants of the development and diffusion of innovations, which is a matter of further work.

In the IS performance measurement related literature several scoreboards can be found (Archibugi et al., 2009; Arundel and Hollanders, 2008; Zabala-Iturriagagoitia et al., 2007a). Among them it is possible to highlight the European Innovation Scoreboard, the Community Innovation Survey (CIS), the UK Competitiveness Index, the index of the Massachusetts Innovation Economy, the New Economy Index, the Global Entrepreneurship Monitor, the Global Innovation Index, and the Word Economic Forum Competitiveness Index among others.[6] In this paper we will focus upon the data provided by the CIS, which is considered as the main instrument for assessing national innovation performance in Europe.

A diverse set of contributions can be found in the literature exploiting the results of the CIS (Laursen and Salter, 2006). Evangelista et al. (1998) were one of the first exploiting the results from CIS surveys. Focusing on the CIS I, they studied the number of

[6] For further information the reading of Table 2.1 in Arundel and Hollanders (2008: 32) is recommended.

innovating firms, the sources of innovation activities and the innovation intensity of European manufacturing firms in 13 different EU countries. Mairesse and Mohnen (2002), using data from CIS I for seven European countries, measure innovation intensity by the share of sales due to innovative products[7]. Sellenthin and Hommen (2002) analyse the Swedish industrial sectors with regard to innovativeness using CIS II data. Faber and Hesen (2004), based on CIS I and CIS II data, use the percentage of sales of new and substantially improved products of industrial firms as an output indicator (among others) so as to develop a model for determining the innovation capabilities of some European nations. Mohnen and Röller (2005) develop a framework for testing complementarities in innovation policies using the share in sales of innovative products as one of the output measures in their analysis, which is based on CIS I data. Grimpe and Sofka (2007), based upon the CIS III, use the share of turnover due to new to the market products as one of the indicators for measuring the absorptive capacity of innovative firms. Arundel et al. (2008) illustrate the major differences between the different CIS that have been developed so far, linking the information provided by these surveys with the uses in innovation policy development. Brouwer et al. (2008) develop a model for analysing the sales of new to the firm products using the data from the Dutch CIS II. Castellaci (2008) uses CIS IV data in order to benchmark innovation activities in Norway in comparison with other European countries, examining the Norwegian paradox, according to which Norway is characterized as an innovative country, but in which the size of innovative sectors is still too small. Ebersberger et al. (2008), using CIS III from Finland, the Netherlands and the UK analyse the distribution of innovative sales across different industrial sectors. Edquist and Hommen (2008b) reconsider the so-called Swedish paradox based on CIS I and CIS II data, being its rationale that the very high values of input indicators for innovation in Sweden do not correspond with the low values achieved in output indicators[8]. Tether and Tajar (2008) use UK's CIS III to focus on the links between firms and specialist knowledge providers. Similarly, Lhuillery and Pfister (2009) exploit the French CIS II to focus on the cooperation failures that had a negative effect on the innovation performance of the firm. Heidenreich (2009) uses CIS IV data to analyse the innovation and cooperation patterns of low and medium technology companies in Europe, including a diverse set of indicators which include among others the percentage of enterprises with innovation activity; enterprises with new to the firm/new to the market products, turnover due to new to the firm/new to the market products. Just to mention a few.

As can be noticed, most contributions explore particular determinants of innovation performance (like cooperation, absorptive capacity, spillovers, etc.) using CIS for a particular country in a particular period of time, that is an individual CIS, or using a concrete CIS for making comparative analyses across countries. Conversely, our contribution focuses on several CIS and different European countries, so as to identify the

[7] The next methodology section will offer the definitions of the main indicators considered in this paper.

[8] A similar contribution can be also found in Bitard et al. (2008) who use the following indicators when explaining the Swedish paradox: (i) percentage of innovating firms; (ii) share of all firms that have introduced new processes; (iii) share of firms having introduced product innovations; (iv) introduction of new to the firm products; (v) introduction of new to the market products; (vi) turnover due to new to the firm products; (vii) turnover due to new to the market products.

extent to which these countries perform (better or worse) in a set of output dimensions. Due to the amount of countries included in our analysis, it is not possible to address the study of the determinants of innovation in a comparative manner, as that would imply an individual study on each country[9], which is not the main target of this paper. Much remains to be done with regard to measurement of innovations, from an output perspective, and this is the focal point of the current paper. We use seven output oriented indicators that we consider helpful to better understand the performance of various national innovation systems.

3.- Methodology and data

During the last decades many efforts have been carried out from different organizations in the development of indicators oriented to estimate innovative activities undertaken by public and private entities within national and regional economies. The OECD's first Oslo Manual (1992) provided a practical guideline regarding the measurement of innovation. This provided the basis for the development of the CIS in Europe, beginning in the 1990s with the CIS I (1992). Since then, the CIS has been repeated in the CIS II, CIS III, CIS IV and CIS 2006 surveys, covering almost 15 years.[10] Similar innovation surveys based upon the guidelines established in the Oslo Manual have also been conducted in other OECD countries (OECD, 2009).[11]

The CIS is still in a development process with several changes among the various surveys undertaken, what influence the comparisons of concrete indicators in time. This refers to the addition of new indicators and countries, the number of sectors (NACE codes[12]) and the sizes of the firms considered (Arundel et al., 2008). As a result, the evolution over time of some indicators, countries and sectors cannot be balanced.

In this paper we will use data from CIS II (covering the 1994-1996 period), CIS III (1998-2000 period), CIS IV (2002-2004) and the recently published CIS 2006 (2004-2006) in order to capture the evolution had by different European countries as regards their innovation outputs. The data have been collected from the Eurostat database on science, technology and innovation, where the results from these CIS can be found[13]. This means that we cover an extended period that may allow us to observe dynamic patterns in the countries considered. As stated, our target in this paper, are those indicators related to the outputs of an IS. Hence, we will select a few of the many indicators included in these surveys. We will just focus upon the output side. In this sense, analyzing the data provided by these CIS, we made a list of 11 possible indicators that might be considered (see Appendix 2). Then, according to the data availability, the

[9] Some contributions in this sense can be found in Edquist and Hommen (2008a) where the determinants of innovation in ten different countries are illustrated.
[10] The CIS was carried out for the first time in 1992. CIS II took place in 1996, CIS III in 2001, CIS IV in 2004 and CIS 2006 in 2006.
[11] For this reason, we consider that the proposal raised in this paper might be complemented with data from other non-European countries.
[12] NACE stands for "Nomenclature générale des activités économiques dans les Communautés Européennes", a standard for classifying economic activities in the EU.
[13] http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database

possibility to develop comparative analyses and the output orientation of these indicators, we decided to focus on the following 7 indicators:

Box 1.- Output Indicators considered and time period covered

Indicator	Availability
1.- Enterprises with product innovation (% relative to all enterprises)	CIS II CIS III CIS IV CIS 2006
2.- Enterprises with process innovation (% relative to all enterprises)	CIS II CIS III CIS IV CIS 2006
3.- Share of firms that have introduced new to the firm products (% of enterprises with innovation activities)	CIS IV CIS 2006
4.- Share of firms that have introduced new to the market products (% of enterprises with innovation activities)	CIS IV CIS 2006
5.- Turnover of new or significantly improved products new to the firm (% of total turnover)	CIS II CIS III CIS IV CIS 2006
6.- Turnover of new or significantly improved products new to the market (% of total turnover) [14]	CIS II CIS III CIS IV CIS 2006
7.- Organizational and marketing innovations (% of enterprises with innovation activities)	CIS IV CIS 2006

The selection of these indicators is mainly based upon the contributions of Edquist and Hommen (2008b) and Bitard et al. (2008) who use six of the seven indicators when illustrating the Swedish paradox. The seventh indicator we have added deals with organizational and marketing innovations, a category of innovations that is in recent times given more relevance by firms in Europe (Borrás and Tsagdis, 2008a).

According to the CIS, an innovation is understood as "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" (Eurostat, 2009). As regards product innovations, the CIS defines them as those "introduced new good or service or a significantly improved good or service with respect to its capabilities", while process innovations are those "implemented new or significantly improved production process, distribution method, or support activity for your goods or services" (ibid). Finally, the enterprises with innovation activity (or propensity to innovate) are defined as those "that

[14] As it could be noticed in the previous chapter, the turnover due to innovative products has been increasingly used as a measure of innovative performance in the literature.

introduce new or significantly improved products (goods or services) to the market or enterprises that implement new or significantly improved processes" (ibid).

The data provided by the different CIS are stratified by the size of the enterprise and its principal activity (NACE code). In terms of the size of the firm, the CIS is divided into three subgroups: 10-49, 50-249, more than 250 employees. However, due to space limitations, in this paper, we will not consider the firm size and the different NACE sectors that are included in the indicators collected. In this sense, the comparison of the diverse NACE activities might become a bit delicate as the sectors included in the CIS change from period to period. In this case, we will just focus upon the main differences between the manufacturing and service sectors. However, the analysis of the firm size and the sectoral differences is a matter of further work.

Next we will illustrate how the CIS questionnaire explicitly formulates the questions concerning the indicators included in our analysis. On its section devoted to product innovation (good or service), the questionnaire asks "who developed the product innovations?" being possible to select one of the following options: (i) mainly your enterprise or enterprise group; (ii) your enterprise together with other enterprises or institutions; (iii) mainly other enterprises or institutions. In order to quantify for product innovations, we have considered the amount of innovations developed "mainly by the enterprise or enterprise group". Indeed, we consider that the analysis of the cooperation patterns shown by firms in the development of innovations is an issue of major relevance, as interactions are considered as one of the most relevant determinants for innovation. In this paper we will not deal with cooperative agreements among organizations or institutions, as it is not considered as an output of innovation despite it plays an important role on them (as a determinant[15]). However, it is a matter for further work. Similarly, in the section dedicated to process innovation the questionnaire formulates the question of "who developed the process innovation": (i) mainly your enterprise or enterprise group; (ii) your enterprise together with other enterprises or institutions; (iii) mainly other enterprises or institutions. Accordingly, and as did with product innovation, we have considered the amount of process innovations developed "mainly by the enterprise or enterprise group" as the most adequate output indicator to be included.

As regards the indicators concerning the new to the firm and new to the market products, the survey asks, in the product innovation section, if there "were any of your goods and services", only new to the firm[16] or new to the market[17]. With it, it becomes possible to measure for the percentage of firms that have introduced these new to the firm/new to the market products. Then, the survey complements the previous question with another one requesting for "the percentage of your total turnover from: (i) good and service innovations that were new to your market; (ii) good and service innovations that were

[15] See discussion about the determinants of innovation in the previous section.
[16] The questionnaire defines that a firm has a new to the firm product when "your enterprise introduced a new or significantly improved good or service that was already available from your competitors in your market".
[17] The questionnaire defines that a firm has a new to the market product when "your enterprise introduced a new or significantly improved good or service onto your market before your (it may have already been available in other markets)".

only new to the firm; (iii) good and service innovations that were unchanged or marginally modified (include the resale of new good and services purchased from other enterprises)". Then the final section of the questionnaire deals with organisational and marketing innovations. On it, firms are enquired to state whether they introduced organisational and marketing innovations respectively[18].

4.- Results

In this section we will illustrate the main results for each of the indicators outlined above. Accordingly this section will be divided into seven subsections (one per indicator), each exploring the main dynamic patterns observed in the countries included in the analysis. As we will see, the relative position of each country is quite dependant on the indicator selected. This means that considering these output indicators in a systematic way might be useful in order to detect possible policy problems (or failures) within each country. This might be helpful in order to balance each national innovation system according to the particular targets defined by their respective innovation policies.

As mentioned in the previous section, the CIS is in a continuous development. This is a positive sign, as different aspects of innovation that were not conceived before are being given increasing relevance. However, it also implies that the data from the different surveys are not comparable among themselves, as the amount of sectors considered differs and the population surveyed also changes from CIS to CIS. Accordingly, and in order to avoid misunderstanding, in the following sections we will not show the values achieved by each country for each indicator[19], but the relative position occupied by them.

4.1.- Enterprises with product innovation

As previously defined, we account for the percentage of firms that have developed a product innovation mainly by the enterprise or enterprise group. For the period considered and the two sectors included, we have observed as a general trend that product innovations are mostly conducted by firms themselves, without being that much engaged in other types of cooperation. This is the mean reason why we do not account for product innovations developed in cooperation.

As regards the manufacturing sector, Italy (CIS II), Norway (CIS III), Bulgaria (CIS IV) and Germany (CIS 2006) are the countries with a highest share of firms developing

[18] For organizational innovations three options are given: (i) new or significantly improved knowledge management systems to better use or exchange information, knowledge and skills within your enterprise; (ii) a major change to the organisation of work within your enterprise, such as changes in the management structure or integrating different departments or activities; (iii) new or significant changes in your relations with other firms or public institutions, such as through alliances, partnerships, outsourcing or sub-contracting. Conversely, the following are the two options given for marketing innovations: (i) significant changes to the design or packaging of a good or service (exclude routine/seasonal changes such as clothing fashions); (ii) new or significantly changed sales or distribution methods, such as internet sales, franchising, direct sales or distribution licenses.

[19] The values achieved by each country for every indicator are publicly available on Eurostat on the Science, Technology and Innovation Statistics, on the section devoted to CIS results.

product innovations at home. However, the degree of stability observed in these countries is very low. Indeed, Italy changes from being ranked first in CIS II to be positioned 24th (out of 25) in CIS IV. Similarly, Bulgaria dramatically alters its position from CIS IV (first) to CIS 2006 (20th of 24), while Norway becomes 15th (out of 25) in CIS IV after being ranked first in the preceding CIS III. This same volatility is also observed in some countries (see for example Greece, Lithuania Poland, Portugal and Romania). On the other hand, we also find some countries performing quite stably along time, though with different profiles, such as Belgium, Czech Republic, Estonia, Cyprus, Austria, Slovakia, Finland and Sweden. However, from our point of view the case of Ireland should be highlighted (at least concerning the manufacturing sector, as there are only data available for CIS II for the services sector in Ireland). The relative position achieved by Irish firms as regards product innovation is kept constant in time, which clearly shows the increasing efforts done by the Irish government towards supporting the development of innovative activities among national firms (Cogan and McDevitt, 2000; Roper et al., 2002).

We would also like to raise some concerns about the data availability for CIS IV. As can be noticed, several countries (i.e. Denmark, France, Luxembourg, Netherlands, Romania) show a noticeable increase/decrease in the relative position when it comes to CIS IV. We don't know the reasons for this peak/nadir change in the performance, but this is a perceptible switch to take into account.

With regard to the services sector Luxembourg leads for all the period considered (with the exception of Ireland for CIS II). Finland, Sweden, Norway and Greece can also be underscored for being ranked high and with quite constant values. From our point of view the cases of Belgium, Netherlands and Austria can be quite illustrative of the swift and increasing change towards a service-oriented economy (Boschma, 1999; de Jong and Marsili, 2006; Tödtling and Traxler, 1995).[20] On the opposite side we find Bulgaria who modifies his relative position in a relative short period of time[21]. Finally, and according to the data collected, it seems that new member countries such as Cyprus, Lithuania, Hungary, Malta, and Poland are still immersed in a convergence process towards a knowledge-based economy, not only as regards the results observed in the service sector, but also concerning those among manufacturing firms.

Table 1.- Enterprises with product innovation (percentage relative to all enterprises)

	Total industry (excluding construction)**				Services			
	CIS II*	CIS III	CIS IV	CIS 2006	CIS II*	CIS III	CIS IV	CIS 2006
Belgium	6	10	9	4	13	5	6	4
Czech Republic			12	14			10	10
Denmark	8		21	9	2		9	5

[20] This is also found with the following indicator concerning the enterprises with process innovation (see sub-section 4.2)

[21] A similar tendency is also found for Malta, Slovakia and Romania.

Germany	7	8	14	1	10	11		
Estonia			6	5				
Greece		3	3	13		3		6
Spain		12	19	17		12	11	11
France	4	4	11		3	8	12	
Ireland	4		2	3	1			
Italy	1	7	24			7	18	
Cyprus			25	22			19	15
Lithuania			8	19			17	17
Luxembourg	9	2	13	2	6	1	1	1
Hungary			17	24			14	14
Malta			4	10			13	18
Netherlands	6	5	20	11	12	9	7	
Austria	3	9	7	7	7	10		2
Poland			10	21			16	13
Portugal	2	13	22	16	11	13	15	
Slovenia				12				8
Slovakia			23	23			8	12
Finland	5	6	18	8	8	2		
Sweden	6	11	16	6	4	6	2	3
United Kingdom	10				9			
Bulgaria			1	20			4	16
Romania			5	18			3	9
Norway	8	1	15	15	5	4	5	7
n	*10*	*12*	*25*	*24*	*13*	*13*	*19*	*18*

Notes:
** Relative to product and process innovators correspondingly*
*** The data for CIS II correspond only to the manufacturing sector within the whole industry sector*

Source: own elaboration from CIS II, CIS III, CIS IV and CIS 2006. Science, Technology and Innovation Database (Eurostat).

4.2.- Enterprises with process innovation

With this indicator we aim to report the percentage of firms that have developed a process innovation mainly by the enterprise or enterprise group. As to manufacturing firms, those in Italy (CIS II and CIS III), Greece (CIS IV) and Ireland (CIS 2006) account for a higher percentage of process innovativeness. As it was the case with the previous indicator, Ireland shows a high degree of stability. The case of is quite illustrative of a national innovation system mainly oriented towards process innovation, not being characterized by developing new innovative products to the market (this will be further elaborated in the following sub-sections). We also detect some kind of unevenness in the data for CIS IV, as can be noticed in the cases of Germany, Austria, Poland, Finland,

Sweden and Romania. Among the countries with a lower movement towards process innovation, the cases of the Czech Republic, Lithuania, Hungary, Netherlands, Slovakia, Bulgaria and Norway are worth to mention.

Table 2.- Enterprises with process innovation (percentage relative to all enterprises)

	Total industry (excluding construction)**				Services			
	CIS II*	CIS III	CIS IV	CIS 2006	CIS II*	CIS III	CIS IV	CIS 2006
Belgium	6	11	9	2	-	13	4	4
Czech Republic			14	17	-		9	11
Denmark	9	13	15	11	-	5	11	6
Germany	14	7	24	3	-	8		
Estonia			8	4	-			
Greece			1	7	-			2
Spain		5	4	12	-	7	3	8
France	4	8	5		-	4	2	
Ireland	2		3	1	-			
Italy	1	1	12		-	2	14	
Cyprus			16	16	-		10	9
Lithuania			13	20	-		16	18
Luxembourg	13	6	11	6	-	1	5	1
Hungary			21	24	-		17	17
Malta			7	10	-		13	15
Netherlands	21	9	25	21	-	11	18	
Austria	3	12	17	8	-	6		3
Poland			6	18	-		7	13
Portugal	7	2	10	9	-	3	6	
Slovenia				14	-			10
Slovakia			20	23	-		8	14
Finland	10	3	22	5	-	10		
Sweden	8	10	19	13	-	12	12	5
United Kingdom	5				-			
Bulgaria			18	22	-			16
Romania			2	15	-		1	7
Norway	11	4	23	19	-	9	15	12
n	*14*	*13*	*25*	*24*	-	*13*	*18*	*18*

Notes:
** Relative to product and process innovators correspondingly*
*** The data for CIS II correspond only to the manufacturing sector within the whole industry sector*

Source: own elaboration from CIS II, CIS III, CIS IV and CIS 2006. Science, Technology and Innovation Database (Eurostat).

As to process innovation in the services sector, firms in Luxembourg (CIS III, CIS 2006) and Romania (CIS IV) are the ones that develop their process innovations in house to a higher extent, performing both countries in quite a constant manner. A similar profile is also found in France, Austria and Portugal, where a high percentage of firms are engaged in this category of innovation. The cases of Italy, Sweden and Belgium are also quite notorious, either because the percentage of firms devoted to process innovation increases a lot (i.e. Belgium and Sweden) or because of the opposite (case of Italy). On the other hand, countries such as Lithuania, Hungary, Malta and the Netherlands lack of this kind of innovations among their firms.

At this point we consider that a comparison between the two indicators illustrated so far becomes necessary, as there are some parallelism between the two for certain countries. On the manufacturing side, firms in most countries follow quite similar behaviours as regards product and process innovations. However, firms in Germany, Netherlands and Norway seem to be much more engaged towards product innovations rather than process ones. On the contrary, manufacturing firms in Greece, Spain, Italy, Cyprus and Portugal, seem to be much more oriented towards process innovations[22]. This is related to what already pointed out by Zabala-Iturriagagoitia et al. (2007b) as regards the role of absorptive capacity within those firms located in countries lacking of a strong science-based community and with difficulties in technology transfer practices from the science environment to firms. Accordingly, it becomes more feasible for firms operating in these countries to be more oriented towards process innovations rather than trying to put new products in the market. This will be complemented in the following sections.

As can be noticed, the amount of countries collecting data for process innovations, particularly in the services sector, can be considered quite short. So, it does not turn out easy to infer some kind of dynamic trends in the countries under analysis, as most of them only collect data for one (or two) of the surveys considered in the paper. Accordingly, it becomes necessary to follow the tendencies to be evidenced by this indicator and the possible relationship it might have with the introduction of new product innovations in the market, which is our next indicator.

4.3.- Share of firms that have introduced new to the firm products

Focusing on product innovation, the CIS survey considers two alternatives: new to the firm, and new to the market products. The following two sub-sections will be devoted to the study of product innovations, accounting for the percentage of firms that have introduced these new to the firm/new to the market products. While the former measures the development of products that could already be found on the market by competing firms, the later accounts for more innovative products, those introduced for the first time in the market and that could hence be considered as new to the world products.

[22] Concerning the service sector, the pattern is replicated.

Table 3.- Enterprises that have new or significantly improved products only new to the firm (% of enterprises with innovation activities)

	Total industry (excluding construction)		Services	
	CIS IV	CIS 2006	CIS IV	CIS 2006
Belgium	20	19	12	10
Czech Republic	12	14	14	9
Denmark	22	16	6	19
Germany	24	24		
Estonia	3	7		
Greece	5	15		11
Spain	15	22	8	13
France	21		18	
Ireland	4	17		
Italy	25	23	16	20
Cyprus	27	3	10	4
Latvia		26		
Lithuania	9	8	15	17
Luxembourg	18	4	2	3
Hungary	26	25	20	18
Malta	7	9	5	16
Netherlands	14	6	7	
Austria	11	10		7
Poland	23	18	19	15
Portugal	19	20	17	14
Slovenia	6	5	11	5
Slovakia	17	21	9	8
Finland	8	13		
Sweden	16	12	3	6
United Kingdom	1			
Bulgaria	10	11	13	12
Romania	2	1	1	2
Norway	13	2	4	1
n	*27*	*26*	*20*	*20*

Source: own elaboration from CIS IV and CIS 2006. Science, Technology and Innovation Database (Eurostat).

In relation to the manufacturing sector, the UK (CIS IV[23]) and Romania (CIS 2006) are the leading countries for this indicator. A high degree of volatility is observed in this particular indicator, with most countries changing their relative positions to a high extent

[23] Due to the lack of continuity given to this measure in the UK it is not possible to track its evolution, nor its comparison with the service sector.

in the two CIS data are available for. This somehow hinders the possibility to reach solid conclusions about national performance. However, some interesting cases can be observed. On the one hand, Estonia, Lithuania, Malta and Slovenia show a remarkable stability, achieving appealing values that clearly show the potentiality of growth of these countries (Leskovar-Spacapan and Bastic, 2007; Heindenreich, 2009; Krammer, 2009). Firms in these countries seem to be more concerned with the development of their respective national markets rather than engaging in global competition (see next sub-section). On the other hand, countries like Belgium, Denmark, Germany, Spain, France, Italy, Hungary, Poland, Portugal and Slovakia show particularly low values which either might either illustrate a lack of interest towards innovation in industrial firms or a higher focus in new to the market products due to the development stage of the national economies (see next sub-section).

Romania (CIS IV) maintains its leading position in the service sector jointly with Norway (CIS 2006), which shows an interesting balance between the two sectors on its economy (Castellaci, 2008). These countries are followed by economies such as Luxembourg and Sweden, whose innovative activities seem to be more service rather than industry oriented according to the data collected. Quite the opposite direction is observed in economies such as Italy, Lithuania, Hungary, Poland and Portugal, who even if mostly sustain a better relative position than in the manufacturing sector, still show a poor performance.

According to this indicator, two possible paths can be distinguished: those countries whose firms are not engaged in the development of innovative products and processes and those who follow a global strategy of developing new to the market products and competing in the global scene. Consequently, the results obtained with this indicator need to be complemented with the following one concerning the share of firms introducing new to the market products.

4.4.- Share of firms that have introduced new to the market products

Ireland (CIS IV) and Malta (CIS 2006) are the countries with a better performance for this indicator in the manufacturing sector. The volatility effect already pointed out in the previous sub-sections is also present here. As a matter of fact, Malta changes its relative position from being 26th (out of 28) in CIS IV to attain a leading position in CIS 2006. Something similar is also found in the cases of Luxembourg and Bulgaria. Greece, Netherlands, Austria, Finland and Sweden show quite stable patterns, being their firms characterized as being innovative, not in the national scene, but in the global. These results are confirmed when comparing the performance of these countries with the previous indicator. The opposite situation is found in the cases of Spain, Italy, Cyprus, Hungary, Portugal and Norway who perform quite low for this indicator. This in a sense confirms the abovementioned hypothesis according to which the countries with a strong research base are more eager to produce new to the market products, while those with a higher absorptive capacity but a lower research focus are keener on producing new to the firm products in a more efficient way (Zabala-Iturriagagoitia et al., 2007b).

However, the cases of Romania and Germany are worth of being highlighted. According to the % of firms introducing new to the firm products, Romania was considered as one of the leading countries in this dimension (see table 3). However, its performance for the introduction of new to the market products has nothing to do with the aforementioned. This visibly shows the concern of Romanian firms on in-house competition, without too much focus on the global market (Borrás and Tsagdis, 2008b). In the case of Germany an interesting scheme is found (which is also replicated in some other countries – see next sub-section). As noticed, according to the available data, German firms are not characterized by being really eager on introducing new products (new to the firm/new to the market). However, when the turnover due to these products is considered (for both categories), German firms are very well positioned. This in fact illustrates the orientation of the German economy with few firms introducing new products on the market, but having a great impact on it. As said, this point will be further detailed in the following two sub-sections.

Table 4.- Enterprises that have new or significantly improved products new to the market (% of enterprises with innovation activities)

	Total industry (excluding construction)		Services	
	CIS IV	CIS 2006	CIS IV	CIS 2006
Belgium	15	13	10	8
Czech Republic	14	11	11	17
Denmark	8	16	8	15
Germany	21	18		
Estonia	19	24		
Greece	9	3		4
Spain	27	27	19	20
France	12		15	
Ireland	1	10		
Italy	24	21	18	19
Cyprus	28	15	20	14
Latvia	18	8		
Lithuania	16	19	13	9
Luxembourg	13	2	3	1
Hungary	20	22	12	13
Malta	26	1	14	5
Netherlands	4	6	7	
Austria	5	7		7
Poland	11	20	4	12
Portugal	23	25	17	16
Slovenia	10	5	6	3
Slovakia	17	14	5	11
Finland	3	9		
Sweden	6	4	2	2

United Kingdom	7	23		
Bulgaria	2	12	1	10
Romania	25	26	16	18
Norway	22	17	9	6
n	*28*	*27*	*20*	*20*

Source: own elaboration from CIS IV and CIS 2006. Science, Technology and Innovation Database (Eurostat).

As regards the service sector, Bulgaria (CIS IV) and Luxembourg (CIS 2006) are the leading countries, followed by Sweden. In general terms, the results observed in the manufacturing sector are also replicated in the services for most countries. However, some exceptions come forward, such as those in Hungary and Slovakia, who seem to be much more oriented towards a service economy (at least as regards innovative products, both new to the firm and new to the market) rather than having an strong industrial base. However, the most prominent case is that of Norway. This is in line with the results observed in the previous sub-section dealing with the introduction of new to the firm products, according to which, Norway seems to be more oriented towards the development of new (innovative) services. Concerning the introduction of new to the firm goods, the performance of Norwegian firms was quite similar, and could even be argued that in that dimensions Norwegian enterprises operate quite fine. However, when it comes to new to the market goods, the differences between the two sectors illustrate the particularities already addressed by Castellaci (2008) about the Norwegian economy; that is, an economy characterized by firms developing new to the firm products but whose competitiveness in the global market can be considered as quite low. This will be further elaborated when studying the turnover due to new to the firm/new to the market products.

4.5.- Turnover of new or significantly improved products as a share of total turnover (new to the firm)

One of the indicators that from our point of view better describes the output orientation of a national innovation system is that concerning the *turnover* (% of total turnover) *produced due to new or significantly improved goods*, both *new to the firm* (table 5), and especially *new to the market* (table 6).

As regards the first of these two measures, most countries vary a lot their relative positions. Maybe the only exception to this general pattern might be Germany, who keeps a constant path. The leading countries are France (CIS II), Germany (CIS III), Malta (CIS IV) and Romania (CIS 2006). As we illustrated in the previous sub-sections the case of Germany deserves some particular focus. According to the share of firms introducing new products (either new to the firm or to the market) the German context cannot be portrayed as been particularly optimistic. However, in terms of turnover these firms achieve significant results, particularly concerning the introduction of products which are new to the firm. These results confirm the orientation of the German economy towards few multinational corporations but whose products have a great impact on the market. A similar case to Germany seems also to be found in Spain, while the opposite is the case

for Norway. In the Norwegian case, it is possible to find many more enterprises introducing new to the firm products, but this is not reflected in the share of the turnover due to innovative products neither in terms of new to the firm nor new to the market. The case of Finland is also quite illustrative. According to the available data, Finland performed really well for this indicator during CIS II and CIS III to then dramatically drop to shoddier positions in CIS IV and CIS 2006. However, as we will see in the next sub-section the Finnish innovation system is really well positioned as regards the turnover due to new to the market products. The Finnish economy can be considered as a small unit, so their firms have to adopt a global perspective, and accordingly, their products, new to the market (Kaitila and Kotilainen, 2008).

In spite of the fact that the data availability for this indicator is much lower in the service sector, the aforesaid trend is replicated to some extent in the service sector, where Greece (CIS III), Luxembourg (CIS IV) and Romania (CIS 2006) are the leading countries. Greece and Romania manage to keep almost a constant position in the three periods covered, while in the case of Luxembourg its relative positions are more altered. This shifting pattern is also observed in some other countries as Belgium, Denmark, France and Slovenia. Finally, the cases of Bulgaria and Spain are worth to mention. As already noticed in the manufacturing sector, Spanish firms perform surprisingly well for this indicator, which could not be expected considering according to the results in the previous sub-sections. But not only do Spanish firms achieve positive results in the manufacturing sector but also in the services one, which from our point of view could be affected to a great extent by the boom of the building sector during last years and the expansion of the tourism (Molina-Azorin et al., 2009).

Table 5.- Turnover of new or significantly improved products as a share of total turnover (new to the firm)

	Total industry (excluding construction)*				Services			
	CIS II**	CIS III	CIS IV	CIS 2006**	CIS II**	CIS III	CIS IV	CIS 2006**
Belgium	8	10	4	15	-	3	8	11
Czech Republic			9	18	-		9	15
Denmark	6	7	10	11	-	6	13	18
Germany	9	1	2	3	-	9		
Estonia			3	10	-			
Greece		9	16	13	-	1		3
Spain	13	5	8	5	-	2	2	4
France	1	11	12		-	7	16	
Ireland	10		15	21	-			
Italy	4	2	22	19	-	4	7	14
Cyprus			28	9	-		11	6
Latvia			27	26	-			
Lithuania			17	4	-		14	17

Luxembourg		12	6	23	-	13	1	7
Hungary			25	25	-		20	19
Malta			1	20	-		18	16
Netherlands	7	6	19	16	-	10	15	
Austria	12	8	18	14	-	11		8
Poland			13	12	-		17	10
Portugal	2	4	21	8	-	8	10	13
Slovenia			11	7	-		19	9
Slovakia			14	2	-		12	5
Finland	3	3	20	22	-	5		
Sweden	11		23		-		5	
United Kingdom	5		7	6	-			
Bulgaria			26	24	-		4	2
Romania			5	1	-		3	1
Norway	14	13	24	17	-	12	6	12
n	*14*	*13*	*28*	*26*	-	*13*	*20*	*19*

Notes:
** The data for CIS II correspond only to the manufacturing sector within the whole industry sector*
*** The data for CIS II and CIS 2006 correspond to the relative value, relating to all enterprises*

Source: own elaboration from CIS II, CIS III, CIS IV and CIS 2006. Science, Technology and Innovation Database (Eurostat).

4.6.- Turnover of new or significantly improved products as a share of total turnover (new to the market)

Concerning the *new to the market goods and services* (table 6) the same degree of heterogeneity as in the previous indicator is observed, being Italy (CIS II), Finland (CIS III) and Malta (CIS IV, CIS 2006) the leading countries in the industry sector. Indeed, Malta and Finland sustain quite regular their relative positions in time, but the Italian case clearly manifests the decreasing tendency shown by national enterprises regarding innovative products[24]. This decrease is also replicated in some of the countries considered like Belgium, Spain, France, Ireland, Netherlands, Austria, Poland, Slovenia and Romania. On the other hand, there are also countries improving their relative positions such as Greece, Hungary and Bulgaria.

As regards the service sector, Greece (CIS III), Slovakia (CIS IV) and Malta (CIS 2006) are the top ranked countries for the three periods covered by the available data for this indicator. From our point of view, the case for Malta is also illustrative of the tourism

[24] Note that the same tendency was also replicated for the turnover due to new to the firm products, where Italy drops radically from CIS III to CIS IV.

orientation already mentioned for Spain, who is also performing quite well in this indicator (with the exception of CIS IV). As can be noticed, most countries do not perform in a constant manner, being possible to find cases in which the relative performance is improved (i.e. Cyprus, Luxembourg, Hungary, Romania) or worsened, case of Belgium, Denmark, Italy, Lithuania or Poland.

Table 6.- Turnover of new or significantly improved products as a share of total turnover (new to the market)

	Total industry (excluding construction)*				Services			
	CIS II*	CIS III	*CIS IV*	*CIS 2006***	CIS II*	*CIS III*	*CIS IV*	*CIS 2006***
Belgium	14	9	16	24	-	7	14	13
Czech Republic			10	4	-		7	7
Denmark	11	4	11	13	-	6	15	18
Germany	12	7	7	8	-	8		
Estonia			25	25	-			
Greece		11	20	2	-	1		2
Spain	2	5	18	15	-	2	19	5
France	3	6	13		-	9	12	
Ireland	4		8	12	-			
Italy	1	3	19	22	-	4	5	16
Cyprus			26	20	-		18	10
Latvia			27	23	-			
Lithuania			24	10	-		3	17
Luxembourg		12	23	21	-	13	4	9
Hungary			21	9	-		11	6
Malta			1	1	-		20	1
Netherlands	5	10	17	14	-	12	16	
Austria	10	8	15	16	-	10		15
Poland			4	18	-		8	14
Portugal	6	2	22	6	-	5	10	12
Slovenia			6	17	-		6	11
Slovakia			3	7	-		1	4
Finland	7	1	2	5	-	3		
Sweden	8		5		-		9	
United Kingdom	9		14	11	-			
Bulgaria			12	3	-		2	8
Romania			9	19	-		13	3
Norway	13	13	28	26	-	11	17	19
n	*14*	*13*	*28*	*26*	-	*13*	*20*	*19*
Notes:								

** The data for CIS II correspond only to the manufacturing sector within the whole industry sector*
*** The data for CIS II and CIS 2006 correspond to the relative value, relating to all enterprises*

Source: own elaboration from CIS II, CIS III, CIS IV and CIS 2006. Science, Technology and Innovation Database (Eurostat).

4.7.- Organizational and marketing innovations

The last indicator we will focus upon in this paper is that related to the *share of firms that have introduced organizational and marketing innovations* (see table 7). During the last decade, and due to the emergence of knowledge management systems, new organizational routines, and changing patterns in the distribution methods, other kinds of innovations have been given special consideration in the literature, in particular those related to new ways of organizing and commercializing innovations (Armbruster et al., 2008; Bender, 1989). These indicators were introduced for the first time in the CIS IV, so it is not possible to observe any real temporal trend for the countries considered.

In the manufacturing sector, Ireland was the leading country for this dimension in CIS IV, followed by Luxembourg, Denmark, Cyprus and Germany[25]. Then, for CIS 2006, Greece was the leading country followed by Germany, Cyprus, Malta and Portugal. The latter two countries improved to a great extent their relative position in comparison with that attained in CIS IV, while Cyprus and Germany maintain their relative positions quite constant. As regards the services sector, Denmark, Luxembourg, Cyprus and Portugal were among the top ranking countries in both periods, being the trends observed quite constant for most countries.

Table 7.- Enterprises introducing organisational and/or marketing innovations (% of enterprises with innovation activities)

	Total industry (excluding construction)		Services	
	CIS IV	CIS 2006	CIS IV	CIS 2006
Belgium	15	15	10	
Czech Republic	12	16	8	10
Denmark	3	9	1	7
Germany	5	2		

[25] The CIS IV also accounts for the "enterprises that introduced organizational innovations" and the "enterprises that introduced marketing innovations" as two different variables. However, since the CIS 2006 does not make this distinction, in order to make the two surveys comparable, we have decided to skip this decomposition for CIS IV. Just mention that most countries do not show a balance between the two categories of innovations, being either positioned very well for organizational innovations and bad for the marketing ones (i.e. Denmark, Germany, Luxembourg, Portugal), or the opposite (case of Greece, Cyprus, Malta or Bulgaria).

Estonia	7	14		
Greece	11	1		
Spain	20		16	
France	16		6	
Ireland	1			
Italy	21		14	
Cyprus	4	5	5	3
Latvia		18		
Lithuania	9	11	7	5
Luxembourg	2	6	2	2
Hungary	19	12	13	11
Malta	14	3	9	4
Netherlands	22	19	17	
Austria	6	7		6
Poland	8	13	12	8
Portugal	10	4	3	1
Slovenia		8		
Slovakia	18		15	
Finland				
Sweden				
United Kingdom				
Bulgaria	23	20		12
Romania	13	10	4	9
Norway	17	17	11	
N	*23*	*20*	*17*	*12*

Source: own elaboration from CIS IV and CIS 2006. Science, Technology and Innovation Database (Eurostat).

Along this section we have studied the performance of a set of European countries concerning seven outputs dimensions of their respective national innovation systems. As manifested in the previous sub-sections the degree of stability observed in most countries is really low. Accordingly there is strong a great margin for improvement in their national innovation policies, so as to achieve a sustainable and stable innovation system. In spite of this general trend, and according to the data availability, it has been possible to illustrate some national peculiarities. Some countries are more oriented towards developing product innovations, others instead adopt a process innovation strategy, some focus on adopting the products already in the market using the competences in their national economies and exploiting their absorptive capacity, while others develop more radical innovations. In addition, and as a general comment we have observed that the amount of observations decreases particularly when it comes to the service sector. In this sense, we consider that especially due to the increasing weight adopted by the service sector is most economies, the data acquisition in this sector should be made more thorough.

5.- Conclusions and further work

In this paper we have addressed the topic of the outputs that better characterize an innovation system based upon available statistics. Particularly, we have used the data provided by the Community Innovation Surveys for European Countries from 1996 (CIS II) to 2006 (CIS 2006) focusing on seven indicators. As discusses in the conceptual framework (section 2) is becomes necessary to differentiate between the inputs of innovation, its determinants, the innovation outputs and their impact. In this case, we have adopted an output view within the innovation systems literature, being our goal to contribute to the literature dealing with the science, technology and innovation indicators in order to make the analysis of an innovation system as thorough and robust as possible. With this contribution we do not aim at offering a taxonomy of innovation systems, a topic that has already been addressed in the literature. In order to accomplish that, we consider that the output approach followed in this paper should be complemented with an input view, also covering the determinants for the development and diffusion of innovations. In fact, this constitutes a matter of further work.

Despite the analysis only comprises European countries, we believe that an interesting line of research could be based on following the approach provided in this paper in those developing countries that are already concerned with the collection of science and technology indicators, and the development of their own innovation systems, as it is the case in many Latin American, African and Asian economies.

As we have pointed out in the paper, the available indicators offer also information concerning firm size and various activities (NACE codes) within the industry and service sectors, which have not been addressed in this paper, and constitute a line for further work to be accomplished. Our view is that when considering size differences, the performance for the different countries might be more comprehensive and their main economic sectors will be better characterized. Another possible line of research might be the comparison of our results with the rankings provided by other different scoreboards such as the European Innovation Scoreboard or the Global Innovation Index to mention a few, what might set the basis for arguing about the accuracy of scoreboard or composite indicators.

Another interesting line of research that we consider might provide many interesting conclusions, especially for policy-makers, deals with the balance between the different dimensions (outputs in the case of this paper) of an innovation system. In this sense, we consider the contribution of Arundel and Hollanders (2008) as being particularly interesting, since it can help territories to find those benchmarks they can learn from according to their structural similarities/failures. However, we do not want to overvalue the information that can be obtained from these empirical analyses in order to support policy-makers. Indeed, we believe that innovation related indicators "could provide the first line of defence in an ongoing evaluation of the effectiveness of science and technology policy" (ibid, 39). That is, indicators might me helpful in the identification of systemic failures, but in order to define, implement and evaluate a successful innovation policy, more in-depth investigations will be required, either based on case studies or

specialized surveys. Actually, as claimed by Arundel et al. "the CIS will always have serious limitations for policy development. Due to the need to keep the questionnaire short and understandable, the CIS cannot go into the necessary level of depth for many policy questions" (2008, 23). So, we claim, for a balance between the quantitative and qualitative approaches.

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Appendix 1.- Key Activities in Innovation Systems (Edquist, 2005)

I. Provision of knowledge inputs to the innovation process

1. Provision of R&D and, thus, creation of new knowledge, primarily in engineering, medicine and natural sciences.

2. Competence building, e.g. through individual learning (educating and training the labour force for innovation and R&D activities) and organisational learning.

II. Demand-side activities

3. Formation of new product markets.

4. Articulation of quality requirements emanating from the demand side with regard to new products.

III. Provision of constituents for Innovation Systems

5. Creating and changing organisations needed for developing new fields of innovation. Examples include enhancing entrepreneurship to create new firms and intrapreneurship to diversify existing firms; and creating new research organisations, policy agencies, etc.

6. Networking through markets and other mechanisms, including interactive learning among different organisations (potentially) involved in the innovation processes. This implies integrating new knowledge elements developed in different spheres of the SI and coming from outside with elements already available in the innovating firms.

7. Creating and changing institutions – e.g., patent laws, tax laws, environment and safety regulations, R&D investment routines, cultural norms, etc. – that influence innovating organisations and innovation processes by providing incentives for and removing obstacles to innovation.

IV. Support services for innovating firms

8. Incubation activities such as providing access to facilities and administrative support for innovating efforts.

9. Financing of innovation processes and other activities that may facilitate commercialisation of knowledge and its adoption.

10. Provision of consultancy services relevant for innovation processes, e.g., technology transfer, commercial information, and legal advice.

Appendix 2.- List of possible indicators to be considered as an output of IS

Indicator	Collected for	Categories
Number of enterprises with innovation activity (percentage relative to all enterprises)	CIS II CIS III CIS IV CIS 2006	- by NACE - by firm size - by: o innovating firms o product only o process only o product and process
Enterprises with product and process innovation (percentage relative to all enterprises)	CIS II CIS III CIS IV CIS 2006	- by NACE - by firm size - by: o innovating firms o product only o process only o product and process
Turnover of new or significantly improved products as a share of total turnover (new to the firm)	CIS II CIS III CIS IV CIS 2006	- by NACE - by firm size - by: o innovating firms o product only o process only o product and process
Turnover of new or significantly improved products as a share of total turnover (new to the market)	CIS II CIS III CIS IV CIS 2006	- by NACE - by firm size - by: o innovating firms o product only o process only o product and process
Total innovation expenditure	CIS II CIS III CIS IV CIS 2006	- by NACE - by firm size
Innovation expenditure by type of activity (share of total	CIS II	- by NACE

turnover)	CIS III CIS IV CIS 2006	- by firm size - by: o intramural R&D o extramural R&D o acquisition of machinery o external technology/knowledge acquisition
Number of innovating firms considering the following goals very important (relative to innovative firms)	CIS II	-by: o reduce environmental damage o extend product/service range o improve product/service quality o reduce labour costs o reduce material consumption o reduce energy consumption o open new markets/increase market share o improve production or internal business process flexibility o replace products/services o fulfil regulations and standards
Highly important effects of innovation	CIS III CIS IV CIS 2006	- by NACE - by firm size - by: o increased range of goods and services o entered new markets or increased market share o improved quality in goods and services o improved flexibility of production or service provision o increased capacity of production or service provision o reduced labour costs per unit output o reduced material and energy per unit output o reduced environmental impacts or improved health and safety o met regulation requirements o reduced time to respond to customer/supplier needs o improved quality of goods and services o reduced costs per unit output o improved employee satisfaction and/or reduced rates of employee turnover

Basic economic information on the enterprises	CIS IV CIS 2006	- by NACE - by firm size - by: o total turnover o total nº of employees
Innovation cooperation (% of enterprises with innovation activities)	CIS II CIS III CIS IV CIS 2006	- by NACE - by firm size - by: o all types of cooperation o other enterprises within your enterprise group o suppliers of equipment, materials, components or software o clients or customers o competitors or other enterprises of the same sector o consultants, commercial labs, private R&D institutes o universities or other higher education institutions o government or public research institutions
Organizational and marketing innovations (percentage of enterprises with innovation activities)	CIS IV CIS 2006	- by NACE - by firm size - by: o organizational innovations o marketing innovations o organizational and marketing innovations

Source: own elaboration