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Outputs of innovation systems: a European perspective

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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). Several studies have proposed methodologies/composite indicators for the measurement of the innovative capacity (Zabala-Iturriagagoitia et al., 2007a; OECD, 2009; Nordic Innovation Monitor, 2009). 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, etc.- (Katz, 2005). In the literature there 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 from an output standpoint. This is precisely our major target; to propose a set of indicators that could help in the characterization of IS from the output side, offering thus policy makers a tool to identify policy failures.

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 (OECD, 2009). 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 innovation systems 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 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 IS 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

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. They represent the commercialization of innovation activities and their introduction in the firms´ markets. On the other hand, *process innovations* are new ways of producing goods and services, being technological, organizational, managerial, marketing oriented, etc. They involve improvements in firms´ internal processes, either through the adoption of new technologies or in-house development (Edquist and Hommen, 2008b: 8; OECD, 2009: 25).

The main purpose of an innovation system 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 IS. 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. These determinants (or activities) represent those factors that influence, support, ease and promote the development of innovation processes within the IS. The four categories of determinants of innovation processes are: (i) provision of knowledge inputs to the innovation process, (ii) demand-side activities, (iii) provision of constituents of IS, and (iv) support services for innovating firms[1]. It is necessary to state that public innovation policy is an element of all the ten activities considered in these categories.

2.2.- Measurement of innovation output

This then brings us to talk about the determinants of innovation, the inputs of innovation, outputs of innovation and their impact. These are different things, even if they are interrelated (Brown and Svenson, 1999; OECD, 2009), and it is important to distinguish among these categories to achieve some clarification. 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 (Pedersen, 1977)[2]. 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

[1] A similar contribution of the factors influencing innovation output can also be found in Brenner and Broekel (2009).

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

are different from innovations as such or the determinants of innovations (Rondé and Hussler, 2005).

During last years, and as a 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). Several related concepts have come out regarding the propensity of territories to innovate, such as "innovative capacity", "innovation potential", "innovation capabilities" or "innovativeness" (Mairesse and Mohnen, 2002; Zabala-Iturriagagoitia et al., 2007a; Nordic Innovation Monitor, 2009). 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 which are the inputs of an IS and what is the contribution of particular spatial units towards the achievement of certain outputs. In this particular paper, our focus is on the outputs of an IS, and the measurements of these.

There are different ways in which innovation performance can be defined and measured[3]. However, there is a lack of consensus regarding the definition of performance in the literature (Lebas, 1995). According to Spronk and Vermeulen (2003: 482) "performance refers to the result(s) of an activity (or set of activities)", that is to the results achieved once the activity has taken place, or within the IS framework, as we suggested above 'what comes out of the system'. However, there appears to be general support "to the premise that all performance evaluations involve comparisons" (Mersha, 1989: 163). Since the performance of an IS can be regarded as the outputs of the system, it might be expected that the different methodologies and proposals raised concerning the measurement of performance should address the issue of IS outputs. However, this is not the case. Indeed, most of the existing methodologies do not thoroughly cope with the consideration of the outputs of an IS. For example, the OECD (2009) presents a set of 20 key indicators of innovation performance across five dimensions – technological innovation (5 indicators), non-technological innovation (3), innovation input (4), innovation output (2) and key policy relevant characteristics (6) -. As to the Nordic Innovation Monitor (2009), it consists of two composite indicators oriented towards the measurement of performance and framework conditions. According to it, performance is regarded as output, while framework conditions are related to the drivers or determinants of innovation. The performance related composite index covers 9 areas using 30 indicators while the framework conditions are measured using 135 indicators across 42 policy areas. However, there is no specific discussion on appropriate output indicators.

The literature in this sense shows some scepticism as to the adequacy of some of the indicators considered as appropriate for the characterization of IS´ performance (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

[3] 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.

factors, such as patents or publications (Arundel et al., 2008)[4], and which might (or not) play a role in the accomplishment of innovative products and processes (Grupp, 1998: 143). The IS should 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.

From the above picture the need for the consideration of proper IS output indicators can be concluded (Godin, 2002; Ertl et al., 2006). In this regard, the OECD (2009: 32) declares that "it may… be more appropriate to focus more on output indicators when measuring innovativeness". Similarly, the Nordic Innovation Monitor (2009: 12) considers that "a key challenge is how to calculate the value created from innovation [as] no direct measure is available". Accordingly, they consider there is a strong "interest in developing the indicators required to make fact-based policy on new innovation trends and the output measures" (ibid: 9). With this paper we aim to shed some light on the characterization of IS from an output perspective.

2.3.- The importance of a comparative perspective

One of the main rationales for pursuing *comparative* studies regarding the performance of particular innovation systems 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 certain innovation intensity is high or low in a concrete system if there is no comparison with those 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 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

[4] 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).

countries and over time" (2008: 16), we will try to cover both aspects, comparing the performance of different European countries among themselves at different points in time, offering thus a dynamic approach to the analysis of the performance of IS.

As illustrated above, the performance of an IS can be measured by means of the proclivity to innovate, also referred to in the literature as innovation intensity. Ideally, these intensities should be known for many specific categories of innovations. If they 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. 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 policies (Frenken et al., 2007). They will have to be discussed in a pragmatic way from case to case (Pennisi and Scandizzo, 2006; Borrás, 2009;). 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 and composite indicators can be found (Zabala-Iturriagagoitia et al., 2007a; Arundel and Hollanders, 2008; Archibugi et al., 2009). 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, the Nordic Innovation Monitor and the Word Economic Forum Competitiveness Index among others[5]. 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 terms of innovation output in Europe.

A diverse set of contributions can be found in the literature exploiting the results of the CIS (Laursen and Salter, 2006). Let us list a number of them:

- 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 innovating firms, the

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

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[6].
- 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 the 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[7].
- 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

[6] The results section (section 4) will offer the definitions of the main indicators considered in this paper.

[7] 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.

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.

- Raymond et al. (2009) provide some insights into the dynamic relationship between innovation input and innovation output in Dutch manufacturing using data from the Dutch CIS between 1994-2004.

As can be noticed, most contributions explore particular determinants of innovation performance (like cooperation, absorptive capacity, spillovers, etc.) using a concrete CIS for a particular country in a particular period of time, or using a concrete CIS for making comparative analyses across countries during the time period covered by the CIS under consideration (OECD, 2009). Conversely, our contribution focuses on several CIS and different European countries, so as to identify the 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[8], 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[9]. Similar innovation surveys based upon the guidelines established in the Oslo Manual have also been conducted in other OECD countries (OECD, 2009). For this reason, we consider that the proposal raised in this paper might be complemented with data from other non-European countries.

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). The CIS defines product innovations as "introduced new good or service or a significantly improved good or service with respect to its capabilities" (ibid). Process innovations are "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 introduce new or

[8] Some contributions in this sense can be found in Edquist and Hommen (2008a) where the determinants of innovation in ten different countries are illustrated.

[9] 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.

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

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[10]) and the size of the firms considered (Arundel et al., 2008). As a result, the evolution of some indicators, countries and sectors over time is a complicated issue to study.

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[11]. It is regarding the NACE sectors considered where the different surveys differ more among themselves (see Appendix 3). In fact, the comparison of the diverse NACE activities may become a bit delicate as the sectors included in the CIS change from period to period. Due to the differences in the sectoral coverage and space limitations, in this paper, we will not consider the firm size and the different NACE sectors, which is a matter of further work. We will just focus upon the main differences between the manufacturing (NACEs C, D and E) and service sectors (NACEs G to K) (OECD, 2009).

In addition to the integration of new sectors in the survey, some other differences among the CIS can also be found. That way, the main differences between CIS II and CIS III are mainly based on a lower cut-off for inclusion in the target population, the use of the same core questionnaire for both manufacturing and services firms and the compilation of additional information on both innovators and non-innovators (Eurostat, 2009). As regards the comparability between CIS III and CIS IV, the CIS IV questionnaire was shorter than the CIS III questionnaire previously used. In addition, CIS IV implemented for the first time questions concerning organisational and marketing innovations and their effects (ibid). Finally, as regards the variation between CIS 2006 and CIS IV, just mention that few modifications were incorporated, some concerning the addition of pilot questions expanding the coverage of marketing and organizational innovations and an additional breakdown as to the R&D status of the firm.

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[12]. The data have been collected from the Eurostat database on science, technology and innovation[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 exclusively those indicators related to the outputs of an IS. Hence,

[10] NACE stands for "Nomenclature générale des activités économiques dans les Communautés Européennes", a standard for classifying economic activities in the EU.
[11] CIS I only considered firms with 10 – 249 employees.
[12] The reason why we have excluded the data from CIS I in the analysis is related to the fact that the only indicators available are those concerning the turnover of new or significantly improved products.
[13] http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database

we will select a few of the many indicators included in the surveys. 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 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)[14]	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)[15]	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 contribution of 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 in Europe (Borrás and Tsagdis, 2008a).

4.- Results

[14] We consider that an indicator that may require further consideration is the one concerning the number of innovative products introduced in the market. In this sense, countries such as Finland, Sweden and Denmark have registered the new products introduced in their SFINNO database of Finnish innovations, XXX and XXX databases respectively. However, since no record has been found in the other countries considered in the analysis, this indicator cannot be used in order to make comparative benchmark studies.

[15] As 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.

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. Each subsection will begin with a short introduction to the indicator devoted. We will thus illustrate how the CIS questionnaire explicitly formulates the questions concerning the indicators included in our 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 may be helpful in order to influence each innovation system according to the particular targets or objectives defined by the respective innovation policies.

As mentioned in the previous section, the CIS is in continuous development. This is a positive sign, as different aspects of innovation that were not conceived before are being given increasing attention. However, as seen, 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 among CISs. Accordingly, and in order to avoid misunderstanding, in the following sections we will not indicate the values achieved by each country for each indicator[16], but the relative position occupied by them. The main aim in this paper is to help to identify those areas or dimensions where the countries included in the analysis lack certainly results, but not to target the values for each country in every indicator, i.e. identify policy failures or areas with further performance needs. This is of course a matter of national innovation policies and the particular goals stated on them. In order to accomplish this target and contribute to international benchmark comparisons on innovation (Arundel and Hollanders, 2005; OECD, 2009) we truly believe that using rankings instead of focusing on particular targets or values to be achieved may allow countries to benefit "from learning from each other when trying to improve their national innovation capacity" (Nordic Innovation Monitor, 2009: 60).

4.1.- Enterprises with product innovation

On the section regarding product innovation (good or service), the CIS questionnaire formulates whether the firm has introduced a new or significantly improved good or service during the last three years[17]. If the answer to any of the two (introduction of a new good, introduction of a new service) is positive, then it asks "who developed the product innovations?" (Community Innovation Statistics, 2006: 9) 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 (ibid). From our point of view, the differences between the second and third choices are not that straightforward though. What does the questionnaire exactly mean by 'mainly', and what does it imply? Accordingly, in the case of the third

[16] 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.

[17] "The simple resale of new goods purchased from other enterprises and changes of a solely aesthetic structure" are excluded (Community Innovation Statistics, 2006: 9).

alternative, to what an extent has the firm answering the survey been involved in the product innovation process? Which is then the role of the firm in this third category, subcontracting, buying a patent, licensing it, etc.? We find these differences unclear in the questionnaire, and for the sake of clarification, we consider that a more clear definition of these different categories becomes necessary.

In order to quantify for product innovation (table 1), and since the differences between the three categories are not that clear-cut, we account for the three possibilities given by the questionnaire[18]. 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. However, this might be affected by the ambiguity of the 'mainly' term used. 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. This are the mean reasons why we have decided to account for product innovations developed in cooperation, regardless the extent of the 'mainly'.

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 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 other countries (see for example Greece, Lithuania Poland, Portugal and Romania). On the other hand, we also find some countries performing quite stably over time, though with different profiles, such as Belgium, Czech Republic, Estonia, Cyprus, Austria, Slovakia, Finland and Sweden. This raises some initial doubts about the inconsistency over time of CIS data on this level of aggregation. 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) show a noticeable increase/decrease in the relative position when it comes to CIS IV. We don't know the reasons for this steep peak/deep change in the performance, but this is a perceptible switch to take into account.

A similar trend is also observed when we move to the products developed in cooperation with other firms and institutions. Austria (CIS II), the Netherlands (CIS III and IV) and Cyprus (CIS 2006) are the leading countries, where a high degree of instability is detected (i.e. Czech Republic, Cyprus, France, Luxembourg, Slovakia). Finally, Belgium (CIS II), the Netherlands (CIS III), Hungary (CIS IV) and Germany (CIS 2006) lead regarding the products developed mainly by other firms or institutions, where the

[18] The OECD Innovation Microdata Project (OECD, 2009: 47-48), which uses data from the CIS IV does neither specify whether the firms introducing a product/process innovation do it in cooperation with other firms or institutions or not. We consider it refers to the product/process developed mainly by enterprise or group category, but it is still unclear.

unsteadiness of the data are once more corroborated (e.g. Belgium, Denmark, Spain, France, the Netherlands, Norway).

From our viewpoint, and as regards the products developed mainly by the enterprise/group, 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 should be related to the efforts made by the Irish government towards supporting the development of innovative activities among national firms (Cogan and McDevitt, 2000; Roper et al., 2002). However, when it comes to the products developed in cooperation Irish firms loose ground, quite the opposite to Finnish firms. This may reflect the small scale of the Finnish economy, which lead their firms to be open to cooperative agreements with other firms and institutions.

With regard to the *services* sector Luxembourg leads in the share of firms that have developed new services for all the period considered (with the exception of Ireland for CIS II). Finland, Sweden, Norway and Greece are also ranked high and with quite constant rankings. The cases of Belgium, Netherlands and Austria can be quite illustrative of the swift and increasing change towards a service-oriented economy (Tödtling and Traxler, 1995; Boschma, 1999; de Jong and Marsili, 2006; OECD, 2009)[19]. On the opposite side we find Bulgaria who modifies its relative position in a rather short period of time[20]. Finally, 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. Concerning the share of firms developing services in cooperation with other firms or institutions, Austria (CIS II), Finland (CIS III), the Netherlands (CIS IV) and Cyprus (CIS 2006) hold a top ranking. This in fact confirms the results also observed in the manufacturing sector for Finland and Cyprus, whose firms were also ranked very high when developing goods in cooperation. Finally, as to the services developed mainly by other firms or institutions Denmark (CIS II), Portugal (CIS III), Malta (CIS IV) and Greece (CIS 2006) are ranked the highest. Compared to the previous categories a slightly higher degree of uniformity is observed, even if some conflicting cases can also be found (e.g. Denmark, the Netherlands, Norway).

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

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

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

	Manufacturing (excluding construction)**											
	Product developed by enterprise or group				Product developed in cooperation with other firms or institutions				Product developed mainly by other firms or institutions*			
	CIS II*	CIS III	CIS IV	CIS 2006	CIS II*	CIS III	CIS IV	CIS 2006	CIS II*	CIS III	CIS IV	CIS 2006
Austria	3	10	7	7	1	8	7	3	2	5	14	2
Belgium	10	11	9	4	10	5	16	9	1	3	15	11
Bulgaria			1	20			17	19			2	
Cyprus			25	22			15	1			21	21
Czech Republic			12	14			3	13			10	5
Denmark	13		21	9	5		10	11	6		22	8
Estonia			6	5			9	7			3	4
Finland	6	6	18	8	2	2	2	4	5	12	24	12
France	5	4	11		3	10	22		8	13	23	
Germany	11	9	14	1	8	6	8	2	9	8	11	1
Greece		3	3	13		14	25	15		11		10
Hungary			17	24			11	18			1	7
Ireland	4		2	3	12		20	12	13		20	3
Italy	1	7	24		11	12	13		11	6	16	
Latvia												
Lithuania			8	19			19	20			13	20
Luxembourg	14	2	13	2	7	7	23	8	12		18	15
Malta			4	10			14	17			9	9
Netherlands	9	5	20	11	6	1	1	6	14	1	8	6
Norway	12	1	15	15	4	4	6	10	3	9	19	16
Poland			10	21			18	21			17	19
Portugal	2	14	22	16	13	11	12	14	7	2	5	14

Romania			5	18			21	22			6	18
Slovakia			23	23			5	16			4	13
Slovenia				12								
Spain		13	19	17		13	24	23		4	7	17
Sweden	8	12	16	6	9	9	4	5	10	10	12	
United Kingdom	15				14				4			
n	*15*	*14*	*25*	*24*	*14*	*14*	*25*	*23*	*14*	*13*	*24*	*21*

	Services											
	Services developed by enterprise or group				Services developed in cooperation with other firms or institutions				Services developed mainly by other firms or institutions			
	CIS II*	CIS III	CIS IV	CIS 2006	CIS II*	CIS III	CIS IV	CIS 2006	CIS II*	CIS III	CIS IV	CIS 2006
Austria	8	11		2	1	4		2	3	7		3
Belgium	13	6	6	4	4	10	16	4	2	2	6	5
Bulgaria			4	16							2	
Cyprus			19	15			2	1			4	14
Czech Republic			10	10			11	9			12	9
Denmark	2		9	5	3		10	13	1		10	13
Estonia												
Finland	7	3			5	1			10	10		
France	3	9	12		2	8	17		12	13	19	
Germany	10	12			7	6			11	12		
Greece		4		6		9		3		14		1
Hungary			14	14			13	10			3	8
Ireland	1				12				6			
Italy		8	18			14	14			5	5	
Latvia												
Lithuania			17	17			5	12			13	15

Luxembourg	6	1	1	1	11	13	3	6	4	11	18	4
Malta			13	18			7	15			1	6
Netherlands	12	10	7		6	2	1		5	3	14	
Norway	5	5	5	7	9	5	9	7	9	6	11	2
Poland			16	13			12	14			7	7
Portugal	11	14	15		10	12	15		7	1	8	
Romania			3	9			8	11			17	10
Slovakia			8	12			6	8			16	11
Slovenia				8				5				
Spain		13	11	11		11	18	16		4	9	12
Sweden	4	7	2	3	8	7	4		13	8	15	
United Kingdom	9				13				8			
n	*13*	*14*	*19*	*18*	*13*	*14*	*18*	*16*	*13*	*14*	*19*	*15*

Notes:
* Relative to product innovators
** The data for CIS 2 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 process innovations (table 2). In the section dedicated to process innovation, the CIS questionnaire formulates if the enterprise has introduced new or significantly improved methods of manufacturing or producing goods or services, new or significantly improved logistics, delivery or distribution methods, or new or significantly improved supporting activities for their processes, such as maintenance systems or operations for purchasing, accounting or computing (Community Innovation Statistics, 2006: 10). As in product innovation, if the answer to any of the three options is affirmative, then it asks "who developed the process innovation" (ibid): (i) mainly your enterprise or enterprise group; (ii) your enterprise together with other enterprises or institutions; (iii) mainly other enterprises or institutions. As did with product innovation, and due to the difficulties in understanding the differences between these categories, in this subsection we have considered the three of them.

As to *manufacturing* firms, Italy (CIS II and CIS III), Greece (CIS IV) and Ireland (CIS 2006) account for a higher percentage of process innovations developed by the firms themselves. As was the case with the previous indicator, Ireland also shows a high degree of stability in this first category. The case of Spain is quite illustrative of a national innovation system mainly oriented towards process innovation, not being characterized by developing new to the market products (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 Austria, Finland, Germany, Norway, Poland and Romania. Among the countries with a lower movement towards process innovation in their firms, the cases of the Bulgaria, Czech Republic, Hungary, Lithuania, Netherlands, Norway and Slovakia are worth mention. With reference to the second category, process innovations developed in cooperation with other firms or institutions, firms in Austria (CIS II), Belgium (CIS III) and Cyprus (CIS IV and 2006) are the ones showing a higher orientation towards these cooperative patterns, while on the other side of the coin the cases of Bulgaria, Estonia, Hungary, Malta and Romania can be found. The cases of Lithuania and Spain are worth to mention due to the differences in their relative position among CIS, what unfortunately, brings once more the limitations of these aggregated data. On the other hand, and as it was also the case in the case of product innovations developed in cooperation with other firms and institutions (table 1) the cases of Austria, Finland and the Netherlands show a high degree of homogeneity. Clearly, firms in these countries are much more eager on cooperating in their innovative activities rather than doing them by themselves. Finally, Italy (CIS II), the Netherlands (CIS III), Cyprus (CIS IV) and Estonia (CIS 2006) are the countries with a higher share of enterprises with process innovations developed mainly by other firms or institutions. In this case we consider that the cases of Italy, Hungary and Spain are remarkable, as they all show quite constant and high ranking positions. Our view is that this fact may be linked to the relevance that the public research organizations have in these countries. In fact, according to R&D expenditures by sectors of performance (Eurostat, 2009) in 2006, the share of all national R&D expenditures executed by the government and higher education sectors represent a 49% in Hungary, 47,8% in Italy and 44,2% in Spain. However, the definition of what the

CIS considers as a product/process developed mainly by other firms or institutions remains utterly unclear.

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 noticeable, 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 this kind of orientation among their firms. As regards the second category included, firms in Belgium (CIS III) and Cyprus (CIS IV and CIS 2006) are those who most develop their innovation processes in cooperation with other firms or institutions, followed by those in Austria, Czech Republic and Portugal. In addition, for this category, most countries perform in quite a constant manner (with the exceptions of Denmark, Lithuania and Spain). Finally, for the grouping related to process innovations developed mainly by other firms or institutions, it can be observed that Belgium (CIS III), Cyprus (CIS IV) and Poland (CIS 2006) rank higher, being characterized by an irregular pattern, specially as to Belgium and Cyprus; unevenness also to be observed in countries like France and Norway. However as it was also the case in the previous dimension concerning process innovations developed in cooperation, most countries act upon quite regularly in time. Ultimately, the cases of Hungary, Italy, Lithuania, the Netherlands and Spain should be also highlighted due to the high ranks achieved.

A comparison between the two indicators illustrated so far leads to the following reflections. On the manufacturing side, firms in most countries follow quite similar behaviours as regards product and process innovations. However, firms in Germany, the Netherlands and Norway seem to perform better with regard to product innovations than to process innovations. On the contrary, manufacturing firms in Greece, Spain, Italy, Cyprus and Portugal, seem to be much more oriented towards process innovations[21]. This is related to what has already been pointed out by Zabala-Iturriagagoitia et al. (2007b) as regards the role of absorptive capacity within 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 issue will be addressed further in the following sections.

As noticed, the number of countries collecting data for process innovations, particularly in the services sector, can be considered quite small. So, it is not easy to identify 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

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

relationship it might have with the introduction of new product innovations in the market, which is our next indicator.

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

	Manufacturing (excluding construction)**											
	Process developed by enterprise or group				Process developed in cooperation with other firms or institutions				Process developed mainly by other firms or institutions*			
	CIS II*	CIS III	CIS IV	CIS 2006	CIS II*	CIS III	CIS IV	CIS 2006	CIS II*	CIS III	CIS IV	CIS 2006
Austria	3	12	17	8	1	4	6	3	6	7	6	4
Belgium	6	11	9	2	10	1	11	5	14	2	19	13
Bulgaria			18	22			23	23			22	18
Cyprus			16	16			1	1			1	23
Czech Republic			14	17			2	10			14	8
Denmark	9	13	15	11	6	10	9	8	7	12	21	14
Estonia			8	4			18	18			15	1
Finland	10	2	22	5	2	6	7	2	9	13	17	20
France	4	8	5		4	9	20		13	11	18	
Germany	14	7	24	3	5	8	13	7	2	8	13	17
Greece			1	7			21	12			25	21
Hungary			21	24			16	21			4	3
Ireland	2		3	1	13		15	13	11		20	22
Italy	1	1	12		11	12	10		1	9	3	
Latvia												
Lithuania			13	20			1	20			8	11
Luxembourg	13	6	11	6	9	13	22	14	3	5	10	12
Malta			7	10			24	17			24	15
Netherlands	12	9	25	21	3	2	8	9	4	1	2	2
Norway	11	4	23	19	8	3	17	15	8	6	23	19
Poland			6	18			14	19			12	9
Portugal	7	3	10	9	12	5	3	11	12	3	9	10

Romania			2	15			19	22			11	16
Slovakia			20	23			5	16			5	5
Slovenia				14				6				7
Spain		5	4	12		7	25	24		4	7	6
Sweden	8	10	19	13	7	11	4	4	10	10	16	
United Kingdom	5				14				5			
n	*14*	*13*	*25*	*24*	*14*	*13*	*25*	*24*	*14*	*13*	*25*	*23*
	Services											
	Process developed by enterprise or group				Process developed in cooperation with other firms or institutions				Process developed mainly by other firms or institutions*			
	CIS II	CIS III	CIS IV	CIS 2006	CIS II	CIS III	CIS IV	CIS 2006	CIS II	CIS III	CIS IV	CIS 2006
Austria		6		3		4		2		9		9
Belgium		13	4	4		1	12	4		1	17	13
Bulgaria				16				16			18	12
Cyprus			10	9			1	1			1	17
Czech Republic			9	11			2	5			9	10
Denmark		5	11	6		12	13	6		10	12	15
Estonia												
Finland		10				5				13		
France		4	2			10	15			8	19	
Germany		8				2				6		
Greece				2				3				7
Hungary			17	17			16	14			4	4
Ireland												
Italy		2	14			7	6			3	2	
Latvia												
Lithuania			16	18			5	12			5	2

Luxembourg	1	5	1	13	11	9	11	15	16
Malta		13	15		17	10		11	8
Netherlands	11	18		6	8		5	6	
Norway	9	15	12	9	14	13	4	16	11
Poland		7	13		7	11		7	1
Portugal	3	6		3	3		7	10	
Romania		1	7		10	15		14	14
Slovakia		8	14		4	8		8	5
Slovenia			10			7			6
Spain	7	3	8	8	18	17	2	3	3
Sweden	12	12	5	11	9		12	13	
United Kingdom									
n	*13*	*18*	*18*	*13*	*18*	*17*	*13*	*19*	*17*

Notes:
* Relative to process innovators
** The data for CIS 2 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).

4.3.- 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 (table 3), and new to the market products (table 4). In this sense, the survey asks, in the product innovation section, if there "were any of your goods and service innovations", only new to the firm or new to the market (Community Innovation Statistics, 2006: 3). 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" (ibid). Conversely, 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 competitors (it may have already been available in other markets)" (ibid). With these two indicators then, it becomes possible to measure for the percentage of firms that have introduced these new to the firm/new to the market products.

Accordingly, the following two sub-sections will be devoted to the study of product innovations, accounting for the percentage of firms that have introduced new to the firm or 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.

It has not been possible to collect any data concerning the share of firms that have introduced new to the firm products (table 3) for CIS II and CIS III. Indeed, these two surveys gather information concerning the turnover due to new to the firm products (which will be addressed in section 4.5) but no information is to be found concerning the percentage of firms that have introduced new to the firm products.

In relation to the manufacturing sector, the UK (CIS IV[22]) 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 in the two CIS's for which data are available. 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 high values that clearly show the potentiality of growth of these countries (Leskovar-Spacapan and Bastic, 2007; Heidenreich, 2009; Krammer, 2009). Firms in these countries seem to be more concerned with the development of their respective national markets than engaging in global competition (see next sub-section). On the other hand, countries like Belgium, Denmark, France, Germany, Hungary, Italy, Poland, Portugal, Slovakia and Spain show particularly low values which 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).

[22] Due to the lack of continuity given to this measure in the UK, it is not possible to track neither its evolution nor its comparison with the service sector.

Romania (CIS IV) also 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 than industry oriented according to the data collected. Quite the opposite direction is observed in economies such as Hungary, Italy, Lithuania, Poland and Portugal. Even if these countries mostly sustain a better relative position than in the manufacturing sector, they still show a poor performance.

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

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

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

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

As introduced in the previous sub-section, firms are regarded as introducing new to the market product when they do so before their competitors. Therefore, it is considered that firms introducing new to the market product could be regarded as developing more radical oriented innovations, as these products are being launched for the first time.

In the case of the share of firms that have introduced new to the market products (table 4) it has not been possible to collect any data for CIS III. While CIS II deals with innovators that have introduced products also new to the market (but not new to the firm as it has been stated in the previous sub-section), CIS III offers information concerning those enterprises that have introduced new or improved products on the market, without making explicit whether these products are new to the firm or new to the market. This is the reason why the data concerning CIS III have not been included in the analysis.

The Netherlands (CIS II), 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 Bulgaria and Luxembourg. Austria, Finland, Greece, the Netherlands and Sweden show quite stable patterns, being their firms characterized as innovative with regard to new to the market –i.e. new to the world – products. These results are confirmed when comparing the performance of these countries with the previous indicator. The opposite situation is found in the cases of Cyprus, Hungary, Italy, Portugal and Spain who perform quite badly for this indicator. This in a sense confirms the abovementioned hypothesis according to which the countries with a strong research base are more successful with regard to produce new to the market products, while those with a higher absorptive capacity but a lower research focus perform better in producing new to the firm products (Zabala-Iturriagagoitia et al., 2007b).

However, the cases of Romania and Germany are worth 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 good at 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 firms introducing few new products on the market, but having a great impact on it (OECD, 2009)– in the sense that these new products are sold in large quantities or having a high market value (i.e. machinery). 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)

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

United Kingdom	10	7	23	8		
n	*15*	*28*	*27*	*15*	*20*	*20*

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

As regards the service sector, Ireland (CIS II), Bulgaria (CIS IV) and Luxembourg (CIS 2006) are the leading countries, followed by Sweden[23]. In general terms, the results observed in the manufacturing sector are also replicated for the services sector for most countries. However, some exceptions come forward, such as 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 a 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 it 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 produced due to new or significantly improved goods*, both *new to the firm* (table 5), and *new to the market* (table 6). In this regard, the CIS questionnaire complements the previous questions concerning the share of firms introducing new to the firm/new to the market products with another 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 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)" (Community Innovation Statistics, 2006: 3).

In the case of new to the firm product innovations, some clarification is needed for CIS II due to the vague way this definition is addressed on it. Indeed, CIS II, when dealing with the turnover due to innovating products, distinguishes between three kinds: improved products, new products and new products also new to the market. Since we cannot

[23] Our results are in line with those of the OECD (2009). Particularly, they found that "for services, shares of new to the market international innovators are highest in Luxembourg, followed by Sweden" (ibid: 35) a trend that can also be observed in table 4.

discern whether the improved products or new products deal with new to the firm products we have decided to consider those labelled as new products to be the ones regarded as being new to the firm.

With reference to the first of these two measures, most countries vary a lot in their relative positions. Maybe the only exception to this general pattern might be Germany, who keeps a constant position. The leading countries are Germany (CIS II and 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 position cannot be portrayed as being particularly good. However, in terms of turnover, these firms achieve significant results, particularly concerning the introduction of new to the firm products. These results confirm the orientation of the German economy towards few multinational corporations but whose products have a great impact on the market. This is confirmed by the OECD report about innovation in firms (OECD, 2009: 33) which declares that "Germany´s share of new to the market products is lower than that of other countries. Its high share of innovative firms is largely due to innovation based on existing products and technologies on both international and domestic markets".

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 III to then dramatically drop to lower positions in CIS IV and CIS 2006, a similar story to that of Sweden. 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 will have to be 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, such 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 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 explosion of the building sector during the last years and the expansion of tourism (Molina-Azorin et al., 2009).

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

	Manufacturing (excluding construction)*				Services			
	CIS II**	CIS III	CIS IV	CIS 2006**	CIS II**	CIS III	CIS IV	CIS 2006**
Austria	4	8	18	14	-	11		8
Belgium	14	10	4	15	-	3	8	11
Bulgaria			26	24	-		4	2
Cyprus			28	9	-		11	6
Czech Republic			9	18	-		9	15
Denmark	12	7	10	11	-	6	13	18
Estonia			3	10	-			
Finland	7	3	20	22	-	5		
France	9	11	12		-	7	16	
Germany	1	1	2	3	-	9		
Greece		9	16	13	-	1		3
Hungary			25	25	-		20	19
Ireland	2		15	21	-			
Italy	11	2	22	19	-	4	7	14
Latvia			27	26	-			
Lithuania			17	4	-		14	17
Luxembourg		12	6	23	-	13	1	7
Malta			1	20	-		18	16
Netherlands	13	6	19	16	-	10	15	
Norway	6	13	24	17	-	12	6	12
Poland			13	12	-		17	10
Portugal	8	4	21	8	-	8	10	13
Romania			5	1	-		3	1
Slovakia			14	2	-		12	5
Slovenia			11	7	-		19	9
Spain	5	5	8	5	-	2	2	4
Sweden	3		23		-		5	
United Kingdom	10		7	6	-			
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 enterprises regarding innovative products. It is to be noted that 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 (table 5). This decrease is also replicated in countries such as Austria, Belgium, France, Ireland, Netherlands, Poland, Slovenia, Spain and Romania. On the other hand, there are also countries improving their relative positions such as Bulgaria, Greece and Hungary.

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. The case of Greece and Malta are also illustrative of the tourism orientation already mentioned for Spain. Malta performs quite well for this indicator (with the exception of CIS IV), while the case of Greece shows a high performance both concerning new to the firm and new to the market services. However, as can be noticed, most countries do not perform in a constant manner. Hence, it is possible to find cases in which the relative performance is improved (i.e. Cyprus, Luxembourg, Hungary, Romania) or worsened (Belgium, Denmark, Italy, Lithuania or Poland).

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

	Manufacturing (excluding construction)*				Services			
	CIS II*	CIS III	*CIS IV*	*CIS 2006***	CIS II*	*CIS III*	*CIS IV*	*CIS 2006***
Austria	10	8	15	16	-	10		15
Belgium	14	9	16	24	-	7	14	13
Bulgaria			12	3	-		2	8
Cyprus			26	20	-		18	10
Czech Republic			10	4	-		7	7
Denmark	11	4	11	13	-	6	15	18
Estonia			25	25	-			
Finland	7	1	2	5	-	3		
France	3	6	13		-	9	12	
Germany	12	7	7	8	-	8		
Greece		11	20	2	-	1		2

Hungary			21	9	-		11	6
Ireland	4		8	12	-			
Italy	1	3	19	22	-	4	5	16
Latvia			27	23	-			
Lithuania			24	10	-		3	17
Luxembourg		12	23	21	-	13	4	9
Malta			1	1	-		20	1
Netherlands	5	10	17	14	-	12	16	
Norway	13	13	28	26	-	11	17	19
Poland			4	18	-		8	14
Portugal	6	2	22	6	-	5	10	12
Romania			9	19	-		13	3
Slovakia			3	7	-		1	4
Slovenia			6	17	-		6	11
Spain	2	5	18	15	-	2	19	5
Sweden	8		5		-		9	
United Kingdom	9		14	11	-			
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* (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 (Bender, 1989; Armbruster et al., 2008). 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.

An organizational innovation is defined as “the implementation of new or significant changes in firm structure or management methods that are intended to improved your firm’s use of knowledge, the quality of your goods and services, or the efficiency of work flows” (Community Innovation Statistics, 2006: 9). A marketing innovation is considered as “the implementation of new or significantly improved designs or sales methods to increase the appeal of your goods and services or to enter new markets” (ibid).

For organizational innovations three options are given in CIS IV: (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. However, CIS 2006 introduces four different categories within organizational innovations, which makes thus the comparison between the two surveys not possible: (i) New business practices for organising work or procedures (i.e. supply chain management, business re-engineering, lean production, quality management, education/training systems, etc); (ii) New knowledge management systems to better use or exchange information, knowledge and skills within your enterprise or to collect and interpret information from outside your enterprise; (iii) New methods of workplace organisation for distributing responsibilities and decision making (i.e. first use of a new system of employee responsibilities, team work, decentralisation, integration or de-integration of departments, etc); (iv) New methods of organising external relations with other firms or public institutions (i.e. first use of alliances, partnerships, outsourcing or subcontracting, etc.). 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 Bulgaria, Cyprus, Greece or Malta).

As to marketing innovations, both CIS IV and CIS 2006 offer the following two alternatives: (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.

In the manufacturing sector, Ireland was the leading country for this dimension in CIS IV, followed by Luxembourg, Denmark, Cyprus and Germany. Then, for CIS 2006, Greece was the leading country followed by Germany, Malta, Portugal and Cyprus. Malta and Portugal improve their relative position to a great extent in comparison with that for CIS IV, while Cyprus and Germany maintain their relative positions quite constant in both cases. Conversely we can find the cases of Belgium, Bulgaria, Norway and the Netherlands, where firms seem not to be that keen on implementing these organisational and marketing innovation practices.

As regards the services sector, Denmark (CIS IV) and Portugal (CIS 2006) lead the ranks for both surveys respectively. In these two cases, the performance as compared to that in the manufacturing sector keeps quite uniform. Similarly, Luxembourg and Cyprus are also positioned among the top ranking countries in both periods. Despite the data availability does not allow to make any dynamic inference about national patterns, it can

be stated that the trends observed both in the manufacturing and services sectors are quite constant for most countries. However, and since the CIS 2008 is already in process of definition, a higher degree of homogeneity should be seek for to allow for a better comparability among the surveys and countries.

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

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

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

5.- Conclusions and further work

In this paper we have addressed the topic of the outputs that characterize an innovation system based upon available statistics. Our major goal is to propose a set of indicators that could help in the characterization of an innovation system from the output side, providing that way policy makers a tool to identify policy failures. Therewith, we want 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. In order to do that, 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.

One of the main purposes of developing comparative studies is to aid policy makers in the identification of systemic problems to be solved by innovation policy. In our case we have tried to offer a balance view, comparing the performance of different European countries among themselves at different points in time, offering thus a dynamic approach from the point of view of different output measures.

5.1.- Reliability

The first conclusion to be deduced from the available data is that the degree of stability observed in most countries is really low. As we have stated, it is not possible to discern if the performance observed for a particular indicator is too high or too low, as optimal innovation intensities cannot be defined. Since the amount of available resources in an innovation system is limited, countries need to focus on particular goals. This implies that high innovation intensities for one indicator may cause low innovation intensities for another, which is precisely one of the main outcomes of our analysis. However, in order to achieve uniformity in the national economy, some balance among different categories of innovations may be recommended. Accordingly there is strong a great margin for improvement in the national innovation policies, so as to achieve a sustainable and stable innovation system.

In spite of this general trend, some national peculiarities have also been identified. Some countries are more oriented towards 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. This is in line with the contributions made by Arundel and Hollanders (2005) and the OECD (2009). Arundel and Hollanders (2005) provide a classification concerning the innovation modes of innovative firms: strategic innovators, intermittent innovators, technology modifiers and technology adopters. Then the OECD (2009: 33, 38) proposes an output-based innovation approach according to which innovative firms can be grouped in new to the market international innovators,

new to the market domestic innovators, international modifiers, domestic modifiers and domestic adopters.

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.

With regard to the consistency of our conclusions, some questions come up out of the analysis. In general terms, there is great variance from CIS to CIS. One country can perform very well for one indicator in a CIS to then dramatically drop its relative position in the next period. This shows that the available statistics may be inconsistent over time. So, can we rely on the aggregated data or is it necessary to focus on the microdata from each particular country? The answer to this question is not clear from the above analysis. The pros and cons of both options are quite clear cut though. While the former allows for comparative studies to be carried out, the latter permits for a higher degree of robustness in the results. But then, what about the performance of innovation systems? How can they learn from the experience of others when comparisons are not any more possible? This necessarily drives us to conclude about the need to further develop the Community Innovation Surveys, allowing for better compare ability among them.

5.2.- Further steps for research

Due to the data availability, in this paper we have merely focused on European countries. However, we believe that an interesting line of research could be oriented to apply the approach provided in this paper in those developing countries that are already concerned with the collection of science and technology indicators, as is the case in many Latin American, African and Asian economies.

As we have pointed out in the paper, the available indicators offer information concerning firm size and various activities (NACE codes) within the industry and service sectors. However, these sectoral differences have not been addressed in this paper and constitute an interesting 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 different scoreboards such as the European Innovation Scoreboard, the Nordic Innovation Monitor or the Global Innovation Index to mention a few. This might help to set the basis for arguing about the accuracy of scoreboard or composite indicators.

Another interesting line of research we consider concerns, for example, the balance between the different dimensions (outputs in the case of this paper) of an innovation system. From our point of view it may provide many interesting conclusions, especially for policy-makers. In this context, 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 be 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 argue 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

Appendix 3.- List of NACEs included in the CIS

CIS II	CIS III	CIS IV	CIS 2006
	c_d_e Total industry (excluding construction)		
	c Mining and quarrying	c Mining and quarrying	c Mining and quarrying
		ca10 Mining of coal and lignite; extraction of peat	ca10 Mining of coal and lignite; extraction of peat
		ca11 Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying	ca11 Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
		ca12 Mining of uranium and thorium ores	ca12 Mining of uranium and thorium ores
		cb13 Mining of metal ores	cb13 Mining of metal ores
		cb14 Other mining and quarrying	cb14 Other mining and quarrying
		c_d_e Total industry (excluding construction)	c_d_e Total industry (excluding construction)
d Manufacturing	d Manufacturing	d Manufacturing	d Manufacturing
da Manufacture of food products; beverages and tobacco			da Manufacture of food products; beverages and tobacco
		da15 Manufacture of food products and beverages	da15 Manufacture of food products and beverages
		da16 Manufacture of tobacco products	da16 Manufacture of tobacco products
db_dc Manufacture of textiles and textile products; manufacture of leather and leather products			db_dc Manufacture of textiles and textile products, leather and leather products
		db17 Manufacture of textiles	db17 Manufacture of textiles
		db18 Manufacture of wearing apparel; dressing; dyeing of fur	db18 Manufacture of wearing apparel; dressing; dyeing of fur
		dc19 Tanning, dressing of leather; manufacture of luggage	dc19 Tanning, dressing of leather; manufacture of luggage

dd_de Manufacture of wood and wood products, manufacture of pulp, paper and paper products; publishing and printing			dd_de Manufacture of wood and wood products, pulp, paper and paper products; publishing and printing
		dd20 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	dd20 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
		de21 Manufacture of pulp, paper and paper products	de21 Manufacture of pulp, paper and paper products
		de22 Publishing, printing, reproduction of recorded media	de22 Publishing, printing, reproduction of recorded media
df_dg Manufacture of coke, refined petroleum products and nuclear fuel, manufacture of chemicals, chemical products and man-made fibres			df_to_di Manufacture of coke, refined petroleum products and nuclear fuel, chemicals, chemical products and man-made fibres, rubber and plastic products, ot...
		df23 Manufacture of coke, refined petroleum products and nuclear fuel	df23 Manufacture of coke, refined petroleum products and nuclear fuel
		dg24 Manufacture of chemicals and chemical products	dg24 Manufacture of chemicals and chemical products
dh_di Manufacture of rubber and plastic products, manufacture of other non-metallic mineral products			
		dh25 Manufacture of rubber and plastic products	dh25 Manufacture of rubber and plastic products
		di26 Manufacture of other non-metallic mineral products	di26 Manufacture of other non-metallic mineral products
dj Manufacture of basic metals and fabricated metal products			dj Manufacture of basic metals and fabricated metal products

		dj27 Manufacture of basic metals	dj27 Manufacture of basic metals
		dj28 Manufacture of fabricated metal products, except machinery and equipment	dj28 Manufacture of fabricated metal products, except machinery and equipment
dk Manufacture of machinery and equipment n.e.c.			dk_dl Manufacture of machinery and equipment n.e.c., electrical and optical equipment
		dk29 Manufacture of machinery and equipment n.e.c.	dk29 Manufacture of machinery and equipment n.e.c.
dl Manufacture of electrical and optical equipment			
		dl30 Manufacture of office machinery and computers	dl30 Manufacture of office machinery and computers
		dl31 Manufacture of electrical machinery and apparatus n.e.c.	dl31 Manufacture of electrical machinery and apparatus n.e.c.
		dl32 Manufacture of radio, television and communication equipment and apparatus	dl32 Manufacture of radio, television and communication equipment and apparatus
		dl33 Manufacture of medical, precision and optical instruments, watches and clocks	dl33 Manufacture of medical, precision and optical instruments, watches and clocks
dm Manufacture of transport equipment			dm Manufacture of transport equipment
		dm34 Manufacture of motor vehicles, trailers and semi-trailers	dm34 Manufacture of motor vehicles, trailers and semi-trailers
		dm35 Manufacture of other transport equipment	dm35 Manufacture of other transport equipment
dn Manufacturing n.e.c.			dn Manufacturing n.e.c.
		dn36 Manufacture of furniture; manufacturing n.e.c.	dn36 Manufacture of furniture; manufacturing n.e.c.
		dn37 Recycling	dn37 Recycling
e Electricity, gas and water supply	e Electricity, gas and water supply	e Electricity, gas and water supply	e Electricity, gas and water supply
		e40 Electricity, gas, steam and hot water supply	e40 Electricity, gas, steam and hot water supply
		e41 Collection, purification and distribution of water	e41 Collection, purification and distribution of water
		f Construction	f Construction

g_to_q Services	g_to_k Services (excluding public administration)	g_to_k Services (excluding public administration)	g_to_k Services (excluding public administration)
	g Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	g Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	gWholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
		g50 Sale, maintenance and repair of motor vehicles	g50 Sale, maintenance and repair of motor vehicles
g51 Wholesale trade and commission trade, except of motor vehicles and motorcycles		g51 Wholesale trade and commission trade, except of motor vehicles and motorcycles	g51 Wholesale trade and commission trade, except of motor vehicles and motorcycles
		g52 Retail trade, except of motor vehicles, motorcycles; repair of personal and household goods	g52 Retail trade, except of motor vehicles, motorcycles; repair of personal and household goods
		h Hotels and restaurants	h Hotels and restaurants
	i Transport, storage and communication	i Transport, storage and communication	i Transport, storage and communication
i60_to_i62 Land transport; transport via pipelines; water transport; air transport			i60_to_i62 Land transport; transport via pipelines; water transport; air transport
		i60 Land transport; transport via pipelines	i60 Land transport; transport via pipelines
		i61 Water transport	i61 Water transport
		i62 Air transport	i62 Air transport
		i63 Supporting and auxiliary transport activities; activities of travel agencies	i63 Supporting and auxiliary transport activities; activities of travel agencies
		i64 Post and telecommunications	i64 Post and telecommunications
i642 Telecommunications			
j Financial intermediation	j Financial intermediation	j Financial intermediation	j Financial intermediation
		j65 Financial intermediation, except insurance and pension funding	j65 Financial intermediation, except insurance and pension funding
		j66 Insurance and pension funding, except compulsory social security	j66 Insurance and pension funding, except compulsory social security
		j67 Activities auxiliary to financial intermediation	j67 Activities auxiliary to financial intermediation

	k Real estate, renting and business activities	k Real estate, renting and business activities	k Real estate, renting and business activities
		k70 Real estate activities	k70 Real estate activities
		k71 Renting of machinery and equipment without operator and of personal and household goods	k71 Renting of machinery and equipment without operator and of personal and household goods
k72 Computer and related activities		k72 Computer and related activities	k72 Computer and related activities
		k73 Research and development	k73 Research and development
		k74 Other business activities	k74 Other business activities
k742 Architectural and engineering activities and related technical consultancy			

Source: own elaboration

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