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METRICS OF INNOVATION: MEASURING THE ITALIAN GAP

by Michele Benvenuti*, Luca Casolaro* and Elena Gennari*

Abstract

The paper surveys the literature on the measurement of innovation activity and evaluates the position of Italy with respect to the other major European countries. As a complex and multidimensional phenomenon, innovation has been measured from different perspectives: the environment in which firms operate, firms' commitment, its outcome. Both traditional and new measures of innovation are considered, using national accounts and survey data. A significant gap is found for Italy on most measures of innovation. Italy shows the largest gap for measures related to regulatory frameworks, ICT infrastructure and financial support for innovation expenditure. Italian firms stand out for the low level of input, especially R&D expenditure and the presence of graduates. This feature is not just driven by the small average size of Italian firms: the analysis of expenditure by size shows that large Italian firms lag behind in the international comparison. Despite these premises, a relatively large share of Italian firms claim to innovate, even if their R&D expenditure is low. In defending intellectual property rights, firms rely more on industrial designs and trademarks than on patents. Overall, the survey confirms that innovation in Italy is more incremental than based on technology and R&D, therefore less able to increase firms' productivity and overall growth.

JEL Classification: O30, O57, L20, I25, D83.

Keywords: innovation, R&D, patents.

Contents

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* Bank of Italy, Economic Research Unit, Florence Branch.

1 Introduction[1]

In recent years innovation has taken on great importance in the economic debate, for two main reasons. Firstly, there is a big need for innovation as a source of economic growth, since in high-income countries GDP has been stagnating and unemployment persisting. Secondly, a leap in innovation is required to tackle social and environmental challenges, such as climate change and shortage of natural resources.

The surge of the financial and economic crisis has certainly increased the need for new drivers of growth, but the issue emerged long before the crisis. For more than a decade the globalization of commerce and production has led to a continuous evolution in the structure of industrialized economies. Sectors exposed to international competition, known as tradable sectors,[2] are forced to increase their competitiveness to survive and continuous innovation is mandatory.

In addition to these tendencies common to industrialized countries, Italy has some peculiarities that actually worsen its growth performance. By adopting the common European currency, Italy achieved monetary stability but abandoned currency depreciation as a means of setting productivity differences in tradable sectors. During the last decade the Italian economy has not reacted to this change with investment in innovation and has performed significantly worse than peer countries in terms of GDP growth, productivity and employment.[3]

As a result, Italy is generally acknowledged to have an "innovation gap"to fill. Some facets of Italian productive system are recognized to limit innovation capacity: the large share of small firms, sectoral specialization in low-tech industries, shortage of human capital, financial costraints and the limited effects of public incentives.[4]

The paper focuses on measuring innovation activity in Italy with respect

[1]We are grateful to Matteo Bugamelli, Luigi Cannari, Francesca Lotti and Silvia Magri for constructive feedbacks. We also wish to thank seminar participants to the Bank of Italy Workshop on "Innovation in Italy" (Perugia, 13-14 December 2012). The opinions expressed in this paper do not necessarily reflect those of the Bank of Italy. All errors are our own responsibility.

[2]Spence-Hlatshwayo (2011).

[3]For a recent review on the structure of the Italian economy see Brandolini and Bugamelli (2009).

[4]Bugamelli et al. (2012).

to a group of peer countries, for which data are available for all the indicators considered: the other main continental European countries (France, Germany and Spain) and a leading innovator (Sweden). To enlarge the analysis, in the appendix tables we also report the comparison with a larger group which includes the other major EU countries, Switzerland, the United Kingdom, Japan and the United States. Starting from the existing international surveys on innovation[5] and gathering data from various sources, we try to innovate with respect to earlier empirical findings by coupling traditional measures of the environment, input and output, with new ones.

Our paper complements the analysis of Bugamelli *et al.* (2012), by providing comprehensive statistical support for the measurement of the Italian gap in innovation activity. Bugamelli *et al.* focuses specifically on the reasons generating the gap and the lines of action for narrowing it.

Two issues are pivotal when a policy is designed to promote innovation: a definition, i.e. the activities that can be labelled "innovative", and a metrics, i.e. a set of indicators able to measure innovation. The complex nature of the phenomenon makes both tasks particularly challenging.

The definition of innovation benefits from a degree of consensus, based on the three published editions of the so called "Oslo Manual".[6] Innovative activity is defined as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practice, workplace organisation or external relations".

The basic idea as regards metrics is that a certain innovation activity, performed by firms and the public sector, uses input factors and produces some outcome within an environment which potentially affects the process from different standpoints. This framework shapes all of the recent empirical scientific production on innovation measures and is also applied in this paper. Yet, a metrics is not easy to implement. On the one hand, a wide range of measures is potentially connected to innovative activity. On the other, innovation arises at firm level, and micro data - difficult to collect - would be the appropriate scale. We try to collect the most comprehensive set of information from different sources, including both national accounts and international surveys. The final table in the appendix reports the series we used.

[5]OECD (2011), and EU (2012).

[6]OECD and Eurostat (2005).

The paper is organized as follows. Section 2 surveys the literature on the subject. Section 3 analyses a selection of indicators in the different areas, showing the relative position of Italy. In Section 4 we provide an overall representation of the phenomenon. Section 5 concludes.

2 Innovation indicators in the literature

Innovation activity cannot be easily measured since it relates to various types of actions by firms, research institutions and public bodies. Nevertheless, given its crucial importance for the growth dynamics of most industrialized countries, various indicators have been proposed to compare countries' efforts in this field and reports have been periodically published by major economic institutions. More recently, to get a better understanding of innovation activity, traditional indicators have been complemented with new measures.

Statistical data come from various sources. The main organizations that collect data on innovation for country comparisons (OECD and Eurostat) mainly draw upon the work of countries' national statistical offices. In addition to this information, a substantial amount of evidence is also gathered through innovation surveys, i.e. questionnaires submitted to a sample of enterprises with the aim of collecting data on previously uncovered aspects. To harmonize data acquired in this way, in 1992 the OECD published the Oslo Manual which provides guidelines on the topics to be covered and the methodology to be adopted in surveys. One of the broadest examples is the Community Innovation Survey (CIS), which started in 1993 under EU sponsorship and the questionnaire for which was prepared by Eurostat in collaboration with the OECD.[7] In addition to surveys and national statistical data, another important source of information is patenting activity. The database of the European patent office (Patstat) is now available for research and allows important aspects of firms' innovation activity to be analyzed.

On the basis of the role that different features play in the production of innovation, indicators have been classified in the literature as environment, input and output measures. Environment indicators are related to the characteristics of the setting where firms and research institutions operate, while inputs represent everything that can be considered an ingredient for innovation activity. Output measures describe the results of the innovation process. While this classification is widely recognized and something similar can be

[7]For the use of surveys in econometric analysis see Mairesse and Mohnen (2010).

found in the main reports, which variables can be used to measure the environment, input and output is more controversial. As a matter of fact, the two main reports on the topic, by the EU and the OECD, make different choices with respect to some important indicators.

The *Innovation Union Scoreboard* classification (EU, 2011) distinguishes between enablers, firm activities and outputs. Enablers, i.e. the characteristics of the environment, are in turn divided into three categories. The first is dedicated to the indicators of human resources, in particular the level of educational attainment, and includes measures of secondary and tertiary education as well as doctorates. A second category comprises indexes which describe the country's research system, such as scientific co-publications and non EU-doctorate students. The last set of environmental indicators is devoted to financial support to innovation activity and comprises venture capital investment and R&D expenditure in the public sector. Inputs, described here as firm activities, include indicators of the firms' commitment, measured as innovation expenditure, divided into R&D and non-R&D, and the way innovation is performed, in-house or collaborating with others. By contrast with the general approach in the literature (see Hall, 2011), patenting activity and community trademarks are considered here as an input in the innovation process rather than an output. Finally, in the last category, accounting for the results of innovation activity, the report includes measures which show the quantity of firms that have introduced new products or new production processes or have adopted a new organization or marketing strategy. A set of indicators showing the economic effects of innovation are also included, such as exports of high-tech products, knowledge-intensive services and patent revenues from abroad.

The OECD report on *Measuring Innovation* (OECD, 2011) does not strictly follow the classification of the EU Scoreboard but the former's indicators can be easily mapped into it. Environmental indicators are first presented in connection with human resources, with education playing a major role in "empowering people to innovate". Education indicators concern both quality, such as basic scientific skills, measured with PISA, or the use of computers by students, and quantity, such as graduation rates at both BA and doctorate level. Market perspectives are also taken into consideration with the unemployment rate of graduates and the demand for supply of highly skilled workers. The environment where innovation takes place is also examined with respect to three aspects: (1) the dynamics of the business sector, with entry rates of corporations, employer enterprises' birth and death

rates, the presence of venture capital and business angels, (2) the regulatory framework within which firms operate, measured by barriers to entrepreneurship, and (3) economic policy, with taxation rates. Differently from the literature in the field and from the EU report, some indicators of patenting activity, namely those related to young firms, are placed within this area. Input indicators focus on firms' expenditure on innovation, in general and on R&D in particular, on public funding of R&D activity and general support for firms' innovation. The section also includes measures of R&D expenditure by higher education institutions and of public funded basic research. Among innovation inputs the OECD also takes into consideration firms' ICT investment expenditure and the use of ICT technologies such as broadband and e-government services. Output indicators are mainly identified by measures of patenting activity (patents granted, patents filed by public research organizations, patent citations) but also by scientific production (published articles) and R&D intensity.

The indicators that we will present in this report draw upon the existing literature in the field making the traditional distinction between environmental, input and output measures. However, the content of each category is somewhat different from that of the main reports and less common indicators are also considered. This is partly due to our focusing on Italy, which led us to choose the indicators that were most informative. The environmental indicators we focus on concern four broad fields that are likely to encourage innovation activity: knowledge production, ICT infrastructure and adoption, rules for doing business and financing. Research activity is proxied by four measures which relate to the population with the highest levels of education, to the international standing and openness of universities, and to their production in terms of the ranking and citation of papers. Differently from previous reports, the institutional setting within which firms run their businesses also considers various indicators of easiness of doing business which include the time and cost of starting a new activity and enforcing a contract. The availability of financing innovation is shown by three indicators: venture capital investment, commonly used in the literature, the presence of business angels, and stock market capitalization. Input measures are divided into three main areas: those concerning the labour force potentially and actually employed in the innovation process, those related to firms' expenditure on R&D and innovation activity in general, and a set of indicators of the degree of cooperation of firms, either with other firms or with universities. Finally, in order to measure output we have to bear in mind that the reason

why a firm invests in innovation is definitely to increase profits, either by pushing up demand or by reducing costs. This means that the most correct output measure would be linked to the increase in profit or, at least, in sales related to firms' innovation. Unfortunately, these variables can be hard to measure even with micro data and are definitely not observable using macro data. For these reasons, we consider innovation as an output *per se*, taking for granted that an innovation leads to an increase in the firm's capacity to produce value. For the same reason firms' activity in protecting intellectual property, i.e. registering patents, trademarks and industrial designs, will be considered as an output.

3 The Italian position

3.1 Environment indicators

3.1.1 Human capital and education

Firms' ability to engage in a high level of innovation activity depends on the quality and quantity of human capital available, i.e. on the possibility of finding skilled workers. High-tech innovation, in particular, is performed by human resources with a high degree of scientific knowledge.[8]

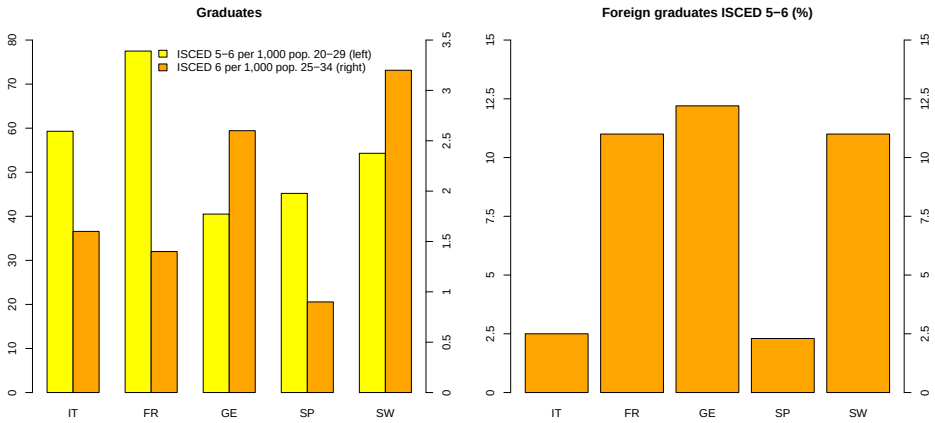
An indicator of human capital which can be used to compare country positions is the young population with tertiary education. According to the Eurostat, which collects data from the national statistical offices, in 2008 the percentage of new graduates as a percentage of the population aged between 20 and 29 years in Italy (around 6 per cent, Figure 1, Table 1) was slightly above that in Sweden and definitely higher than in Germany (4.0 per cent).[9] The picture is different if we look at education at doctoral level, where Italy performs worse than Germany and Sweden, but still better than France and Spain.

The presence of top research institutions and universities contributes to the development of a fertile ground for innovation, especially when collaboration with the business sector is established. It is then crucial to measure the attractiveness of country's university systems, which we will do in this

[8]For a recent contribution in the field, see Messinis and Ahmed (2013).

[9]This performance has also been driven in the recent years by the reform of the university system, which reduced the number of years needed to graduate.

Figure 1: Human capital



Source: Eurostat. Year: 2008/2009.

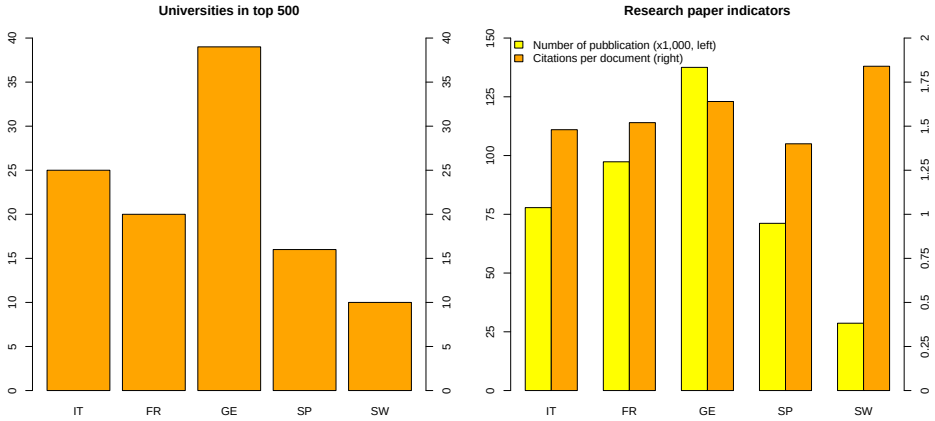
survey through four indicators: share of foreign students, international ranking of universities, quantity and quality of published research articles. The presence of foreigners in the Italian university system is very limited (Figure 1, Table 1): in 2009 the share of foreign graduates was slightly above 2.5 per cent against a 12.2 per cent in Germany and 11.0 per cent in France and Sweden.

There are various indicators to measure the international position of worldwide universities. One of these is the *Leiden* ranking, which uses a set of bibliometric indicators to measure the scientific impact of the first 500 institutions and their involvement in collaboration projects. On the basis of this index, the number of universities among the first 500 (Figure 2, Table 1) is higher in Italy than in France and more than double that in Sweden;[10] it is well below that in Germany, however.

Two other measures of the research level of a country are the quantity and quality of scientific publications. Using the *SCImago Journal and Country* ranking, which exploits the information on scientific publications of the Elsevier Scopus database, the evidence shows that the number of Italian published scientific articles is definitely lower in comparison with France and, especially, with Germany (Figure 2, Table 1). The picture improves if we

[10]It must be acknowledged that there are fewer universities in Sweden than in the other countries of the peer group.

Figure 2: International ranking of research



Source: Leiden ranking. Year: 2011/12 (left), SCImago journal and country rank. Year: 2010 (right).

look at the quality of research, proxied by the average number of citations per published article (Figure 2, Table 1), for which the gap with respect to the most innovative countries tends to close.

Summing up, the Italian education system compares well with the peer group of countries for the number of graduates and the quality of research but it definitely lacks attractiveness. As we will show in the section concerning input indicators, the system is also not sufficiently open to collaboration with enterprises.

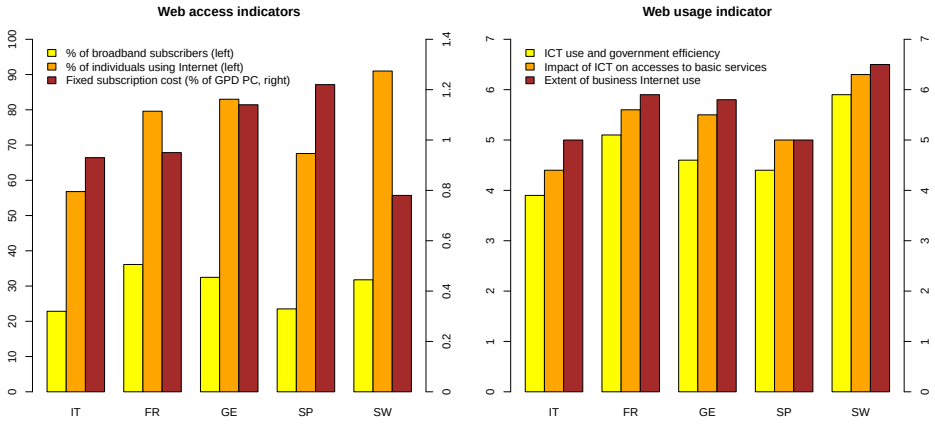
3.1.2 ICT diffusion

Investment in ICT is strictly related to innovation potential and, in turn, to economic growth. The probability of innovation has been shown to be linked to the intensity of ICT investment and use.[11] ICT fosters innovation by facilitating firm networking, speeding up and enlarging communications and empowering households and public sectors. We consider two different aspects of ICT: first, costs and the use of broadband technology, the main tool to access the Internet; second, a synthetic index measuring the use of ICT by businesses, governments and households (to access basic services). Data come from the 2012 edition of the *Web index*, computed by the World Wide Web Foundation (Table 2).

[11] See the recent contribution by Spiezia (2011).

Figure 3 shows less intensive adoption of ICT in Italy than in the peer countries. The share of the population with a broadband connection is 22.8 per cent, the lowest for all the countries considered (around 32.0 per cent for Germany and Sweden, with a peak of 36.1 per cent for France). Adopting a more general measure, the share of individuals using the Internet, the distance between Italy and the peer countries widens: the 56.8 per cent recorded in Italy is 25-30 percentage points lower than in other countries. The cost of broadband subscription does not seem to play a major role: 0.93 per cent of GDP per capita in Italy is lower than in Germany but higher than in Sweden.

Figure 3: Web indexes



Source: *Web index 2012*, The World Wide Web Foundation.

The real impact of the Internet, an indirect measure of ICT "culture", is even more important than mere adoption. Figure 3 shows three scores ranging from 1 to 7 and measuring to what extent the government's use of ICT has improved the efficiency of government services and allowed all citizen to access basic services (health, education, financial services) and to what extent companies use the Internet for their business activity. The results highlight the bad performance of Italy with respect to all three indicators.

Italy's ICT gap is due to a lower rate of adoption but, also, and to a greater extent, to its low impact on households, businesses and the government. Why is this so? Supply and demand-side reasons interact: broad band connections may not be available in the smallest towns (Italy has a very sparse population), and a low demand for Internet services may arise

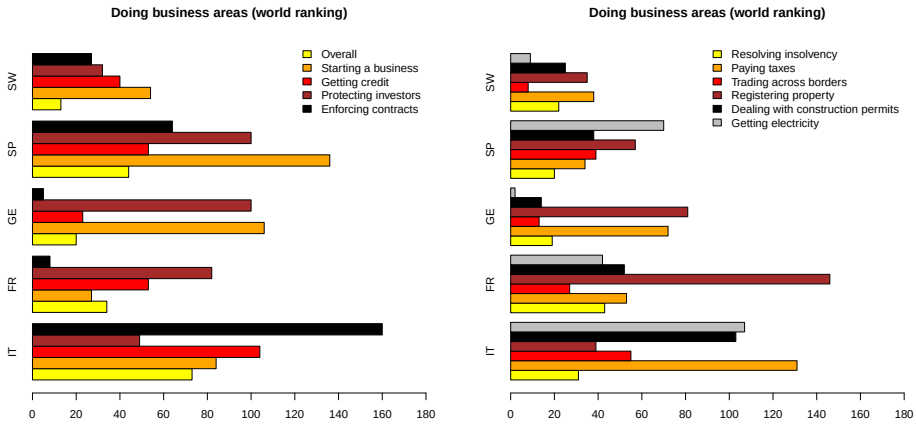
from both the low average level of education of Italian citizens and the lack of stimulus by the public sector.

3.1.3 Regulatory framework

The regulatory environment is pivotal in creating incentives, either positive or negative, to entrepreneurial activity. Fostering entrepreneurship requires new ideas to be quickly and inexpensively turned into an up-and-running business. Once a business is established, both administrative and fiscal burdens should be kept at a low level, to avoid wasting efforts. Property rights should be defined, contracts enforced, disputes solved and disclosure promoted. As far as the main issue of this paper is concerned, innovation turns easily into products and jobs provided an appropriate framework of rules is in place.

The *Doing business* survey, conducted by the World Bank in 183 countries, compares different aspects of regulation for domestic firms and computes an overall ranking. In the latest survey Italy ranked 73rd (Figure 4, Table 3), performing worse than the peer countries and also worse than the average of the OECD high income countries in any section included in the survey. Particularly, the United Kingdom and the United States achieved a very high ranking.

Figure 4: *Doing business* ranking



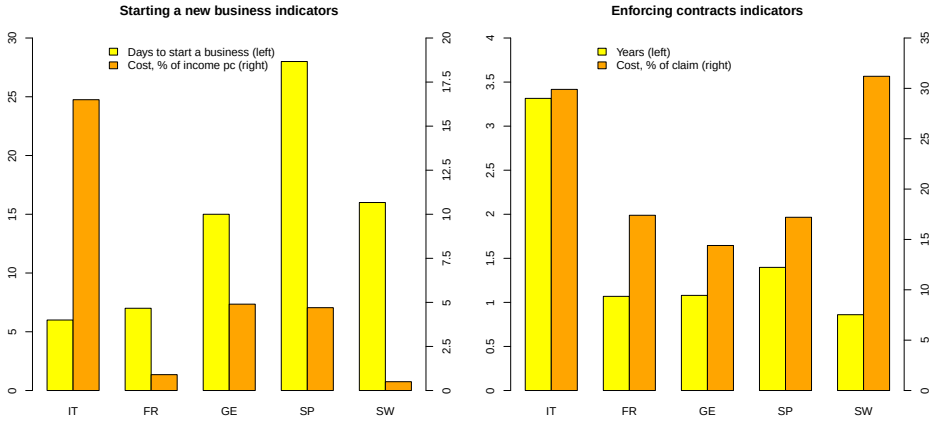
Source: *Doing business* survey 2013, The World Bank.

There are two matters covered in the *Doing business* survey that relate directly to innovative activity. The first refers to the conditions for starting a

new business, since a large amount of innovation is conveyed by *de novo* firms, the second is based on enforcing contracts to protect intellectual property rights arising from innovation. The ranking distance between Italy and the major European countries is large for both areas.

Starting a new enterprise involves two main factors: time and money. In Italy it takes 6 days to have a business up and running (Figure 5), a value among the lowest, [12] although the cost of the procedure is comparatively high (16.5 per cent of per capita income), more than three times larger than in Germany and Spain.[13] Furthermore, in Italy it is also time consuming and costly for a new business to get access to the electricity grid.

Figure 5: Ease of doing business



Source: *Doing business* survey 2013, The World Bank.

The enforcement of contracts is considerably affected by the efficiency of the judicial system: in Italy it takes a significant amount of time (3.3 years), effort (41 interactions) and money (29.9 per cent of the value of the claim)[14] to settle a commercial dispute. The length of trials is the indicator where Italy performs worst: it is twice as long as in Spain and more than three times as long as in Germany and France.

[12]Since 2009 a business can be started through a single electronic filing; in 2011 the on-line registration system was enhanced.

[13]It is mostly composed of notary fees. A recent reform allows young people (aged less than 35) to start a new limited liability firm with a minimum capital of one euro and no expenditure.

[14]Lawyers' fees are the largest component.

Other topics surveyed by *Doing business* are also relevant. Italy ranks worse than the peer countries in getting credit (because of the limited strength of legal rights), paying taxes (due to the high overall tax rate and the time-consuming transactions involved) and dealing with construction permits.

3.1.4 Finance

The financing of innovation activity is problematic. Information asymmetries arise: the expected benefit from investment is difficult to transmit to external financiers, and so is the very nature of technological innovation. Asymmetries may also produce moral hazard, that is, once obtained, funds can be diverted to riskier projects. Furthermore, innovation relies on intangible assets, which usually cannot be used as collateral. Finally, innovation is inherently risky because of the uncertainty associated with new products and processes. The risk may be too high for a bondholder or a financial intermediary to bear, whose upside return from the investment is limited. Indeed, financing problems are exacerbated when innovative firms are small and young.

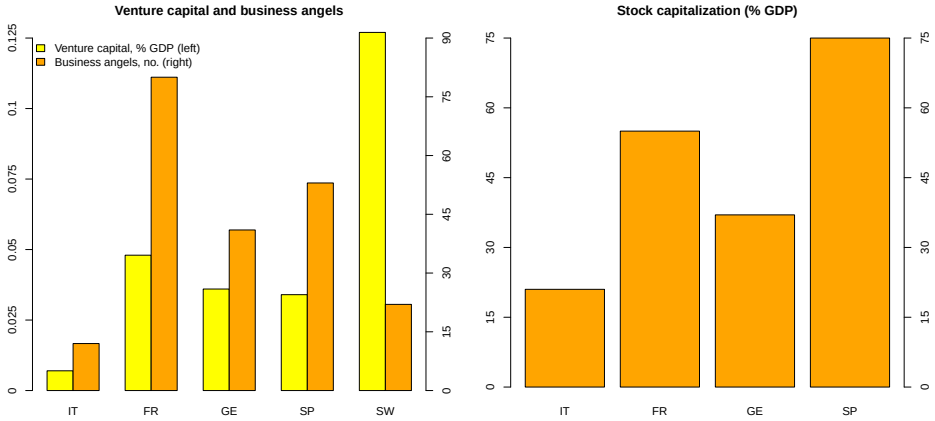
As a result, an innovative enterprise is more likely to face a financial constraint than a non-innovative one. It turns out that the most appropriate source of finance for innovative projects is equity, which has to be raised either through a specialized intermediary (venture capitalist) or by listing on a market. Figure 6 and Table 1 show that venture capital[15] in Italy is rare: in 2011 its stock was equal to 0.003 per cent of GDP, the smallest value among the peer countries. Another way of financing innovative firms is for them to be linked to a business angel, which can be defined as "a high net worth individual, acting alone or in a syndicate, who invests his or her own money directly in an unquoted business in which there is no family connection and who, after making the investment, is generally actively involved in the business, for example, as an advisor or member of the board of directors"(Mason and Harrison, 2008). Data on the number of business angel groups or networks in operation exhibit a very low ranking for Italy.[16]

The stock market is also important when it comes to funding innovative projects. A smooth, liquid, efficient stock market makes it easier to raise equity capital, for both incumbent and *de novo* enterprises. Stock markets

[15]Total venture investment (seed, start-up, later-stage ventures).

[16]This result is partially mitigated by the fact that the average number of deals per network in Italy is double that of the peer countries.

Figure 6: Financing of innovative activity



Source: Eurostat and OECD (left), Datastream (right). Year: 2010/2011.

also encourage venture capital, by providing a viable exit option from equity investments in growing firms. Again, Italy does not perform adequately: the ratio of stock market capitalization to GDP is 21 per cent, the lowest value among the countries considered (Figure 6).

3.2 Input indicators

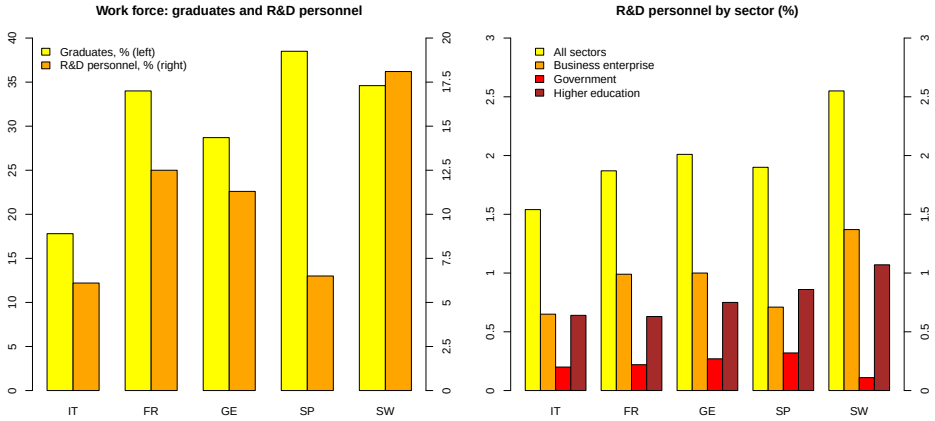
3.2.1 Labour force

Skilled workers are necessary for the development of new projects. The educational level of a firm's workforce can thus be a fair indicator of its potential ability to engage in innovation. In 2011, on the basis of Eurostat data, the percentage of graduates employed in business enterprises in Italy was very low (Figure 7, Table 1) in comparison with the other main European countries.

Although R&D does not account for all innovation efforts, it is nevertheless one of the activities which can be most easily measured. The number of employees devoted to it is then a good, albeit narrower, indicator of firms' innovation effort. If we look at the percentage of R&D personnel in firms in 2010 (Figure 7, Table 5), the picture that emerges is similar to that of the previous indicator. Even if the average share of employees that perform R&D has increased since 1981, Italy still lags behind.

R&D activity is performed not only by the business sector but also by

Figure 7: High skilled workers



Source: Eurostat (2011) and OECD (2010) (left); Graduates include ISCED 5 and 6. Eurostat (2009) (right).

universities and, to a lesser extent, by government. Accounting for these sources in the share of personnel devoted to R&D activity (Figure 7) reveals that the gap for Italy mainly emerges in the business sector, while the contributions of government and higher education are aligned with the figures for its peers.

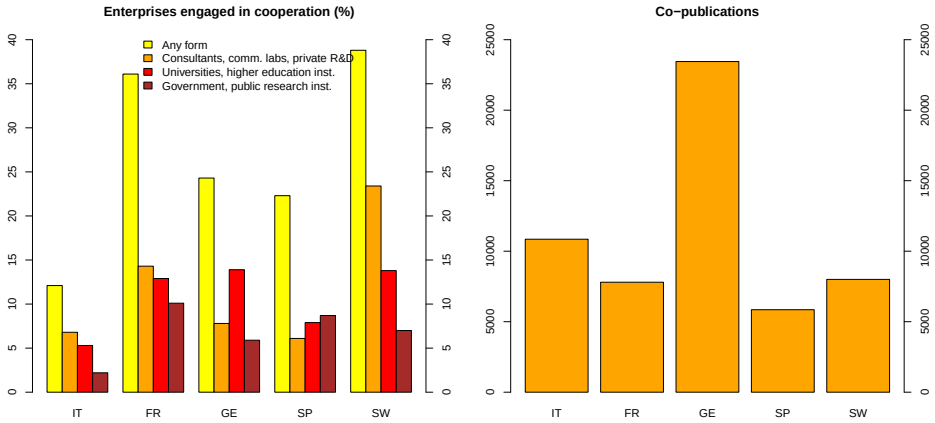
3.2.2 Cooperation

Cooperation is an essential ingredient for the development of new projects. Firms' collaboration with other firms or with universities is a fundamental input in the innovation process. We exploit data from the Community Innovation Survey (CIS) to measure the share of firms involved in some form of cooperation (Figure 8, Table 4) for a group of European countries in the period 2008-2010. Italy's innovation gap with respect to France and Sweden is very large, but a substantial difference also emerges in comparison with Germany and Spain. If we limit the analysis to links with universities, the difference is still present but less pronounced.

Among the indicators based on firms' collaboration with universities, co-publications represent a measure of the quality of the innovation performed by the partnership. In this respect, the Italian position is above that of France, Spain and Sweden[17] but well below that of Germany (Figure 8, Table

[17]The result for Sweden is partially affected by scale effects.

Figure 8: Cooperation



Source: Eurostat, CIS 2010 (left) and Leiden ranking 2011 (right).

1). Although there is a clear adverse gap in the number of Italian firm-university collaboration projects, when they are present thay are important and this allows Italy to gain some positions in the international ranking.

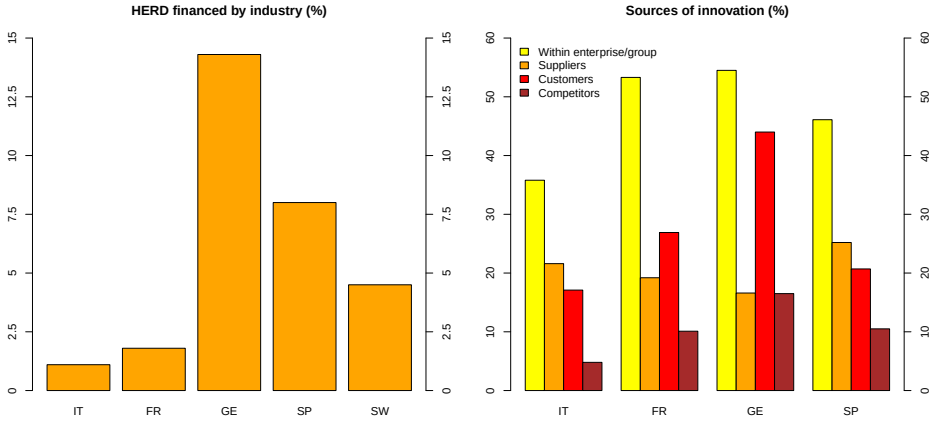
A useful indicator, which analyses firm-university partnerships from another perspective, is the financing of university R&D activity by industrial firms (Figure 9, Table 5). In 2009, the financing of high-education R&D (HERD) expenditure was extremely low in Italy by international standards.

In their innovation activity, firms making the effort to collaborate with external entities are able to obtain precious information either from other firms of the group, suppliers, clients and even competitors (Figure 9, Table 4). In Italy firms do not fully exploit the benefits of information spillovers: the percentage of firms acquiring information from outside is the lowest for three of the four categories.

3.2.3 R&D expenditure

The indicator widely recognized in the literature to signal firms' innovation effort is their R&D expenditure (BERD). If we consider the ratio of this expenditure to value added, Italy lags behind the major industrialized countries and, in particular, the peer group of countries apart from Spain (Figure 10, Table 5). About the propensity to do in-house R&D activity (Figure 11, Table 4), the Italian indicator is not so far from those of the peer countries.

Figure 9: R&D financing and information sources

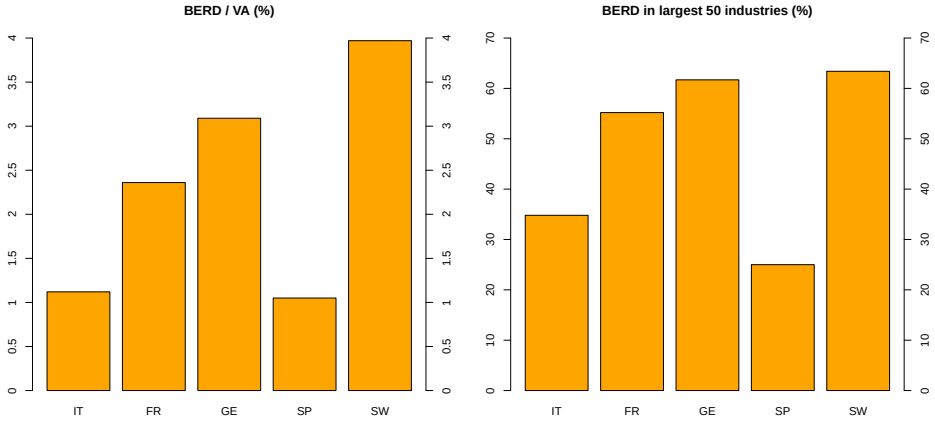


Source: OCSE (left) and Eurostat, CIS 2010 (right). Year: 2010 (2008 for Germany).

Another interesting indicator is the degree of R&D expenditure among the enterprises in a country, although its interpretation is not clear-cut. On the one hand, in fact, less concentrated spending might be preferable since, if efforts are pervasive among firms, countries' innovation depends less on the presence of a few big enterprises and there could be a more fertile ground for new ideas. On the other hand, dispersed investment lacks the critical size needed to drive an effective innovation activity. Looking at the share of R&D expenditure of the 50 largest enterprises in each country (Figure 10, Table 5), firms' R&D activity in Italy appears less concentrated than in the peer countries, except for Spain. This result, taken together with the data on the R&D expenditure and innovation activity of Italian enterprises, confirms the characteristics of the Italian innovation system, where R&D investment, widespread among firms, is often too small to produce results that go beyond incremental innovation.

Innovation activity is costly and characterized by some uncertainty about its results in terms of business. For this reason the government generally distributes funds to enterprises to help them finance their activity. If we compare, using CIS data, the percentage of innovative firms that receive a public contribution within the selected group of European countries (Figure 11, Table 4), what emerges is that Italian public funding to firms is more widespread than in Germany and Spain.

Figure 10: Business enterprises R&D



Source: OECD (left) and EU Industrial R&D Investments Scoreboard (right). Year: 2010/11.

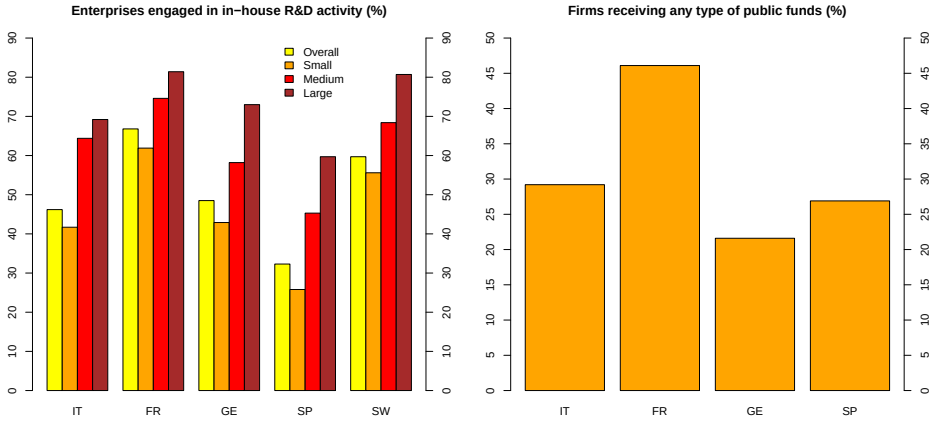
3.3 Output indicators

Following the Oslo Manual, we consider a firm innovative if, in the period considered, it has introduced in the market or within its own organisation some non negligible innovations, either technological (implying a change in the product or in the production process) or not (implying a change in the organisational structure of the firm or in the product presentation or other marketing elements). The introduction of an innovation at the firm level is the outcome of a process originating from the environment in which the firm operates and developed through its own effort. After looking at environmental and input indicators, we evaluate the position of Italy with respect to the outcome of the innovation process looking at two different measures: firms declaring they perform innovation in CIS survey data and the steps taken to protect intellectual property rights.

3.3.1 Innovative enterprises

On the basis of CIS data, 56.3 per cent of Italian firms introduced some kind of innovation between 2008 and 2010 (Figure 12, Table 4), a value that is just below that of Sweden, but a long way short of Germany's (79.3 per cent). At first sight the result is rather unexpected given the low Italian ranking in almost all the variables related to the environment and inputs. The picture

Figure 11: In-house R&D and public sector funding



Source: Eurostat, CIS 2010. Percentages of enterprises with technological innovation.

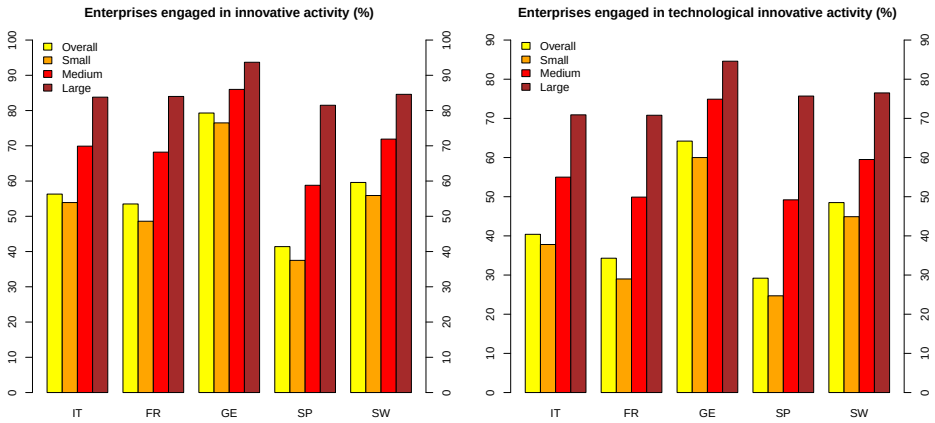
changes slightly when we focus on technological innovation, i.e. the kind of innovation which is expected to have the greatest impact on firms' outcome, where the gap widens with respect to both Sweden and Germany.

These results are broadly confirmed when we look at turnover (Figure 13): In Italy innovative firms account for almost 80 per cent of total turnover, a value in line with that of Sweden. The ranking does not change if we confine the analysis to firms performing technological and non-technological innovation.

These results confirm that innovation is closely related to firm size: In Italy, innovative firms are over 80 per cent of large enterprises, while they are only 53.9 per cent of SMEs. This value, although very far from that of Germany (76.5 per cent), is nonetheless above that of France, and more than 16 percentage points higher than that of Spain.

In order to better interpret the results presented above, however, we have to make a deeper analysis of the phenomenon. In fact, the concept of innovation is extremely wide and changes realized with different technological contents can affect firms' performance in very different ways. Innovation coming from R&D investment is not comparable - in terms of intensity and quality - to that carried out without research, purely on an incremental basis (see Bugamelli *et al.* (2012)). This kind of low quality innovation is also less likely to produce patents and industrial designs, to create products that are new to the market and not only to the firm, i.e. it is also less likely to

Figure 12: Innovative enterprises by size



Source: Eurostat, CIS 2010.

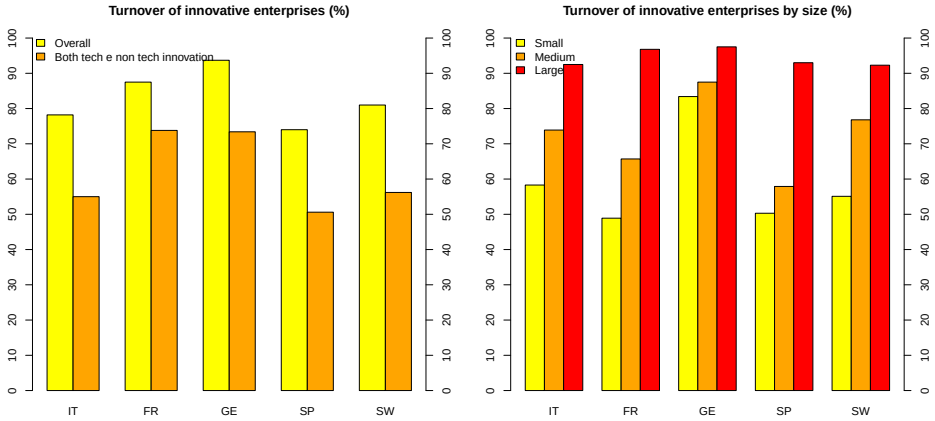
increase firms' productivity and profits substantially. It is thus important to analyse the contents of innovation at country level in order to understand firms' performance.

Figure 14 shows that, in Italy, only half of firms' innovation expenditure, scaled by turnover, is related to R&D, very far from Sweden's over 75 per cent, and also from Germany's (61.5 per cent). These results are partially driven by the peculiar structure of Italian industry, dominated by low technology sectors and characterized by a prevalence of small firms. Although they do not permit sectoral analysis, our data allow us to break down R&D investment by firm size. It turns out that the low propensity to invest in R&D of Italian firms involves all sizes. Large firms, in particular, display a low level of R&D-related innovation expenditure with respect to the peer contries. This cannot be without consequences for the quality of Italian innovation and consequently for Italian firms' performance.

3.3.2 Intellectual property rights

Innovation inside a firm is aimed at establishing a competitive advantage. To exploit this advantage, i.e. to exclude competitors from benefiting from the firm's effort, the result of the innovation process has to be protected in some way. Several tools exist, the choice being related to the nature of innovation. We focus on three: patents, i.e granting the exclusive use of an

Figure 13: Turnover of innovative enterprises



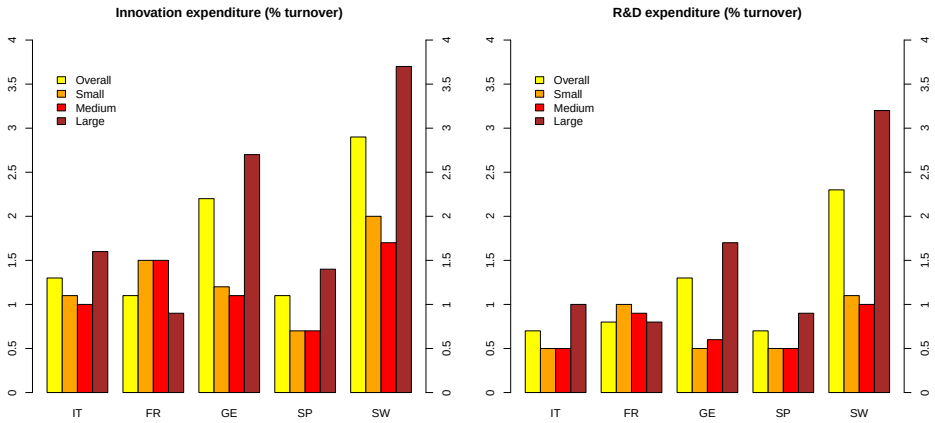
Source: Eurostat, CIS 2010.

invention, trademarks, which are related to a recognizable sign, design or expression, and industrial designs, i.e protecting the visual design of objects. As explained in Section 2, we consider the registration of patents, designs and trademarks as an output indicator, since it is an outcome of the innovation process.

A patent is the exclusive right to exploit an invention which may have a practical application for a certain time within a given country. It makes it possible for the holder to gain a monopolistic position for a limited time, and to set a higher price for the innovative good or service, thus allowing the recovery of the innovation costs. The use of data on patents calls for some caveats. The first is related to the risk of underestimating innovation, given that patents capture only a part of it: for some inventions patenting is excluded, while in some other cases it is not considered an efficient way to protect innovation, mainly for the disclosure related to the patenting process.[18] A second problem arises when we consider that only a fraction of patents can actually be translated into commercially viable products or processes, i.e. into real innovations. Finally, some difficulties arise in international comparisons of patent data owing to the presence of remarkable country differences in the propensity to patent and in the value of patents

[18] According to Crépon et al. (2000), within the French manufacturing sector less than one third of innovation is patented.

Figure 14: Innovation and R&D expenditure over turnover



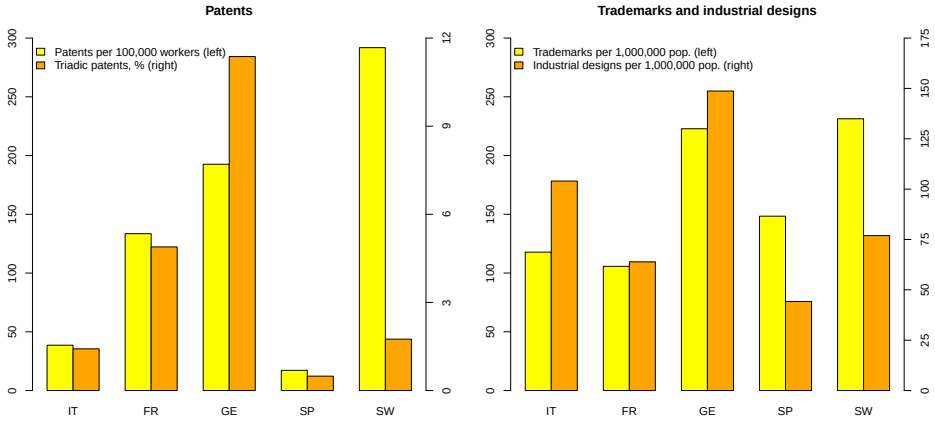
Source: Eurostat, CIS 2010 (CIS 2008 for German R&D expenditure).

(related to several factors, such as the regulatory framework and enforcement efficiency). Notwithstanding the above, patent data are an important resource for understanding firms' innovation performances, given the high level of detail and the possibility of using up-to-date information.

In Figure 15 (Table 5) we present a measure of the number of patents registered over working population. The country ranking documented so far is not altered: the value for Italy is much lower than those of Germany and Sweden. This outcome can be partially related to the low technological content of Italian firms' innovation consequent on the limited investment in R&D. Another factor influencing the low propensity to register patents in Italy is the high percentage of small and micro firms, which encounter significant financial difficulty in patenting activity. Finally, the small number of patents can be associated with the great difficulty in enforcing rights in Italy.

Other information about innovation can be obtained from data on industrial designs and trademarks. Trademarks are used to appropriate the benefits of a brand or a new product; data are available immediately after registration, which permits prompt monitoring of innovation activity. A trademark can be defined as a sign that distinguishes the goods and services of one firm from those of other firms. The results show that, although Italy ranks fourth for number of trademarks registered over the labour force, its gap with respect to the peer countries is small. According to the Office for

Figure 15: Patents and trademarks



Source: OECD (right) and OHIM (left). Year: 2010, 2012.

Harmonization in the Internal Market (OHIM), "a design is the outward appearance of a product or part of it, resulting from the lines, contours, colours, shape, texture, materials and/or its ornamentation". Apart from Germany, Italy exhibits the highest adoption of industrial designs inside the peer group (Figure 15, Table 5). These results are related to the specialization of the Italian economy in sectors such as textiles, furniture and fashion, which are characterized by incremental rather than technological innovation, so that it is considered appropriate to protect intellectual property through designs and trademarks.

4 An overall view of innovation performance

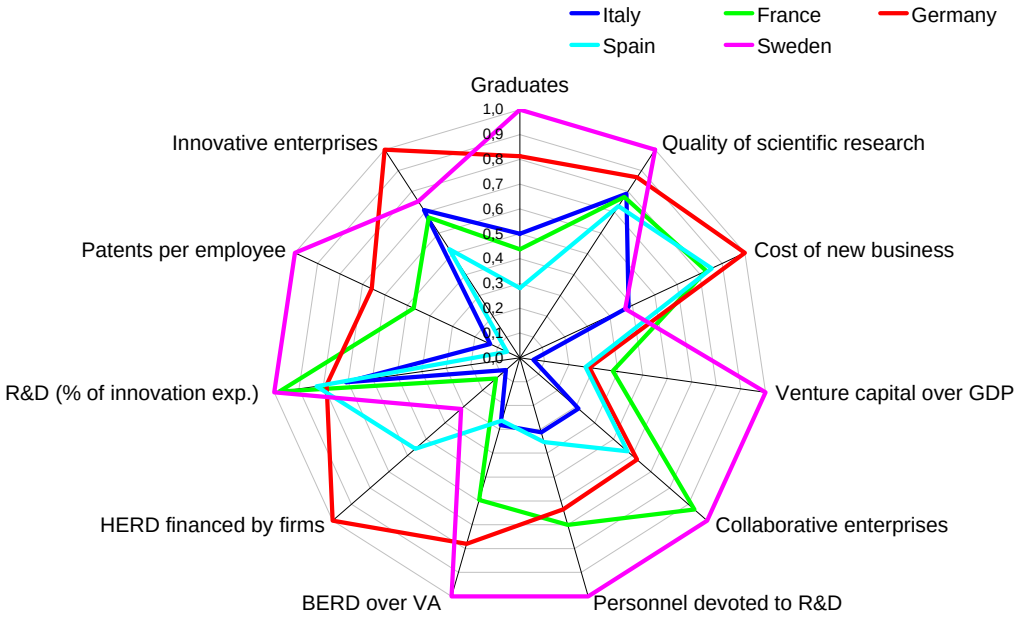
In order to get an overview of the innovation performances of Italy and the group of peer countries (France, Germany, Spain and Sweden), in Figure 16 we present a radar graph, which includes several indicators related to environmental, input and output innovation measures. The indicators, ranging between zero and one, are computed by normalising each variable with respect to the top performing country. The best performer will thus have value one (on the boundary of the radar) while the other countries' values will represent the relative gap to the boundary. From the picture it is possible to infer that the top innovators, Sweden and Germany, perform very well for

almost every innovation indicator, especially as regards BERD. The results of the innovation leaders reflect a very small variance in their performance across all the 11 innovation indicators, corroborating the idea that innovation needs a balanced performance across all the different categories of indicators. Success in innovation is thus not given by the excellence in just a few areas, but comes from an overall effort regarding both government, which should guarantee an optimal socio-economic environment, and firms, which should supply a level of investment consistent with the innovation target and the necessary degree of collaboration to benefit from informational spillovers.

Germany registers the highest values in 3 out of 11 indicators, one related to the environment (cost of new business), one to firms' innovation efforts (HERD financed by firms) and one to outputs (innovative enterprises), with only a medium ranking on collaboration. Sweden dominates in the other 8 indicators, related to the environment (graduates, quality of scientific research and venture capital), inputs (BERD and personnel devoted to R&D, collaboration and R&D percentage of innovation expenditure) and outputs (patents). Sweden displays an even more symmetric graph than Germany, with a low-medium ranking only in two indicators (HERD financed by firms and cost of new business).

Data from Italy exhibit a low and very irregular profile, reflecting the weaknesses of the environment and the limited effort of firms in innovation and R&D investment. In particular, Italy ranks lowest for all the input measures (apart from BERD/VA) and, among the environmental indicators, ranks lowest for venture capital. The values for innovation output partially reflect this pattern, with Italy in the last-but-one place for patents but third for number of innovative enterprises.

Figure 16: Innovation performance



5 Conclusions

The framework adopted in this paper is that innovation outcomes are the result of a process where both inputs and environmental factors play a major role. The evidence gathered points to a substantial "innovation gap" for Italy. It shows that Italian enterprises suffer from competitive disadvantages in regulation and finance and, to a lesser extent, in the countries' educational and research systems too, with the quality of research and its links with industry only marginally worse than in the peer countries. These weaknesses combine with the limited amount of investment in a qualified workforce and in R&D, despite the relatively high level of incentives provided by the public sector.

Looking at the results of innovation activity, the peculiarities of the Italian gap are not about diffusion: the share of Italian enterprises declaring they perform innovation activity does not differ from that of the peer countries, apart from Germany. The distribution by size classes of these enterprises is also very close to that of the competitors. The shortfalls arise from three factors: the intensity of the effort, the nature of the effort and the role of large firms. As a general rule, Italian firms assign a smaller share of their resources to innovation. Innovation expenditure (including R&D) amounts to 1.3 per cent of total sales, as against to 2.1 per cent in Germany and 2.9 per cent in Sweden. R&D outlays represent a small part of total innovation expenditure: 55.3 per cent in Italy, less than in Spain (64.6 per cent), France (76.5 per cent), Germany (61.5 per cent) and Sweden (78.1 per cent). Since R&D is usually associated with more technologically advanced activity, this evidence means that innovation is more oriented to organizational and marketing changes than to new products and processes. This is also related to the sectoral and size structure of the Italian economy, where high-tech sectors and large firms account for a smaller share than in the peer countries. Finally, dividing expenditure by firm size, the evidence shows that small and medium-sized Italian firms spend a similar amount on innovation compared, for instance, with Germany, while large firms spend much less: 1.6 per cent of sales in Italy, 2.7 per cent in Germany and 3.7 per cent in Sweden. Large Italian firms are thus peculiar in their limited spending. These results are corroborated by data on intellectual property, which show that Italy ranks very low in patenting activity, which is more linked to R&D-driven innovations, while it performs better in the registration of industrial designs and trademarks, which typically protect innovation activity less related to R&D.

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Innovation
1) Environment
1.1) Human capital and education
% young with tertiary education
% young with doctoral degree
% foreign graduates
Universities in top 500
Amount of research papers
Citation per research paper
1.2) ICT diffusion and usage
% population connected
Internet subscription cost
ICT and government effiency
ICT and basic services
ICT and business use
1.3) Regulatory framework
Starting a business: time
Starting a business: cost
Enforcing a contract: time
Enforcing a contract: cost
1.4) Finance
Venture capital
Business angels
Stock market
2) Input
2.1) Labour force
% graduates
% R&D personnel
R&D personnel by sector
2.2) Cooperation
% firms cooperating
Kind of cooperation
Co-publications
2.3) Public and private R&D
BERD / added value
BERD concentration
% firms with in-house R&D
% firms receiving public funds
3) Output
3.1) Share of innovative firms
% firm with innovation
% firms with tech. innovation
Turnover of innovative firms
Innovation expenditure
R&D expenditure
3.2) Intellectual property rights
Patents
Industrial designs
Trademarks

Tables

Table 1: **Higher education, scientific research and innovation financing**

		Italy	France	Germany	Spain	Sweden	Austria	Belgium	Denmark	Finland	Netherlands	Switzerland	UK	Japan	United States	China	Korea, Rep.
Documents	1996	36,844	53,159	70,590	22,990	16,074	7,155	10,911	7,673	7,394	21,884	14,815	81,192	82,878	322,129	27,549	9,757
published	2011	77,838	97,343	137,519	71,155	28,652	18,694	25,416	18,052	14,866	45,689	33,272	145,899	115,416	519,573	373,756	60,846
Citations per	1996	18.92	21.54	21.98	17.73	27.81	23.77	23.55	28.14	24.51	26.88	30.88	24.28	16.19	29.00	6.57	12.68
document	2010	1.11	1.14	1.23	1.05	1.38	1.28	1.41	1.55	1.24	1.52	1.70	1.26	0.82	1.2	0.47	0.79
Universities																	
in the world top 500	2011	25	20	39	16	10	5	7	4	6	12	7	36	24	127	31	18
Industry-university																	
co-publications	2011	10,850	7,800	23,450	5,850	8,000	3,250	4,500	4,000	3,250	12,000	6,000	26,500	21,500	107,850	2,100	6,750
Graduates ISCED 5-6																	
per 1,000 aged 20-29	2008	59.3	77.5	40.5	45.2	54.3	41.2	73.3	79.8	86.2	47.0	71.9	85.2	-	-	-	-
Graduates ISCED 6																	
per 1,000 aged 25-34	2008	1.6	1.4	2.6	0.9	3.2	2.0	1.4	1.6	3.0	1.6	3.4	2.1	-	-	-	-
Foreign graduates																	
ISCED 6 (% graduates)	2009	2.5	11.0	12.2	2.3	11.0	13.5	10.4	9.8	4.4	8.5	10.6	24.0	-	-	-	-
Graduates employed																	
in firms (%)	2011	17.8	34.0	28.7	38.5	34.6	19.7	40.2	31.6	39.9	32.4	33.3	37.9	-	-	-	-
Graduates employed																	
in high-tech firms (%)	2011	32.8	65.9	45.1	74.2	53.9	34.2	68.8	49.7	67.6	55.8	49.0	63.0	-	-	-	-
Venture capital activity																	
% of GDP	2007	0.007	0.048	0.036	0.034	0.127	0.013	0.057	0.084	0.075	0.062	0.103	0.076	-	-	-	-
	2011	0.003	0.037	0.030	0.012	0.061	0.008	0.030	0.065	0.041	0.033	0.034	0.047	-	-	-	-
Investments	2007	27	811	1,363	157	670	66	166	119	307	273	129	946	-	-	-	-
(number)	2010	68	982	1,555	103	454	69	105	189	241	242	191	642	-	-	-	-
Companies	2007	22	365	955	125	441	52	133	105	199	249	111	577	-	-	-	-
(number)	2011	47	458	959	121	324	69	90	109	131	195	120	377	-	-	-	-

Sources: SCImago Journal, Leiden ranking, The Economics of Industrial Research & Innovation (IRI) and Eurostat.

Table 2: **Web index**

	Italy	France	Germany	Spain	Sweden	Finland	Switzerland	UK	Japan	United States	China	Korea, Rep.
Overall index (score)	56.45	78.93	74.87	72.12	100.00	91.88	90.49	93.83	68.56	97.31	51.72	81.06
Readiness (score)	67.22	73.95	81.01	79.18	96.76	95.78	94.85	94.07	71.24	94.98	45.44	78.06
Communications infrastructure (score)	70.76	80.35	85.63	73.85	97.11	90.65	96.94	92.33	80.19	82.57	58.00	85.44
International bandwidth per user (MB/s)	60,820	78,590	74,786	64,069	244,440	118,445	167,636	166,073	23,111	47,174	2,692	17,170
Broadband subscribers (x1,000 pop)	22.84	36.12	32.47	23.52	31.77	29.50	39.20	32.74	27.36	28.75	11.61	36.91
% households with a PC	66.36	81.16	89.58	72.55	91.45	86.57	90.00	84.02	86.00	77.20	38.00	81.90
Mobile phone subcribers (x 100 pop)	151.84	105.03	132.30	114.23	118.57	166.02	130.06	130.75	102.67	105.91	73.19	108.50
Fixed broadband Internet cost (% GPD)	0.93	0.95	1.14	1.22	0.78	0.91	0.57	0.64	0.69	0.49	4.1	1.45
Secure Internet servers (x mln pop)	198	386	1,081	275	1,627	1,643	2,464	1,714	764	1,604	3	1,502
Institutional infrastructure (score)	65.29	69.49	76.90	81.49	93.61	96.17	90.83	92.51	65.48	100.00	40.39	72.55
Laws against cyber crime (1-10)	9	8	8	8	10	8	10	10	7	10	8	6
Quality of training computer engineers (1-10)	5	9	6	6	7	9	10	9	7	9	7	8
Quality of educational system (1-7)	3.3	4.5	4.9	3.2	5.3	5.9	5.9	4.8	4.4	4.7	4.0	3.9
Internet access in schools (1-7)	3.8	4.6	4.9	4.6	6.4	6.4	6.2	6.1	4.9	5.8	5.7	6.2
ICT in government vision (1-7)	3.2	4.3	4.2	3.5	5.4	4.9	4.4	4.6	4.3	4.6	5.0	5.0
The web (score)	68.19	70.67	83.09	72.40	82.02	88.53	92.18	94.69	70.40	100.00	43.34	65.56
Web use (score)	66.52	62.93	81.05	63.62	78.67	89.27	97.30	80.25	58.46	87.01	33.67	59.29
% population using Internet	56.8	79.6	83.0	67.6	91.0	89,4	85,2	82.0	79,5	77,9	38,3	83,8
Web content (score)	60.11	69.29	73.03	71.96	73.66	74.32	72.26	97.24	73.98	100.00	48.67	63.29
Publication fiscal data (1-10)	8	6	8	8	8	9	8	10	8	9	8	9
Publication health data (1-10)	5	7	8	6	8	9	10	10	7	9	6	8
Publication education data (1-10)	6	7	10	8	6	9	10	10	6	9	5	8
Tax filing via the web (1-10)	5	9	10	10	10	9	9	10	10	9	9	7
Government online services (index)	0.58	0.88	0.75	0.76	0.84	0.88	0.67	0.97	0,86	1.00	0.53	1.00
Impact (score)	48.60	78.82	67.23	66.97	100.00	86.44	83.55	87.86	64.50	91.07	55.04	82.38
Social impact	53.08	74.40	68.58	59.45	98.50	83.26	72.82	86.42	74.99	89.13	73.98	80.61
Use of virtual social networks (1-7)	5.6	5.9	5.8	5.4	6.4	6.1	6.2	6.5	5.2	6.2	4.9	5.8
Impact of ICT on access to basic services (1-7)	4.4	5.6	5.5	5.0	6.3	5.6	6.0	5.4	4.9	5.3	5.3	6
Economic impact	42.39	78.88	72.36	63.40	89.36	79.30	98.36	88.28	69.15	81.14	53.27	71.94
Trust in web for commerce (1-10)	5	8	9	7	10	9	10	10	7	8	5	8
Business development around the web (1-10)	6	8	8	6	10	8	10	9	9	9	6	9
Extent of business internet use (1-7)	5.0	5.9	5.8	5.0	6.5	6.0	6.1	6.3	6.0	6.1	5.3	6.4
Political impact	47.33	75.13	54.30	72.62	100.00	87.29	70.84	78.85	42.62	92.54	32.27	85.82
Use of web for political mobilization (1-10)	7	8	5	9	10	9	8	8	5	9	4	7
ICT use and government efficiency (1-7)	3.9	5.1	4.6	4.4	5.9	5.2	5.3	4.9	4.2	4.9	4.9	5.7

Source: World Wide Web Foundation, 2012.

Table 3: **Doing business indicators**

	Italy	France	Germany	Spain	Sweden	Austria	Belgium	Denmark	Finland	Netherlands	Switzerland	UK	Japan	United States	China	Korea, Rep.
Ease of doing business (rank)	73	34	20	44	13	29	33	5	11	31	28	7	24	4	91	8
Starting a business (rank)	84	27	106	136	54	134	44	33	49	67	97	19	114	13	151	24
Procedures (number)	6	5	9	10	3	8	3	4	3	5	6	6	8	6	13	5
Time (days)	6	7	15	28	16	25	4	6	14	5	18	13	23	6	33	7
Cost (% of income per capita)	16.5	0.9	4.9	4.7	0.5	4.9	5.2	0.2	1.0	5.1	2.1	0.7	7.5	1.4	2.1	14.6
Minimum capital (% of income per capita)	9.7	0.0	0.0	13.2	13.2	49.1	18.2	24.2	7.0	49.4	26.3	0.0	0.0	0.0	85.7	0.0
Getting credit (rank)	104	53	23	53	40	23	70	23	40	53	23	1	23	4	70	12
Strength of legal rights index (0-10)	3	7	7	6	8	7	6	9	8	6	8	10	7	9	6	8
Depth of credit information index (0-6)	5	4	6	5	4	6	4	4	4	5	5	6	6	6	4	6
Public registry coverage (% of adults)	24.1	42.4	1.3	53.3	0.0	1.8	89.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.7	0.0
Private bureau coverage (% of adults)	100.0	0.0	100.0	13.2	100.0	52.6	0.0	7.3	18.9	81.7	26.8	100.0	100.0	100.0	0.0	100.0
Protecting investors (rank)	49	82	100	100	32	100	19	32	70	117	169	10	19	6	100	49
Extent of disclosure index (0-10)	7	10	5	5	8	5	8	7	6	4	0	10	7	7	10	7
Extent of director liability index (0-10)	4	1	5	6	4	5	6	5	4	4	5	7	6	9	1	4
Ease of shareholder suits index (0-10)	7	5	5	4	7	5	7	7	7	6	4	7	8	9	4	7
Strength of investor protection index (0-10)	6.0	5.3	5.0	5.0	6.3	5.0	7.0	6.3	5.7	4.7	3.0	8.0	7.0	8.3	5.0	6.0
Enforcing contracts (rank)	160	8	5	64	27	7	18	34	9	32	20	21	35	6	19	2
Procedures (number)	41	29	30	40	30	25	26	35	33	26	32	28	30	32	37	33
Time (days)	1,210	390	394	510	314	397	505	410	375	514	390	399	360	370	406	230
Cost (% of claim)	29.9	17.4	14.4	17.2	31.2	18.0	17.7	23.3	13.3	23.9	24.0	25.9	32.2	14.4	11.1	10.3
Resolving insolvency (rank)	31	43	19	20	22	12	7	10	5	6	45	8	1	16	82	14
Time (years)	1.8	1.9	1.2	1.5	2.0	1.1	0.9	1.0	0.9	1.1	3.0	1.0	0.6	1.5	1.7	1.5
Cost (% of estate)	22	9	8	11	9	10	4	4	4	4	4	6	4	7	22	4
Recovery rate (cents on the dollar)	63.4	48.4	78.1	76.5	74.7	83.3	88.7	87.1	89.7	88.8	47.5	88.6	92.8	81.5	35.7	81.8
Paying taxes (rank)	131	53	72	34	38	77	75	13	23	29	18	16	127	69	122	30
Payments (number per year)	15	7	9	8	4	12	11	10	8	9	19	8	14	11	7	10
Time (hours per year)	269	132	207	167	122	170	156	130	93	127	63	110	330	175	338	207
Total tax rate (% of profit)	68.3	65.7	46.8	38.7	53.0	53.1	57.7	27.7	40.6	40.1	30.2	35.5	50.0	46.7	63.7	29.8
Trading across borders (rank)	55	27	13	39	8	26	29	4	6	12	35	14	19	22	68	3
Documents to export (number)	4	2	4	5	3	4	4	4	4	4	4	4	3	4	8	3
Time to export (days)	19	9	7	9	8	8	9	5	8	6	8	7	10	6	21	7
Cost to export (US$ per container)	1,145	1,078	872	1,260	705	1,090	1,230	744	540	895	1,435	950	880	1,090	580	665
Documents to import (number)	4	2	5	6	3	5	5	3	5	4	5	4	5	5	5	3
Time to import (days)	18	11	7	9	6	8	9	3	7	6	9	6	11	5	24	7
Cost to import (US$ per container)	1,145	1,248	937	1,350	735	1,155	1,400	744	620	975	1,440	1,045	970	1,315	615	695
Registering property (rank)	39	146	81	57	35	34	176	6	24	49	15	73	64	25	44	75
Procedures (number)	3	8	5	5	1	3	8	3	3	5	4	6	6	4	4	7
Time (days)	24	59	40	13	30	21	64	10	14	7	16	29	14	12	29	11
Cost (% of property value)	4.5	6.1	5.7	7.1	4.3	4.6	12.7	0.6	4.0	6.1	0.4	4.7	5.8	3.5	3.6	5.1
Dealing with construction permits (rank)	103	52	14	38	25	75	57	8	34	89	50	20	72	17	181	26
Procedures (number)	11	9	9	8	7	13	11	8	16	14	13	9	14	15	28	11
Time (days)	234	184	97	182	116	194	205	68	66	159	154	99	193	27	270	29
Cost (% of income per capita)	184.2	68.0	48.1	51.8	77.3	57.3	54.2	57.1	43.3	78.9	39.1	62.4	28.5	14.4	375.3	127.2
Getting electricity (rank)	107	42	2	70	9	24	82	14	21	67	8	62	27	19	114	3
Procedures (number)	5	5	3	5	3	5	6	4	5	5	3	5	3	4	5	4
Time (days)	155	79	17	101	52	23	88	38	47	143	39	105	105	68	145	28
Cost (% of property value)	319.2	43.9	48.3	232.0	37.1	104.5	92.6	119.7	29.6	33.5	61.1	108.9	0.0	16.1	547.0	33.3

Source: International Bank for Reconstruction and Development / The World Bank, 2013.

Table 4: **Community innovation survey indicators**

		Italy	France	Germany	Spain	Sweden	Austria	Belgium	Denmark	Finland	Netherlands
Innovative firms with in-house R&D											
All firms		46.2	66.8	48.5	32.3	59.7	50.9	56.3	44.8	79.2	56.9
Small firms		41.7	61.9	42.9	25.8	55.6	45.9	48.2	38.5	75.6	52.8
Medium-sized firms		64.4	74.6	58.2	45.3	68.4	57.4	70.9	55.2	84.9	65.9
Large firms		69.2	81.4	73.0	59.7	80.7	71.4	83.1	72.3	94.1	69.7
Innovative firms with external R&D											
All firms		17,0	32,2	16,9	19,0	28,0	28,3	31,5	20,7	54,9	24,1
Small firms		14,4	26,9	11,2	15,2	23,1	21,9	25,3	17,6	49,5	19,7
Medium-sized firms		25,9	37,9	26,7	25,2	37,8	36,5	41,7	22,5	62,2	33,0
Large firms		36,2	56,3	43,7	39,3	56,6	55,3	55,8	43,9	81,1	41,8
Turnover of innovative firms											
All firms		78.2	87.5	93.7	74.0	81.0	80.3	84.0	74.9	82.4	81.7
Small firms		58.3	48.9	83.4	50.3	55.1	61.4	52.4	56.0	62.7	58.3
Medium-sized firms		73.9	65.7	87.5	57.9	76.8	74.9	84.4	68.4	74.2	75.4
Large firms		92.5	96.8	97.5	93.0	92.3	91.0	94.9	89.3	90.0	95.8
Public sector funding of innovation											
All firms		29.2	46.1	21.6	26.9	-	40.0[1]	22.6	-	35.2	34.1
Small firms		27.5	40.6	20.6	24.1	-	34.1[1]	18.6	-	31.6	29.1
Medium-sized firms		35.8	54.6	21.8	31.9	-	48.2[1]	26.8	-	37.7	44.5
Large firms		38.4	64.1	32.2	40.7	-	60.1[1]	46.6	-	58.0	53.0
Source of information for innovation											
Within enterprise/group		35.8	53.3	54.5[1]	46.1	-	-	54.4	-	62.1	42.7[1]
Suppliers		21.6	19.2	16.6[1]	25.2	-	-	26.9	-	14.8	20.2[1]
Clients		17.1	26.9	44.0[1]	20.7	-	-	25.7	-	39.5	26.8[1]
Competitors		4.8	10.1	16.5[1]	10.5	-	-	8.9	-	11.5	8.1[1]
Co-operation for innovation											
Any form		12.1	36.1	24.3	22.3	38.8	51.0	42.3	39.7	39.8	33.5
With consultants or private R&D institutes		6.8	14.3	7.8	6.1	23.4	18.7	15.3	14.3	30.1	11.2
With universities		5.3	12.9	13.9	7.9	13.8	21.8	16.9	12.8	30.3	8.3
With government or public research institutes		2.2	10.1	5.9	8.7	7.0	9.2	9.3	10.5	23.3	6.6
Expenses over turnover											
All firms	Innovation	1.3	1.1	2.1	1.1	2.9	1.7	1.9	3.7	2.9	1.6
	R&D	0.7	0.8	1.3[1]	0.7	2.3	1.4	1.4	3.1	2.4	1.0
Small firms	Innovation	1.1	1.5	1.1	0.7	2.0	1.2	1.2	1.9	1.8	2.1
	R&D	0.5	1.0	0.5[1]	0.5	1.1	0.8	0.6	1.4	1.3	0.6
Medium-sized firms	Innovation	1.0	1.5	1.1	0.7	1.7	1.2	1.5	1.2	1.7	1.0
	R&D	0.5	0.9	0.6[1]	0.5	1.0	0.9	0.9	0.7	1.1	0.6
Large firms	Innovation	1.6	0.9	2.7	1.4	3.7	2.2	2.3	6.3	3.6	1.8
	R&D	1.0	0.8	1.7[1]	0.9	3.2	1.9	1.9	5.7	3.1	1.5
Number of innovative firms											
All firms	Firms with innovation	56.3	53,5	79,3	41,4	59,6	56,5	60,9	54,7	56,2	56,7
	Firms with tech. innovation	40.4	34,3	64,2	29,2	48,5	43,9	51,6	42,9	46,4	47,1
Small firms	Firms with innovation	53.9	48,6	76,5	37,5	55,9	51,1	55,0	50,5	52,8	52,1
	Firms with tech. innovation	37.8	29,0	60,0	24,7	44,9	37,9	45,4	39,6	42,3	43,0
Medium-sized firms	Firms with innovation	69.9	68,2	86,0	58,8	71,9	71,2	79,3	64,2	63,4	70,3
	Firms with tech. innovation	55.0	49,9	74,9	49,2	59,5	60,5	70,8	48,9	54,6	58,8
Large firms	Firms with innovation	83.8	84,0	93,7	81,5	84,6	87,7	86,9	83,0	83,3	85,0
	Firms with tech. innovation	70.9	70,8	84,6	75,7	76,5	79,6	79,4	71,7	80,4	76,1

Source: Eurostat, CIS 2010. - (1) Data referred to CIS 2008.

Table 5: **R&D, patents, trademarks and industrial designs**

		Italy	France	Germany	Spain	Sweden	Austria	Belgium	Denmark	Finland	Netherlands	Switzerland	United Kingdom	Japan	United States
% R&D personnel															
All sectors	2009	1.54	1.87	2.01	1.90	2.55	2.37	2.01	3.03	3.23	1.22	-	1.75	1.84	-
Business enterprise	2009	0.65	0.99	1.00	0.71	1.37	1.24	0.94	1.75	1.68	0.61	-	0.54	1.11	-
Government	2009	0.20	0.22	0.27	0.32	0.11	0.15	0.12	0.09	0.35	0.15	-	0.07	0.11	-
Higher education	2009	0.64	0.63	0.75	0.86	1.07	0.96	0.93	1.18	1.18	0.47	-	1.11	0.59	-
% R&D personnel in industry	1985	3.3	8.5	12.7	1.8	11.4	4.7	7.7	6.0	6.5	7.2	12.0[1]	8.5	8.5	-
	2010	6.1	12.5	11.3	6.5	18.1	13.0	10.1	19.6	17.5	9.1	11.7[4]	7.0	11.9	-
HERD financed by industry	1985	1.5	1.9	5.4	1.1	5.5	1.7	8.7	1.0	3.8[2]	1.0	3.3[1]	5.2	1.5	6.1
	2010	1.1	1.8	14.3	8.0	4.5[3]	5.2[3]	11.0[3]	3.4	5.7	8.2[3]	9.1	4.6	2.6	6.0
BERD over value added	1985	0.87	2.03	2.78	0.39	3.02	0.99	1.74	1.13	1.37	1.67	2.91[1]	2.01	2.38	2.99
	2010	1.12	2.36	3.09	1.05	3.97	2.87	2.20	3.66	4.67	1.41	3.09[4]	1.63	3.76	3.28
% R&D investments of top 50 firms	2011	34,8	55,2	61,7	25,0	63,4	9,8	28,6	56,7	89,8	90,6	-	61,2	61,4	37,0
Patents per 100000 employees	1985	29.8	91.0	167.7	3.6	149.0	60.1	61.8	43.7	31.5	132.8	261.1	62.1	93.7	100.7
	2010	38.6	133.5	192.6	17.2	291.8	135.2	130.9	155.5	209.3	145.1	250.6	71.7	304.3	141.1
World share of triadic patents	1985	2.25	6.58	15.99	0.15	1.91	0.71	0.73	0.35	0.26	2.43	3.30	5.59	22.03	34.61
	2010	1.42	4.89	11.37	0.49	1.75	0.83	0.80	0.58	0.73	1.72	1.70	3.17	31.21	27.85
Trademarks per million pop	2000	49.2	37.4	59.8	54.3	97.3	60.0	61.3	104.0	75.9	57.1	-	75.2	7.9	32.1
	2012	117.8	105.7	222.8	148.4	231.3	289.8	137.2	211.5	176.0	220.3	-	141.5	16.0	40.9
Industrial designs per million pop	2003	50.8	23.1	48.6	34.7	59.7	37.8	34.2	85.2	26.9	46.7	-	32.7	7.7	9.1
	2012	104.0	63.9	148.7	44.2	76.9	170.2	65.4	162.5	95.8	94.4	-	42.7	19.0	13.6

Sources: OECD, Eurostat, OHIM. - (1) Data referred to 1986. (2) Data referred to 1987. (3) Data referred to 2009. (4) Data referred to 2008.

Table 6: **Statistical sources of data**

Figure	Table	Variable	Source	Table
1	1	Educational levels	Eurostat	educ_itertc
	1	Share of foreign graduates	Eurostat	educ_mo
2	1	Universities among the top 500	Leiden ranking	http://www.leidenranking.com/ranking.aspx
	1	Quantity of scientific research	SCImago Journal & Country Rank	http://www.scimagojr.com/countryrank.php
	1	Quality of scientific research	SCImago Journal & Country Rank	http://www.scimagojr.com/countryrank.php
3	2	Share of broadband subscribers	World Wide Web Foundation	ITUB
	2	Share of individuals using the Internet	World Wide Web Foundation	ITUH
	2	Fixed subscription cost (% of GDP)	World Wide Web Foundation	ITUE
	2	ICT use and government efficiency	World Wide Web Foundation	WEFN
	2	Impact of ICT on accesses to basic services	World Wide Web Foundation	WEFJ
	2	Extent of business Internet use	World Wide Web Foundation	WEFK
4	3	Doing business sectoral rankings	The World Bank	Doing business survey
5	3	Days to start a business	The World Bank	Doing business survey
	3	Cost to start a business (% of PC GDP)	The World Bank	Doing business survey
	3	Years to enforce a contract	The World Bank	Doing business survey
	3	Cost to enforce a contract (% of claim)	The World Bank	Doing business survey
6	1	Venture capital	Eurostat	htec_vci
	-	Business angels	OECD	OECD elaboration(1) based on EBAN and ACA(2)
	-	Stock market participation	Datastream	see Bank of Italy, Annual report on 2011, p. 192
7	1	Graduates and R&D personnel	Eurostat	htec_emp_nisced
	1	R&D personnel by sector	Eurostat	rd_p_perslf
8	4	Cooperation for innovation	CIS	inn_cis7_coop
	4	Industry-university co-pubblications	Leiden ranking	http://www.socialsciences.leiden.edu/cwts/ research/uirc-scoreboard-2011.html(3)
9	5	HERD financed by industry	OECD	MSTI excel file(4), spreadsheet 48-H XFB
	4	Source of information for innovation	CIS	inn_cis7_sou
10	5	BERD over value added	OECD	MSTI excel file, spreadsheet 26-B XVA
	1	Concentration in R&D expenditure	Economics of industrial research and innovation	Elaboration based on the 2011 EU Industrial R&D Investment Scoreboard(5)
11	4	Enterprises engaged in in-house R&D	CIS	inn_cis7_exp
	4	Public sector funding of innovation	CIS	inn_cis7_pub
12	4	Innovative firms by size	CIS	inn_cis7_type
	4	Firms with technological innovation by size	CIS	inn_cis7_type
13	4	Turnover of innovative firms	CIS	inn_cis7_bas
	4	Turnover of innovative firms by size	CIS	inn_cis7_bas
14	4	Innovation and R&D exp. over turnover	CIS	inn_cis7_exp
	4	Innovation expenditure by size	CIS	inn_cis7_exp
15	5	Patents per 100,000 workers	OECD	MSTI excel file, ratio spreadsheet 65 P TRIAD/spreadsheet G INDEMP
	5	World fraction of triadic patents	OECD	MSTI excel file, spreadsheet 66-P XTRIAD
	5	Statistics on trademarks and design	OHIM	http://oami.europa.eu/ows/rw/pages/OHIM/statistics.it.do

(1) See the volume "Financing High-Growth Firms - The Role of Angel Investors", Figure 2.6. (2) Respectively The European Trade Association for Business Angels, Seed Funds, and other Early Stage Market Players, and the Angel Capital Association. (3) Elaborations on the file "world_top_500_20111107.xls". The values used for the calculation correspond to the upper bound of each class. For the highest class (more than 1500 co-pubblications) we consider a value of 2500. (4) Excel file MSTI_2012_2 available on "http://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB", clicking on "export/related files". (5) Available on http://iri.jrc.ec.europa.eu/research/scoreboard_2011.htm, file "R&D ranking of the top 1400 World companies". We consider for each country the first 50 enterprises for R&D investments. A projection has been inserted for those countries with a number of enterprises in the ranking below 50.