Knowledge intensive sectors in moderate innovative countries in Europe: overcoming the missing links, stepping over barriers

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ABSTRACT

In this paper we characterize the national innovation systems of two moderate innovative countries – Italy and Portugal. We argue that moderate innovative countries are at a crossroads, since they do not have the attributes to compete with either the most advanced economies or the emerging countries. Bearing this in mind, we provide some elements for the design of a comprehensive catch-up strategy aimed at overcome the barriers, constraints and weaknesses of these national innovation systems.

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1. INTRODUCTION

The ability to innovate, create, combine and incorporate knowledge in the creation and development of new products or services has become a major driving force for the destiny of nations. Advanced countries have the necessary attributes to compete in the production of knowledge-intensive goods and services. Emerging countries seemingly have an insuperable advantage in cost-competitive and labour intensive production. However, the countries that show weak or modest levels of innovative performance and intermediate levels of development are living in a limbo, in a 'Rubicon moment' of their history. Since they do not have the competitive attributes to compete with the more advanced countries or the emerging ones, they either 'cross the river' and join the select club of the advanced economies by developing their national innovation systems, making them robust and dynamic, or they just 'stand on the sidelines' and live in a permanent dilemma or, in the worst scenario, face severe economic stagnation and decline.

Although Portugal and Italy have very different levels of wealth and development, they belong to this group of moderately innovative countries. They not only face the same general challenges and problems but also share many features and particularities. In this paper we seek to characterize the national innovation systems of these two countries, how they have evolved, their performance and their main strengths and weaknesses. We also seek to provide moderately innovative countries with elements for a catch-up strategy based essentially on the following pillars: taking advantage and consolidating their areas of scientific and technological excellence, by increasing the critical mass and internationalization of these areas; strengthening and upgrading their competitiveness clusters through the incorporation of technological, organizational and commercial innovation; promoting cooperation among companies and between companies and universities through partnerships and networks in order to make up for the companies' lack of resources, including knowledge; increasing the available venture capital; substantially improving the coordination and synergies among the components of the innovation systems, which are characterized as incomplete and ill articulated in these countries.

2. NATIONAL INNOVATION SYSTEMS: THE DIVERSITY OF PERSPECTIVES

The concept of national innovation system (NIS) is based on the understanding that innovation is a social, complex and systemic process, influenced by the particular context where it occurs.

The leading nineteenth century German economist Friedrich List (1789–1846) may be considered the founding father of this approach. List developed the concept of 'national system of political economy' which, according to Freeman (1995), might also be called 'national innovation system'. But only in the 1980s, authors such as Lundvall and Freeman began to systematize and properly formalize this approach.

Lundvall is part of a group of authors that put emphasis on the interrelationships and interdependencies, and on the knowledge circulation and interactions that lead to learning processes within the NIS (Salavisa 2001). For Lundvall (1992), an innovation system arises from the combination of the formal R&D subsystem – constituted by universities, laboratories and public institutes – with the system of production and consumption (Salavisa 2001). Informal learning processes (learning by doing, learning by using, learning by interacting) emerge from the routines of production and consumption, which, together with the creation and formal application of knowledge in the R&D subsystem, is responsible for the innovation process.

Other authors, such as Freeman and Nelson, prefer to focus not on relations, but on the actors and formal institutions, whose activities and interactions promote the creation and diffusion of innovations (Salavisa 2001).

Richard Nelson organized a major work regarding the national innovation systems approach: *National Innovation Systems – a comparative analysis* (1993). Adopting a comparative perspective, 15 national cases were systematically characterized in this book. As Edquist (2005) noted, Nelson, unlike Lundvall – whose theoretical approach sought to provide an alternative to the neoclassical economics tradition, placing innovation, interaction and learning at the centre of the analysis – adopted an empirical approach, focusing on specific national case studies.

Other authors chose to reject the concept of NIS. This was the case of Bruno Amable, Rémi Barré and Robert Boyer who, in 1997, proposed instead the concept of 'social system of innovation and production'. The diversity of specifications (national, international or local) for analysing innovation was one of the main weaknesses of the NIS approach, according to the

French authors. As Amable (2003) later argued, the international nature of knowledge production and the increasingly higher rate of diffusion of new technologies and new organization modes are not consistent with an analysis strictly focused on the national context. Moreover, an analysis focused on the nation-state is problematic in terms of comparability between different national case studies.

The different perspectives outlined here raise a question whose answer is of central importance: what is, after all, the definition of national innovation system?

3. A SYSTEMIC APPROACH TO NATIONAL INNOVATION

Charles Edquist (2005) broadly defines the innovation system as a set of all economic, social, political, organizational and institutional factors that influence the development, diffusion and use of innovations. Assuming that the national set-up is the optimal framework for studying the influence of these factors – because the legislation, education and training systems, R&D system, culture and social and political institutions are still under the direct control of national states or are explained by national historical idiosyncrasies (notwithstanding the Europeanization process in the case of the EU member states) – we endorse the approach of national innovation systems.

The process of transforming knowledge into new marketable goods, services or processes – the innovation process – is the outcome of the activity carried out by a complex set of different actors – companies, universities and laboratories, government, schools, intermediary institutions – and of the interactions established among these actors. The total sum of those actors and their activities, alongside the interactions established by them, forms an integrated and coherent whole – a system where innovation takes place – which we call a national innovation system. This narrower definition emphasizes the two elements that form any system: its components and the relationships between these components.

In any case, there is no canonical definition of national innovation system. As we have seen, the main authors responsible for the systematization and development of this approach have proposed many different definitions and perspectives, which reflect the specific theoretical focus of each. Some authors stress the inter-relationships, the knowledge flows and the learning processes that take place within the NIS, while others emphasize the formal organizations, their action and configuration.

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Regardless of the definition adopted, we find that there are two core assumptions on which the national innovation systems approach is built:

- First, the assumption that innovation is a social process, with a *systemic nature*.
- Secondly, the assumption that this social process is influenced by *national* (or local or social) *idiosyncrasies*.

As to the first idea, the supporting argument goes as follows: the paradigm of information and communication technologies (ICT) has created a social and economic context in which knowledge has been assigned the status of a production factor. Producing new goods and services requires not only labour and capital, but also the incorporation of knowledge in the production process. But knowledge is complex and this complexity is increasing. All companies need to interact with the exterior in order to obtain knowledge and other resources – such as funding, facilities, a skilled workforce and human capital, information, credibility and influence – since their internal capabilities are, to a greater or lesser extent, limited. As to knowledge, it flows in networks established by companies with other companies and external institutions. Innovation is thus a collective undertaking, characterized by processes of interchange, learning and absorption of knowledge produced elsewhere. In the context of this collective enterprise, the actors and the interactions they establish constitute a system – and innovation therefore has a systemic nature and is a social process that involves actors and interaction between these actors.

Underlying the second idea is the recognition that these actors and their interactions are characterized by national specificities. In simple terms, this means that the innovation process takes place in a different way across countries due to the influence of national idiosyncrasies on production, absorption and diffusion of new goods, services or processes.

Due to various determinants and constraints, nations differ in terms of the government's role in the economy, the innovation policies followed, the dominant form of business organization, the types of relationship between companies, the organization and quality of education systems, the financial systems, the role of intermediary institutions, culture, social norms and attitudes towards innovation, the attitude of citizens towards risk and entrepreneurship, work ethics, etc. As the innovation process is embedded in the social system, it will be influenced and determined by these characteristics, thus creating specific cases and national models.

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We will now address four major questions. The first concerns the importance of what Edquist (2005) called 'the rules of the game'. The second relates to the question whether it makes sense to talk about *national* innovation systems (see Amable, Barré and Boyer 1997). The third one involves the adequacy of the NIS approach to less or moderately innovative countries. Finally, we shall conclude by analysing the role of research institutions and innovation networks in these types of country.

3.1. The role of social and political institutions

A reductionist approach assumes that a system can be reduced to the sum of its main components and, therefore, the understanding of such system may be achieved through the separate study of each of its key parts. Thus, it would suffice to study the activities of the formal organizations involved – companies, universities, public institutes and laboratories and foundations, just to mention the most relevant. However, the NIS approach does not take a reductionist point of view. It is a holistic approach (Edquist 2005), i.e., it considers that innovation emerges from a collective and integrated contribution of the various components of the system and, therefore, it cannot be studied only as an aggregate of isolated and individual contributions of formal organizations. Thus, it makes sense to study not only the behaviour of the individual players, but also the 'rules of the game' that define, constrain and influence the players' activity and performance. These 'rules of the game' are the social institutions. Edquist (2005) defines social institutions as the norms, laws, habits, routines and practices that influence the relationships between the formal components – the players – of the system.

Sir Edward Tylor (1871), an influent British anthropologist, coined one of the most famous definitions of 'culture', defining it simply as 'that complex whole which includes knowledge, belief, art, morals, law, custom and any other capabilities and habits acquired by man as a member of society.' Indeed, if we define culture this way, it becomes obvious that any complex social process carried out by humans, such as innovation, is influenced by the cultural traits of the individuals and society.

History provides interesting examples of how national culture may serve as a barrier or enabler of economic growth, technological progress, entrepreneurship and innovation.

In the book *Why Has Japan 'Succeeded'? Western Technology and the Japanese Ethos* (1984), Michio Morishima argues that Japanese success since the Meiji Restoration (1868) has mainly been due to the country's specific cultural traits and value system: the Confucian ethics that promoted the spirit of sacrifice and total dedication to the company and country combined with the adaptation of Western science and technology in a logic of government intervention, has supported the Japanese Miracle since the opening of Japan to the outside world. In a second book – *Japan at Deadlock* (2000) – Morishima reflects on the recent decline of the Japanese economy and argues that one of its causes is precisely the mutation of the Japanese value system and the progressive breaking away from the Confucian *ethos* (in the education system for instance).

In his influential work *The Rise and Fall of Great Powers* (1988), the historian Paul Kennedy reflects, among other issues, on the reasons that explain the rise and meteoric takeoff of the European world after the Renaissance. Indeed, in 1500 it was not obvious that the small and belligerent Western European states would come to dominate a large part of the planet three centuries later. The historian sustains that the great Eastern empires – the Ming China, the Ottoman Empire or the Mughal India – were much more plausible candidates, not only because of their overwhelming military power, but also because of the advantages they possessed in the fields of 'culture, mathematics, engineering or navigational technologies' (Kennedy 1988: 30). The author adds that 'a considerable part of the European cultural and scientific heritage was, in any case, "borrowed" from Islam, just as Muslim societies had borrowed for centuries from China' (Kennedy 1988: 30).

In that case, what does explain the decadence of the great eastern empires? Kennedy argues that these empires made the mistake of turning inward. Whereas the relatively unsophisticated European states benefited from fragmentation, decentralization, diversity and political rivalry – which encouraged competitive interaction and continuous dynamics of innovation – and from the absence of a central and uniform authority that could systematically suppress this or that scientific, cultural or commercial development, the great eastern empires were centralized and *dirigiste* entities that became monolithic, closed and self-centred. New ideas and scientific progress that challenged the official orthodoxy could be easily crushed and asphyxiated by the central authority. This was the case of Ming China: a brilliant and technologically advanced civilization that 'decided to turn its back on the world' (Kennedy 1988: 33) – trade with the outside world was successively forbidden, entrepreneurial developments and investments were increasingly restricted, commercial activities, once flourishing, came to be regarded with contempt and suspicion, the manufactures were abandoned, the introduction of new techniques and ideas developed in the West was vigorously rejected by the emperors and the imperial bureaucracy.

The isolationism, conservatism and traditionalism of Ming China, as well as the Japanese Confucian *ethos* are examples of how historical conditions and society's specific cultural traits may combine at a given moment to promote or block innovation and knowledge creation.

3.2. The national framework

As Freeman (1995) states, the idea that the nation-state is the optimal set-up for analysing the innovation phenomenon has been challenged by rival specifications. To what extent does the national framework still bear relevance in the present context, where companies' domain of activity has ceased to be local and has become global? To what extent is it still relevant to focus on national innovation systems, when several determinants of the innovation process are supranational – such as science, which is produced by universities, laboratories and researchers from all around the world? To what extent does it make sense to speak about national specificities of the innovation processes when the differences tend to blur in the sequence of the growing economic integration and interdependence and the global competition? And finally, to what extent is it possible to underestimate the Europeanization of the innovation policies, particularly since the Lisbon Strategy in 2000?

Despite these relevant questions, which weaken the concept of national innovation system in a certain way, several influential authors, such as Edquist (2005) and Freeman (1995), emphasize that the NIS approach remains important and appropriate.

First, as Edquist argues, the myriad of comparative studies that have been carried out since the books organized by Lundvall (1992) and Nelson (1993) shows that 'there are sharp differences among various national systems in such attributes as institutional set-up, organizational set-up, investments in R&D, and performance' (Edquist 2005: 199). The author exemplifies with the remarkable differences between the NIS of his own country, Sweden, and that of Denmark, a neighbouring nation so similar in other aspects. Thus, there is some empirical evidence in favour of the NIS's relevance.

Other national (and local) specificities also remain, despite the internationalization and globalization processes. From geographical and climatic conditions (Freeman 1995) to social institutions, legal frameworks and cultural norms, national idiosyncrasies that have the ability to influence innovation processes have not yet been diluted. Aspects such as the recognition of merit and knowledge, the work ethic, trust in institutions, the ability to cooperate, social responsibility or the system of individual incentives and rewards differ widely among countries.

Secondly, it is not just a matter of the geographical definition of the innovation systems, but rather the recognition of the fact that state power is exerted within specific boundaries (Edquist 2005). In other words, most public policies and social institutions such as laws and regulations are still defined and implemented at national level, although increasingly defined at a supranational level in the case of EU countries.

Finally, it is a mistake to consider the various specifications – national, regional or sectoral – as mutually exclusive approaches. As Edquist (2005) states, these variants may even be complementary, since each one can be useful for a deeper look into different parts of the same system.

Indeed, the innovation systems approach may assume various specifications. Thus, we speak about 'regional innovation systems' (Asheim and Gertler 2005), 'sectoral innovation systems' (Malerba 2005) or 'social innovation systems' (Amable, Barré and Boyer 1997). The national specification, while important, is by no means unique to the innovation systems approach.

To conclude, it should be noted that although the concept remains relevant, the NIS interactions with the exterior are increasingly important (Freeman 1995; Salavisa 2001). Moreover, the application of the national specification is not universal: there are countries where the lack of a high level of internal coherence of the innovation processes means one cannot speak about the existence of a single national innovation system at all (Edquist 2005). As we shall see, Italy is a paradigmatic example.

3.3. National innovation systems in moderately innovative contexts

Does it make sense to apply the approach of national innovation systems to national contexts of low to moderate innovative performance? The fact that Nelson included the cases of intermediate and developing countries in his book on national innovation systems indicates that the answer is yes, provided some adaptations are made. In such cases the analysis focuses on the transfer and adoption processes of foreign technology and on the formal R&D subsystem, especially the public institutions funded by the government (Dahlman and Frischtak 1993).

In fact, in low to moderately innovative contexts, the limited presence of high technology industries implies that much of the R&D effort will be made by universities and public laboratories rather than domestic firms, hence the great relevance of public R&D expenditures (Salavisa 2007). The study of these actors' performance and activities is therefore especially important in these countries. This is precisely what happens in the case of Portugal. Although in a far higher level of economic and industrial development, Italy shares many of these problems.

On the other hand, Fagerberg (2005) states that complementarity among components is an important characteristic of any system. If a critical component is missing or is limited, this may block or reduce the performance of the entire system. The presence of such imbalances, blockages or constraints (bottlenecks) is a feature of moderately innovative contexts. This may, for instance, originate deficiencies in the funding subsystem (shortage of venture capital), lack of infrastructures, shortage of skills among the population, weaknesses of the education and training systems or other specifically national blockages.

In addition, these countries usually have strong regional imbalances. Developed centres and regions with excellent teaching and research institutions, good infrastructure and nuclei or clusters of technologically advanced companies coexist with depressed and backward areas, declining economic activities and severe shortage of resources. The former are generally well positioned in international networks of knowledge and production, while the latter are disconnected and set aside. The first are in a catching up process, the latter in a falling behind process.

In these contexts, besides promoting innovation and technology transfer, public policies also have a renewed role in neutralising and correcting these limiting or paralyzing constraints so that the national system may function properly. This applies not only to innovation policy in the strict sense, but also to broader public policies – from education policy to regional policy. In fact, according to the IUS 2010, despite various national particularities, one characteristic shared by the most innovative countries – is the fact that all of them have balanced NIS, i.e., they display harmonious performances without the presence of large asymmetries and imbalances among the various factors that influence the innovation process.

To conclude, in the case of moderately innovative countries, greater importance should be assigned to the set of actors and interactions that influence the introduction of new technologies and innovations created outside the system, to universities and government laboratories as the key components of the formal R&D subsystem and to the role of public policies.

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3.4. The role of universities and social networks in the catching-up of less advanced countries

In recent decades, the importance of universities has increased. This is mostly due to the new centrality and notable progress of scientific knowledge and the vast expansion of graduate professionals in advanced societies. But it is also due to the increased interaction between the academy and the business world, particularly in some fields of science and technology. Examples of these relationships are the multiplication of academic spin-offs in areas like biotechnology or computer science and the increase of co-authored publications between academia and industry (Mowery and Sampat 2005). New approaches have emerged to reflect this reality, such as the 'Mode 2' concept of research (Gibbons *et al.* 1994) and the Triple Helix model (Etzkowitz and Leydesdorff 2000; Etzkowitz 2003).

The 'Mode 2' research process is characterized by interdisciplinarity, pluralism and networking in the innovation system, which results from the increasing complexity and diversity of knowledge inputs required for the process (Gibbons *et al.* 1994).

The Triple Helix model arises when the three institutional spheres (university, business and government), starting from a position of relative autonomy, initiate reciprocal relations of cooperation. This increased interaction leads to the creation of trilateral networks and sets new organizational mechanisms that act as channels of interaction: incubators, science and technology parks and venture capital companies are some examples. These platforms act as sources of innovation, economic growth and community building. The increase of the interaction brings about an overlapping of the roles of the three helices, i.e. each Triple Helix partner 'takes the role of the other' (Etzkowitz and Leydesdorff 2000; Etzkowitz 2003). Thus, in addition to their primary role, each institutional sphere assumes secondary capabilities that constitute the core mission of the other spirals of the Triple Helix (keeping the distinct identities): companies also carry out research and advanced training of human resources; in addition to defining the rules of the game, the government also becomes involved in providing venture capital to finance new and risky businesses; and universities not only do teaching and research but also play a more active and decisive role in promoting economic growth and social development, especially at regional level.

These approaches signal the new role of universities and their new relationship with the economy, even though, according to Mowery and Sampat (2005), this only holds true for specific research areas and particular university-industry relationships.

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The strong dependence on universities is evident in knowledge-intensive sectors, especially when they operate on the knowledge frontier. The role of universities is equally or even more important in moderately innovative countries. This is due to the fact that in these countries there is a lack of high technology industries with a capacity to conduct R&D on a large scale. To fill this gap, companies in emerging sectors resort to the external environment, to cooperation with domestic research institutions and to very active networking strategies to access the multitude of resources they need. These are the cases of biotechnology and software for telecommunications sectors analysed in this book.

4. NATIONAL INNOVATION SYSTEMS IN PORTUGAL AND ITALY: A BRIEF CHARACTERIZATION

In this section, we will carry out a brief diagnosis and an empirical characterization of the national innovation systems in two moderate innovative countries: Portugal and Italy.

Godinho (2007) argued that the S&T, innovation and knowledge indicators have undergone an evolution that reflects the economic changes of recent decades. The author identified three generations of indicators in the last half century: input and output indicators (the first generation); S&T impact indicators (the second generation) and the so-called third generation indicators. The creation of the latter was strongly influenced by the SNI approach. The assumption that the innovation process is systemic, and influenced by a wide range of economic, social, political, cultural and organizational factors led, in this new stage, to the creation of statistical publications composed of internationally comparable indicators originating from a variety of sources, in order to capture the multifaceted nature of the innovation process (Godinho 2007).

Bearing this in mind, the analysis of the Italian and Portuguese cases will be based on the European Innovation Scoreboard (Innovation Union Scoreboard since the 2010 edition), a European Commission instrument aiming to compare and analyse the innovative performance of the member states and the EU as a whole. To this end, it presents a composite indicator drawing on a great variety of quantitative and qualitative indicators (in the 2010 edition, the composite indicator draws on 24 indicators divided into eight innovation dimensions). This indicator functions as a single measure of the national innovation system's performance – both in static and dynamic terms – in each European member state. We will also use other relevant indicators and statistical data.

4.1. The Italian national innovation system

In the seminal work edited by Richard Nelson (1993), in which 15 national innovation systems were analysed and compared, the Italian case was presented by Franco Malerba.

Malerba claimed that there is not one single NIS in Italy but two, each with different capabilities and displaying different organization and innovation performances. As mentioned above, there must be a high internal degree of coherence in the innovation processes in order to justifiably speak of a national innovation system. Malerba argued that there is no such coherence in Italy at the national level; instead, there is a dualistic structure, with two distinct innovation systems. However, contrary to what one might expect, the author does not identify the two Italian innovation systems with the well known North-South divide. The two Italian innovation systems defined by Malerba are a system characterized by a small firms' network and the core R&D system.

The small firms network comprises a vast number of SMEs operating in traditional and 'made-in-Italy' sectors (especially in textiles, apparel and footwear) and also in mechanics and equipment supply. Malerba argued that companies in this innovation system are highly profitable and show great dynamism and international success. Their great strengths have been the specialization in the production of differentiated and customized consumer goods (the successful Italian fashion industry is a good example), which incorporate high value added in terms of design and quality, and the production of specific components for particular customers and specific needs. This is the case of the small and medium size equipment suppliers that specialized in components and machinery targeting the specific needs of sophisticated customers such as FIAT (Malerba 1993).

SMEs operating in this innovation system show a strong capacity to absorb, adapt and improve technology developed elsewhere and subsequently apply it to the specific needs of their customers. Innovations are often incremental and arise from both informal learning processes (learning by using, learning by doing, learning by interacting) and design and customization.

Malerba identified three types of firm in this system: firms located in industrial districts (especially in the textile districts of Northern Italy); equipment suppliers (which produce for both large companies like FIAT and small companies from the industrial districts, to whom they supply namely textile machinery); and companies operating in traditional sectors (Malerba 1993).

In the industrial districts – which have a long tradition in Italy and are characterized by social and cultural homogeneity, specialization and territorial embeddedness – technological change takes place through horizontal interactions in atomistic networks with a large number of small and medium companies. These local interactions facilitate the diffusion of new technologies or processes: since the various actors share a common culture and similar characteristics, the diffusion and assimilation of new information and tacit knowledge is high, namely through informal networks, personal contacts and labour mobility between companies in the same district. To complete the picture we have just to mention the links established between the companies in the district and the local and regional organizations, which comprise local governments, technical and vocational schools and local banks.

SMEs from the equipment goods industry have extensive technical capabilities in the mechanical equipment production (and even robotics) and a large capacity to absorb and incorporate new technologies into their products, focusing on particular customer needs and specific solutions to explicit market segments, generating a continuous stream of incremental innovations. They are located mainly in Northern Italy and many of them were created by former engineers and technicians of large conglomerates like FIAT. Most of these companies have no formal R&D laboratories and their knowledge base is tacit and idiosyncratic and is embodied in engineers and other skilled workers.

Finally, the system includes small and medium companies operating in traditional sectors, but not located in industrial districts. There are not many innovative companies in this group. Generally, they benefit from innovations (in terms of new machinery) introduced by equipment suppliers. This group is mainly characterized by strong specialization and decentralization: these companies are usually dedicated to very specific stages of production as subcontractors for large companies.

The second Italian innovation system is the core R&D system. It includes the large companies with R&D laboratories, small high-tech companies, universities, large public research institutes and the national government. In this sense, it encompasses the actors which are more traditionally associated with the concept of NIS. According to Malerba (1993), this system is more recent than the previous one and is quite incipient when compared to other industrialized nations. Malerba pointed out some factors/constraints that explained the poor performance of the Italian core R&D system in that period.

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First, many industries did not reveal either research capabilities or potential for the adoption of advanced technologies. In part, this blockage was due to the fact that there were few large companies in Italy, although there was an oligopolistic core of industrial groups – like FIAT, Indesit and Pirelli – where the bulk of industrial R&D was concentrated. However, the existing industrial R&D was far from the technological frontier. Furthermore, there was a limited number of small high-technology companies in sectors such as electronics, software, biotechnology and services (Malerba 1993). In Italy this kind of company has emerged through a demand pull (not science push) process driven by the oligopolistic core. Secondly, there was a lack of domestic demand, both public and private, for cutting-edge technology. Thirdly, the advanced research conducted by universities and public laboratories was fragmented among institutions, which hampered the generation of technological breakthroughs. The quality of the outputs of the scientific subsystem was also quite uneven: areas and centres of excellence coexisted with domains well below the international standards. Fourthly, there was a widespread shortage of scientists and engineers in the country. Fifthly, there was no tradition of scientific and technological collaboration between industry and academia. According to the author, this was due to several factors: a limited number of excellence centres in Italian universities; reduced domestic and overseas mobility of scientists; excessive bureaucracy in academic organizations. Finally, public policies were usually inadequate and uncoordinated.

Malerba mentioned these factors as ‘qualitative weaknesses’, in spite of some developments (especially in the 1980s) in quantitative indicators such as R&D expenditure. According to the author, the whole picture was even more complex due to the North-South gap, the South being at a great disadvantage.

Malerba (1993: 257) concluded his analysis by arguing that ‘The case of Italy has also shown that a country can enter the club of advanced industrial economies, and even prosper and grow, without a developed formal R&D system.’ and that ‘The Italian R&D system faces the choice of either remaining emarginated (as in the past) from international technological competition among advanced industrialized countries, or making the move from being a follower to a leader in some high-technology sectors.’ (Malerba 1993: 257).

Based upon this account, we will examine the evolution of the Italian NIS in the two subsequent decades. In terms of its overall performance, measured by the composite indicator of the IUS 2010, we find that Italy belongs to the group of ‘moderate innovators’ (countries whose NIS performance ranges between 10 per cent and 50 per cent below the average performance of the

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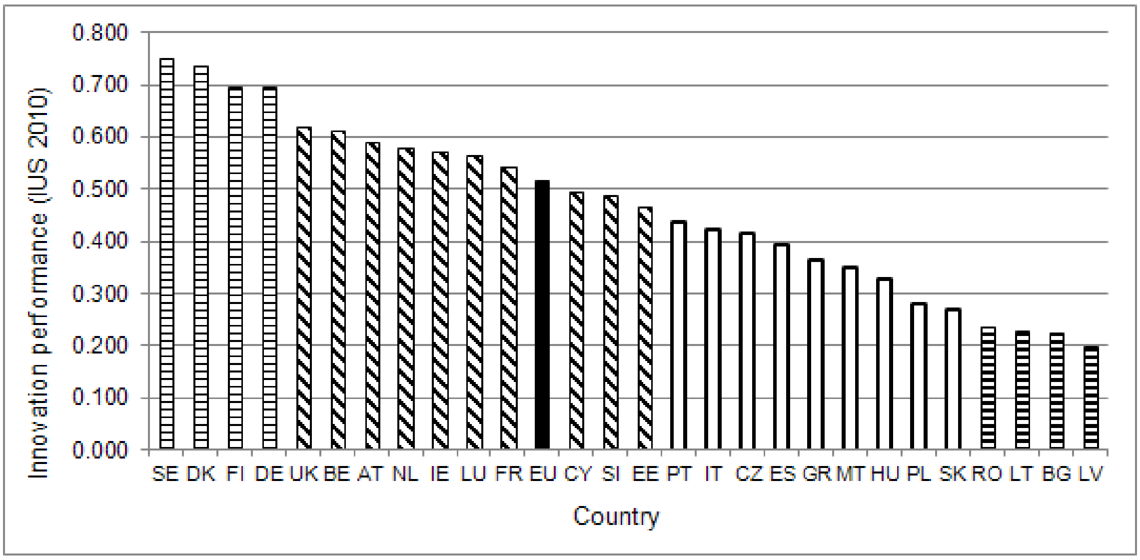
EU 27), ranking second in this group of countries – behind Portugal – and 16th among the EU 27 countries (Figure 1).

FIGURE 1 – EU member states' innovation average performance (IUS 2010)



Source: Adapted from Innovation Union Scoreboard 2010.

Note: 'Average performance is measured using a composite indicator building on data for 24 indicators going from a lowest possible performance of 0 to a maximum possible performance of 1. Average performance in 2010 reflects performance in 2008/2009 due to a lag in data availability.

The performance of Innovation leaders is 20% or more above that of the EU27; of Innovation followers it is less than 20% above but more than 10% below that of the EU27; of Moderate innovators it is less than 10% below but more than 50% below that of the EU27; and for Modest innovators it is below 50% that of the EU27.' (Innovation Union Scoreboard 2010).

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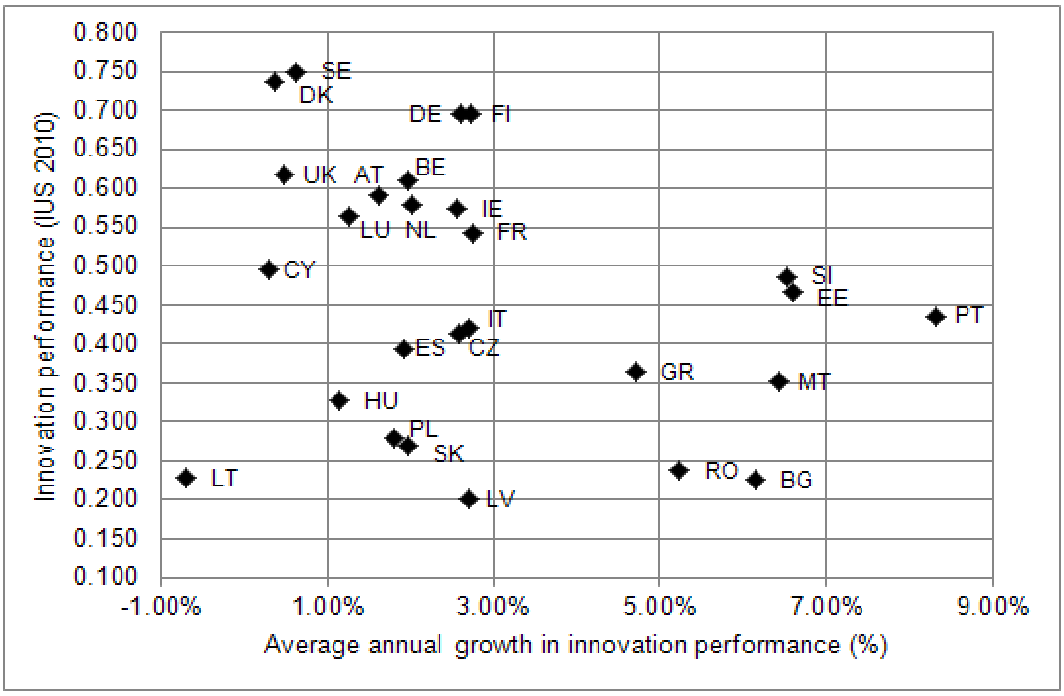
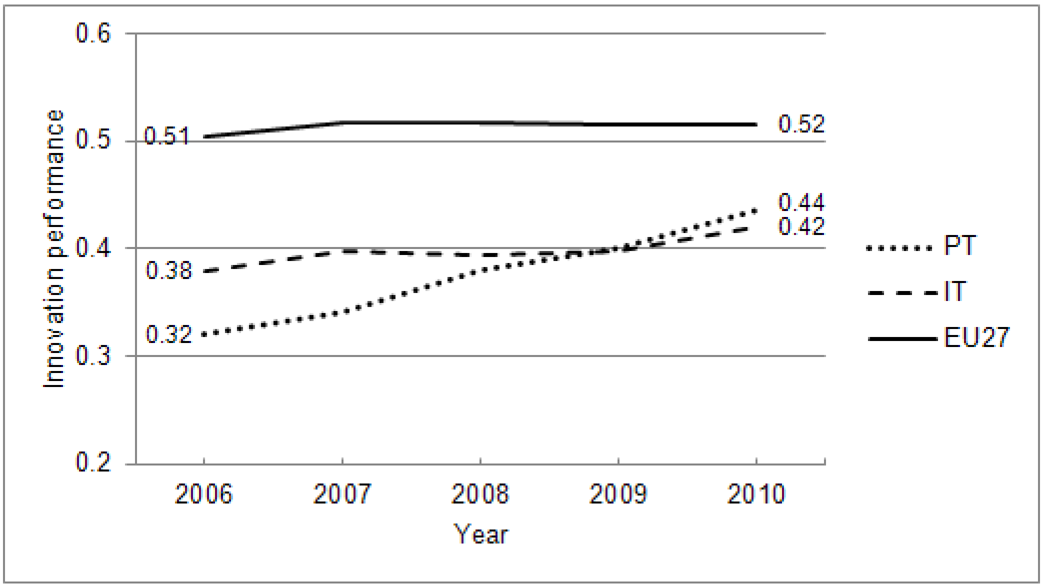
FIGURE 2 – Average annual growth in innovation performance (2006–2010) (IUS 2010)



Source: Adapted from Innovation Union Scoreboard 2010.
Note: 'Average annual growth rates as calculated over a five-year period (2006–2010)' (Innovation Union Scoreboard 2010).

FIGURE 3 – Performance of Italy and Portugal on the EIS/IUS composite indicator (2006–2010)



Source: Innovation Union Scoreboard 2010.

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In terms of growth performance, Italy is among the 'moderate growers': over the past five years (2006–2010) its innovative performance has grown less than 3 per cent per year, which is considerably higher than the EU growth rate of 0.85 per cent but lower than the moderate innovators' rate of 3.5 per cent. These results point to an obvious conclusion: in the EU context, the Italian NIS's performance remains weak despite some progress. But has there been a major change in the characteristics of the Italian NIS since Malerba's portrait in 1993?

The report by Furlani, Vulcano and Lucas in 2009, on behalf of PRO INNO Europe,[2] gives us valuable clues to this question. Based on this report and on the IUS indicators, we have drawn several conclusions on recent evolution of the Italian NIS.

First, the medium-technology industrial base remains important and successful, particularly in the field of industrial mechanics. This is supported by the fact that the share of medium and high technology exports on total exports in 2009 (Table 1) was higher than the European average (51.3 per cent versus 47.4 per cent). However, if we consider high-tech exports alone, we find that the country is well below the EU average (6.8 per cent against 16.9 per cent, in 2009), and the situation has got worse since 1995 (Figure 4).

TABLE 1 – Innovation performance of Italy and Portugal (IUS 2010)

	EU 27	IT	PT
ENABLERS			
Human resources			
1.1.1 New doctorate graduates per 1000 population aged 25–34	1.4	1.6	3.0
1.1.2 Percentage population aged 30–34 having completed tertiary education	32.3	19.0	21.1
1.1.3 Percentage youth aged 20–24 having attained at least upper secondary education	78.6	76.3	55.5
Open, excellent and attractive research systems			
1.2.1 International scientific co-publications per million population	266	414	485
1.2.2 Scientific publications among the top-10% most cited publications worldwide as % of total scientific publications	0.11	0.10	0.09
1.2.3 Non-EU doctorate students as a % of all doctorate holders	19.45	4.15	7.81
Finance and support			
1.3.1 Public R&D expenditures (% of GDP)	0.75	0.58	0.71
1.3.2 Venture capital (% of GDP)	0.110	0.048	0.087
FIRM ACTIVITIES			
Firm investments			
2.1.1 Business R&D expenditures (% of GDP)	1.25	0.65	0.78
2.1.2 Non-R&D innovation expenditures (% of turnover)	0.71	0.61	0.68
Linkages & entrepreneurship			

[2] PRO INNO Europe is an initiative of the Directorate General Enterprise and Industry of the EU and its main objectives consist of analysing the EU member states' innovation policies and fostering policy cooperation in Europe.

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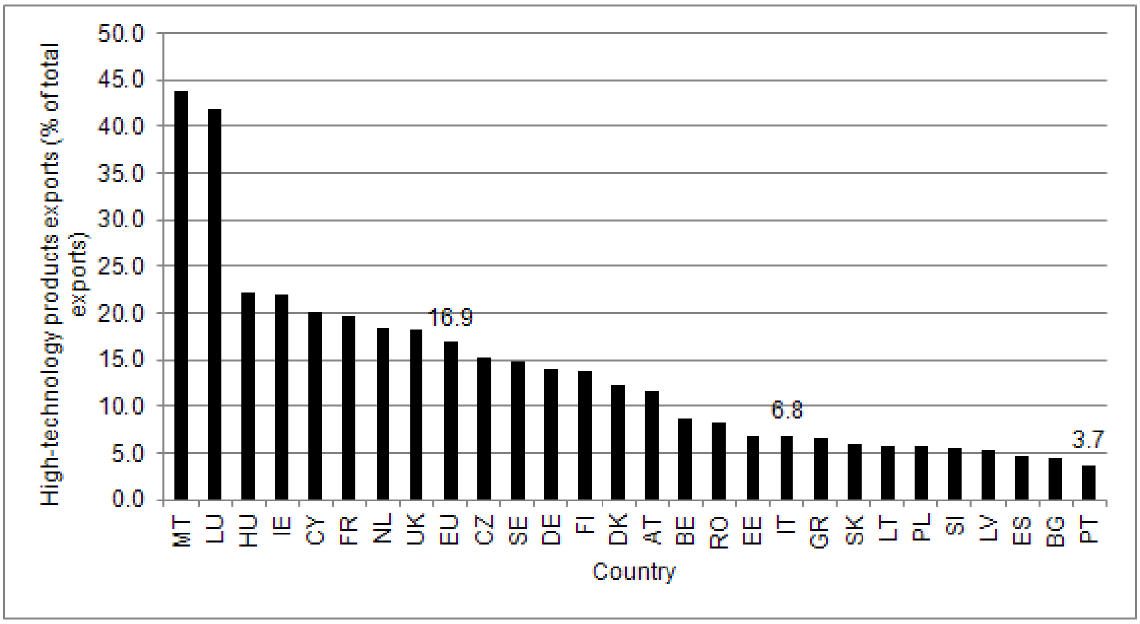
2.2.1 SMEs innovating in-house (% of SMEs)	30.31	34.09	34.10
2.2.2 Innovative SMEs collaborating with others (% of SMEs)	11.16	5.98	13.31
2.2.3 Public-private co-publications per million population	36.2	20.7	8.7
Intellectual Assets			
2.3.1 PCT patent applications per billion GDP (in PPP€)	4.00	2.12	0.53
2.3.2 PCT patent applications in societal challenges per billion GDP (in PPP€)	0.64	0.36	0.13
2.3.3 Community trademarks per billion GDP (in PPP€)	5.41	5.08	4.92
2.3.4 Community designs per billion GDP (in PPP€)	4.75	6.85	5.70
OUTPUTS			
Innovators			
3.1.1 SMEs introducing product or process innovations (% of SMEs)	34.18	36.91	47.73
3.1.2 SMEs introducing marketing/organisational innovations (% of SMEs)	39.09	40.62	43.84
Economic effects			
3.2.1 Employment in knowledge-intensive activities as % of total employment	13.03	13.32	8.76
3.2.2 Medium and high-tech product as % of total product exports	47.36	51.32	35.40
3.2.3 Knowledge-intensive services exports as % of total services exports	49.43	35.60	30.89
3.2.4 Sales of new to market and new to firm innovations as % of turnover	13.26	11.79	15.57
3.2.5 Licence and patent revenues from abroad as % of GDP	0.21	0.05	0.07

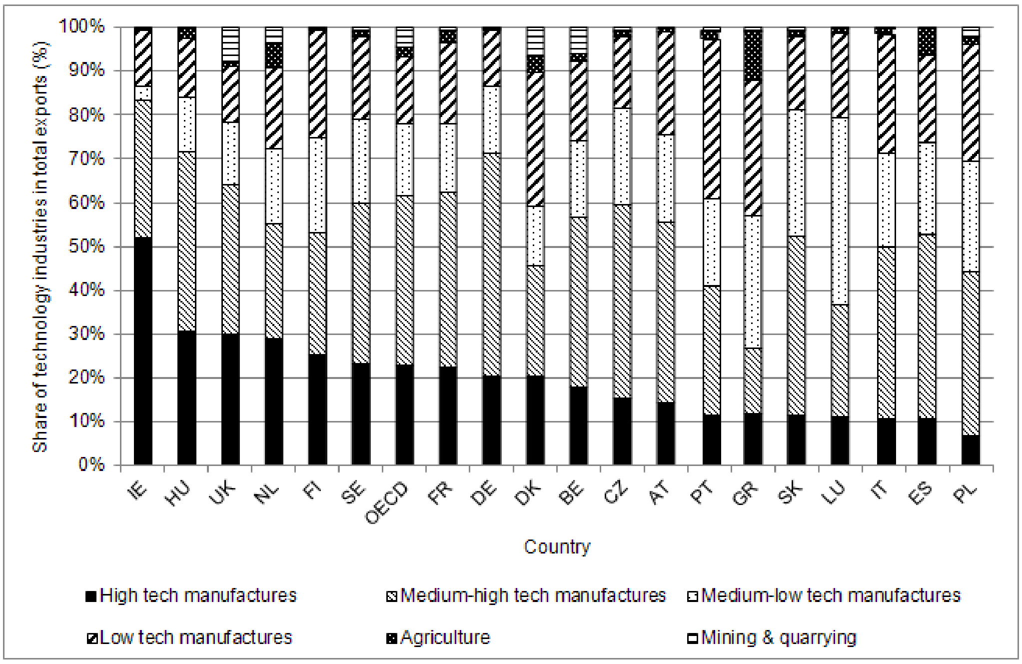
Source: Adapted from Innovation Union Scoreboard 2010.
Note: Most data refer to 2009 and 2008.

FIGURE 4 – High-technology products exports (% share of total exports) (2009)



Source: Eurostat.
Note: High-technology products are the following: aerospace, computers office machines, electronics, telecommunications, pharmacy, scientific instruments, electrical machinery, chemistry, non-electrical machinery, armaments.

FIGURE 5 – Share of technology industries in total exports of manufactured goods and primary products from agriculture and mining (% total) (2005)



Source: OECD Science, Technology and Industry Scoreboard 2007.
Note: OECD and EU aggregates exclude Luxembourg.

Trademark and design protection assumes great importance; this indicates the continuity of Italian leadership in traditional sectors ('made-in-Italy' sectors), such as footwear and clothing, and the success of Italian SMEs' strategy to compete through differentiation, customization and focus on quality, creativity and design. The number of new design applications (per billion of GDP) was much higher than the European average in 2009 (6.85 versus 4.75) (Table 1).

SMEs show a good innovative performance. The percentage of Italian SMEs with in-house innovation activities in 2008 is above the EU average, as well as the percentage of SMEs that introduced a new product, a new process, or a new marketing or organizational innovation. If read with due caution,[3] these results reveal the continuous dynamism and competitiveness of the Italian small business innovation network.

The available knowledge base remains insufficient. The Italian adult population has low education levels – in 2008, only 14 per cent of the population between 25 and 64 and only 20 per cent of the youth (25 to 34) had attained an academic degree (Table 2). The average for OECD countries is 28 per cent and 35 per cent respectively. Italy has a widespread shortage of

[3] SMEs indicators draw on the Community Innovation Survey, and therefore are based on self-assessment.

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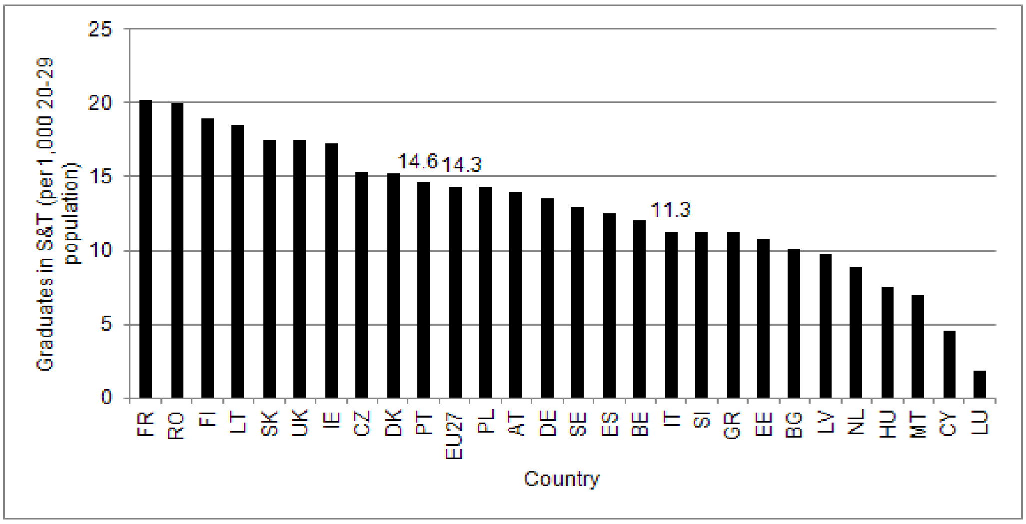
technicians, engineers, scientists (Figure 6), and researchers (Figure 7 and 8) and suffers from a 'brain drain' process (Furlani *et al.* 2009). Few foreign students are attracted to the country.

Table 2 – Population with at least upper secondary education (2008)

	Upper secondary education at least (*)		Tertiary education	
	25–64 years	25–34 years	25–64 years	25–34 years
Greece	61	75	23	28
Ireland	69	85	34	45
Portugal	28	47	14	23
Spain	51	65	29	39
Germany	85	86	25	24
France	70	83	27	41
United Kingdom	70	77	33	38
Italy	53	69	14	20
USA	89	88	41	42
OECD average	71	80	28	35

Source: Adapted from OECD, Education at a Glance 2010: 35–36.
Note: * Excluding ISCED 3C short programmes.

FIGURE 6 – Tertiary graduates in science and technology per 1,000 of population aged 20–29 years (2009)



Source: Eurostat.
Notes: Greece; Italy; Luxembourg (2007). Graduates (ISCED 5–6) in mathematics, science and technology per 1,000 of population aged 20–29.

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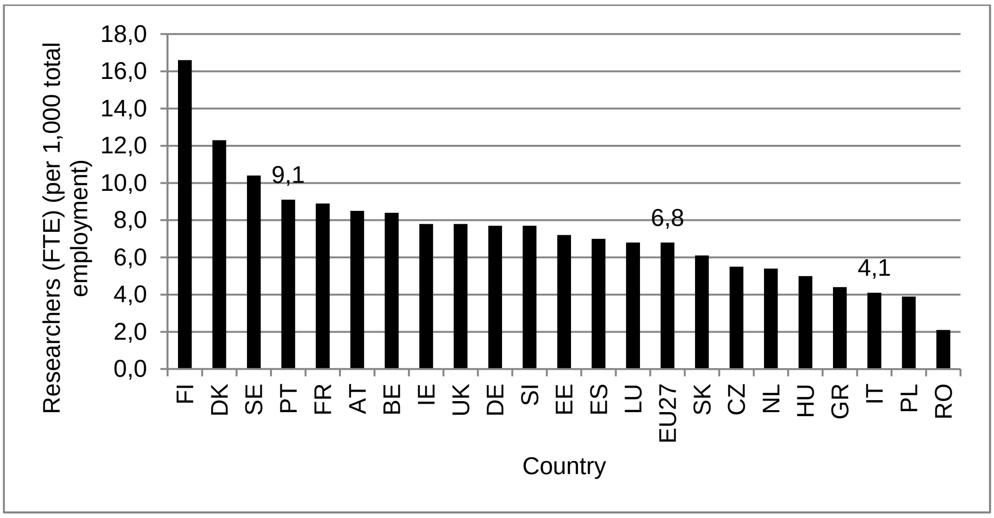
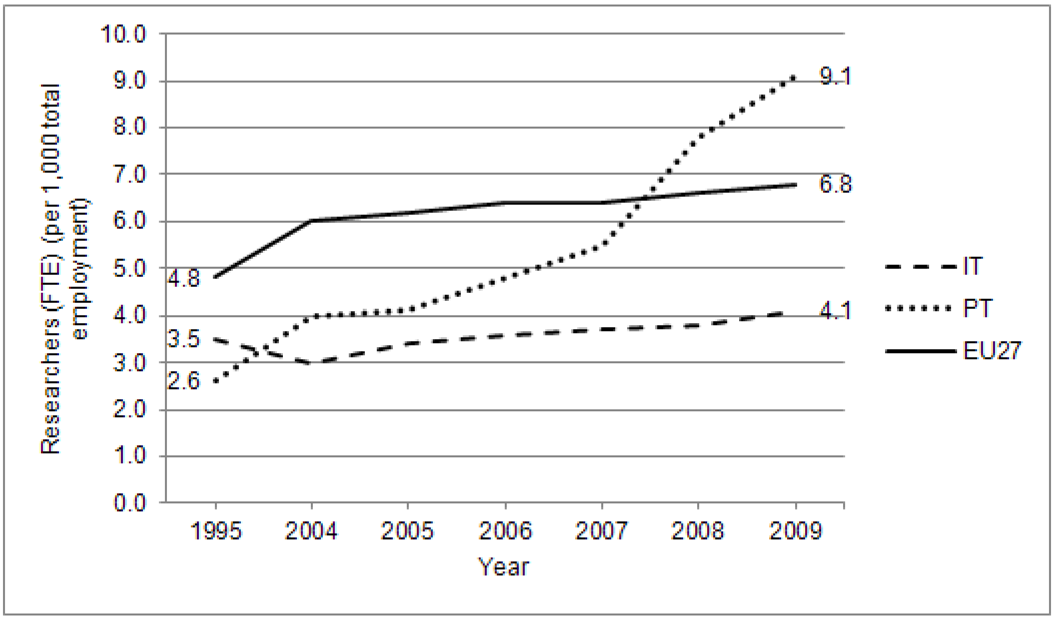
FIGURE 7 – Total researchers (FTE) per thousand total employees (2009)



Source: Main Science and Technology Indicators 2010/2.
Note: 2009 or latest year. For some countries, data for 2009 are provisional.

FIGURE 8 – Total researchers (FTE) per thousand total employees (1995, 2004-2009)

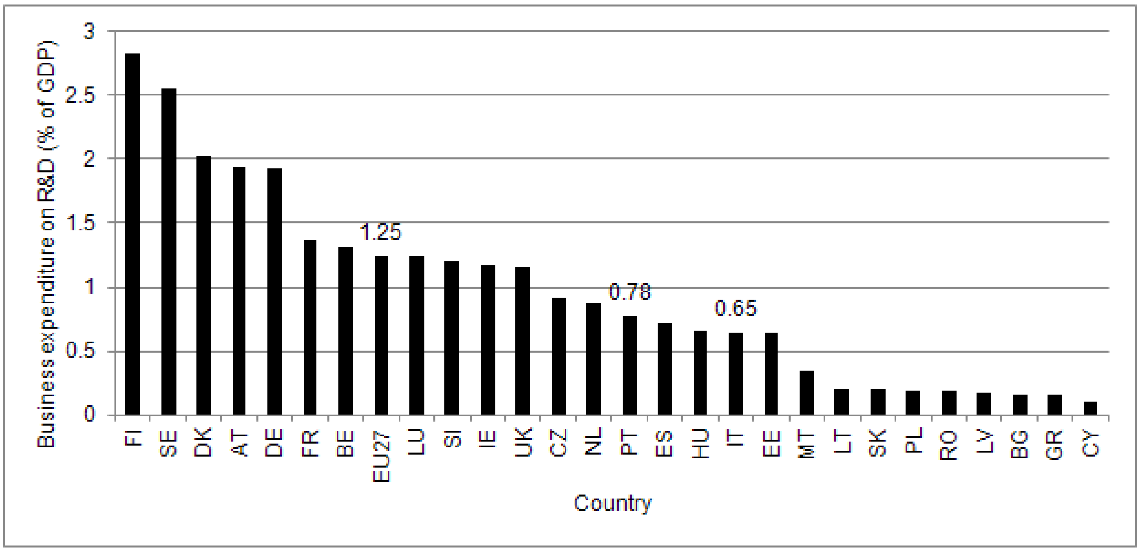


Source: Main Science and Technology Indicators 2010/2.
Note: 2009 or latest year. For some countries, data for 2009 are provisional.

The financial system is not efficient enough, and this is an obstacle to the creation of new technology-based companies. Venture capital, which is essential for funding risky innovative projects, is widely lacking. In 2009, venture capital as a percentage of GDP was only 0.048 per cent compared with 0.110 per cent in the EU. Furlani *et al.* (2009) explain that this is due in part to the prevalence of a conservative and risk-averse mentality among Italian investors.

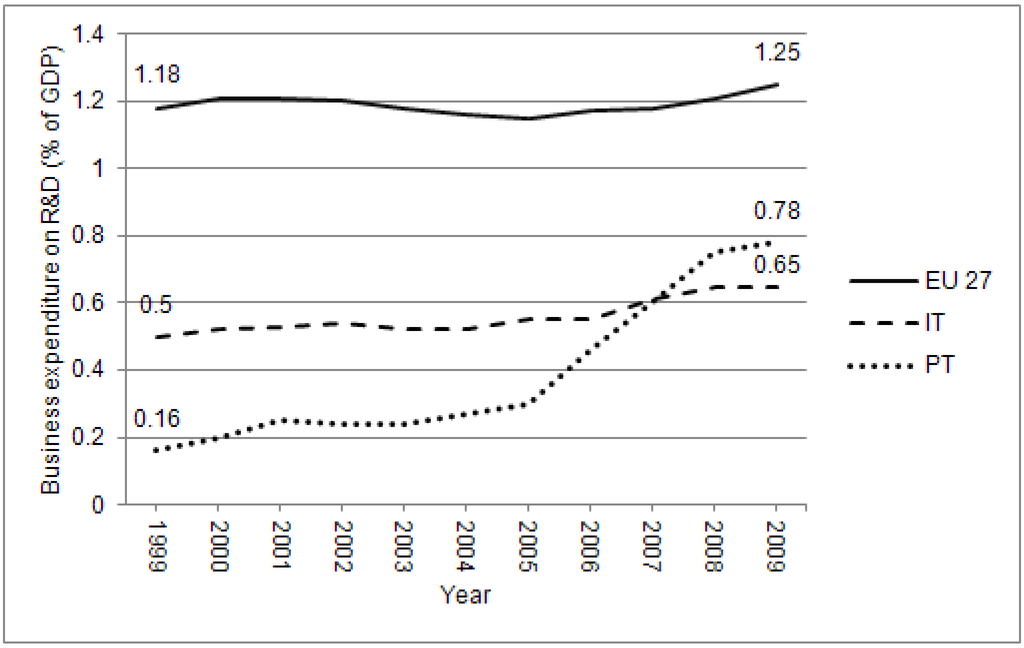
Industrial R&D expenditure in 2009 was only 0.65 per cent of the GDP, which is well below the European average of 1.3 per cent (Figure 9 and 10) and far lower than countries like Sweden or Finland where business investment in R&D exceeds 2.5 per cent of the GDP. In 2007, less than half (42 per cent) of R&D expenditure in Italy was funded by companies, which compares negatively with the EU 15 (55.9 per cent) and OECD (64.5 per cent) averages (Figure 11).

FIGURE 9 – Business expenditure on R&D (% of GDP) (2009)



Source: Eurostat.
Note: Greece (2007).

FIGURE 10 – Business expenditure on R&D (% of GDP) (1999–2009)



Source: Eurostat.

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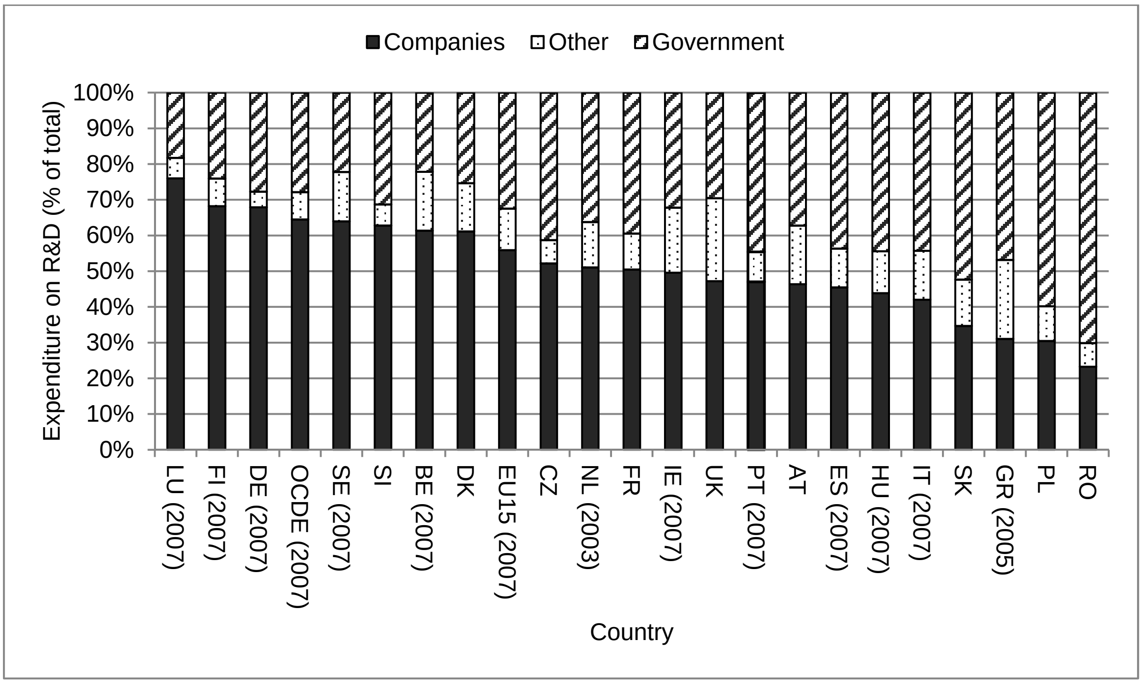
FIGURE 11 – Expenditure on R&D by source of funds (% total) (2008)



Source: Science, technologie et industrie: perspectives de l'OCDE 2010
Note: "Other" encompass other national sources plus abroad.

The above data indicate that, in relative terms, the specialization of the Italian industry is still based on traditional and low-technology sectors – in which, as discussed above, innovation is mainly incremental in nature and highly based on customization and design and less on formal R&D expenditures (Furlani *et al.* 2009) – and on medium-technology sectors (Malerba 1993; Furlani *et al.* 2009). In 2005, more than one quarter (26.9 per cent) of total Italian exports of manufactured goods and primary products from agriculture and mining originated from low-technology sectors (15.6 per cent in OECD), 21.5 per cent from medium-low (16.2 per cent in OECD), 39.0 per cent from medium-high (in line with 38.8 per cent in OECD) and only 10.8 per cent sprung from high-technology sectors (22.6 per cent in OECD countries) (Figure 5).

Furlani *et al.* (2009: 3) summarize the previous two points:

> The business sector in Italy is characterized by a large number of very small firms (more than 98 per cent of Italian firms have less than 20 employees), and a small number of large companies. Although small firms have traditionally been a source of dynamism, their limited financial resources hamper the ability to invest in new R&D activities, innovation enhancement and human capital improvement. [...] In addition, the country is specialized in sectors (mature/traditional sectors) that are not R&D and innovation-intensive.
>
> (Furlani *et al.* 2009: 3)

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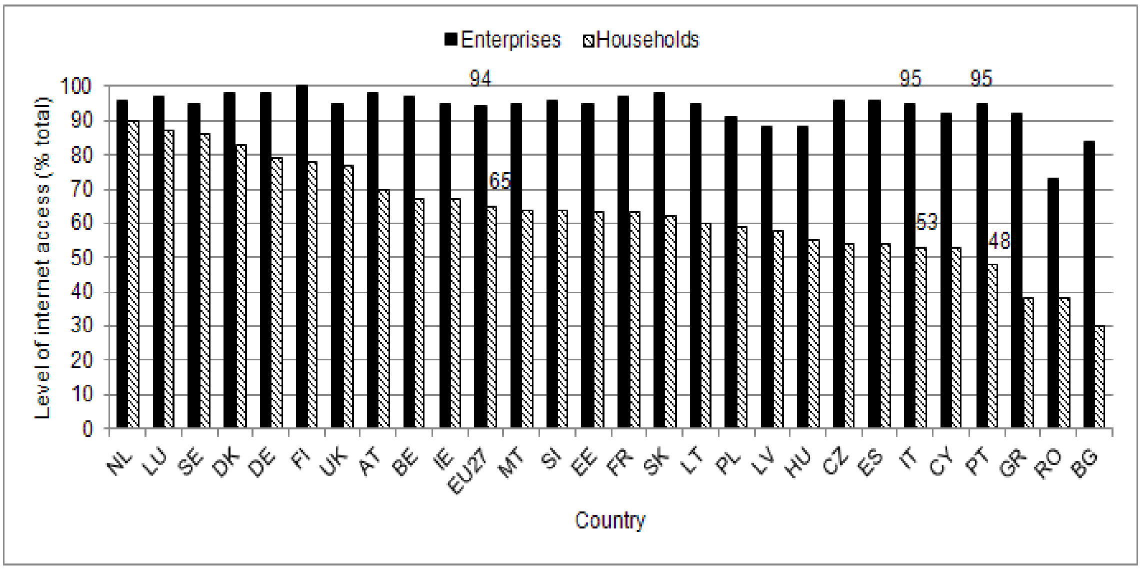
The low level of cooperation and interaction among the components of the core R&D system remains a problem and this has a particularly marked effect on the relations between private and public sectors, academia and the industry and between companies. Furlani *et al.* (2009) claim, however, that the level of firms' cooperation is not usually properly captured by the traditional indicators due to the highly informal nature of these collaborations in Italy.

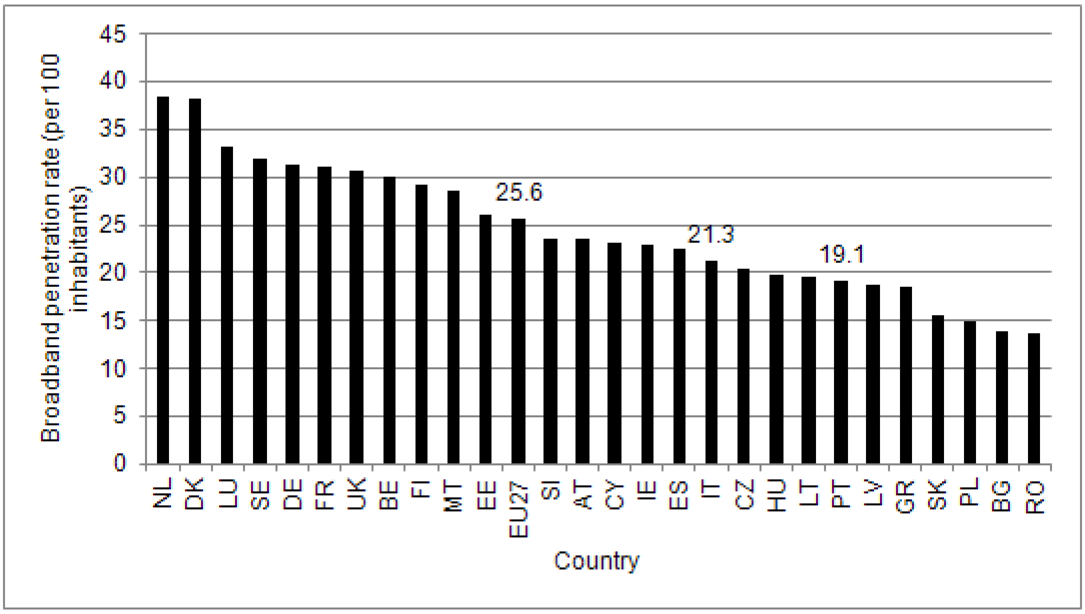
The level of ICT dissemination is still low. In 2009, Italy had one of the lowest levels of households' access to the Internet in the EU (Figure 12). It is also below the EU average for broadband access lines per 100 inhabitants (Figure 13).

FIGURE 12 – Level of internet access (% total) (2009)



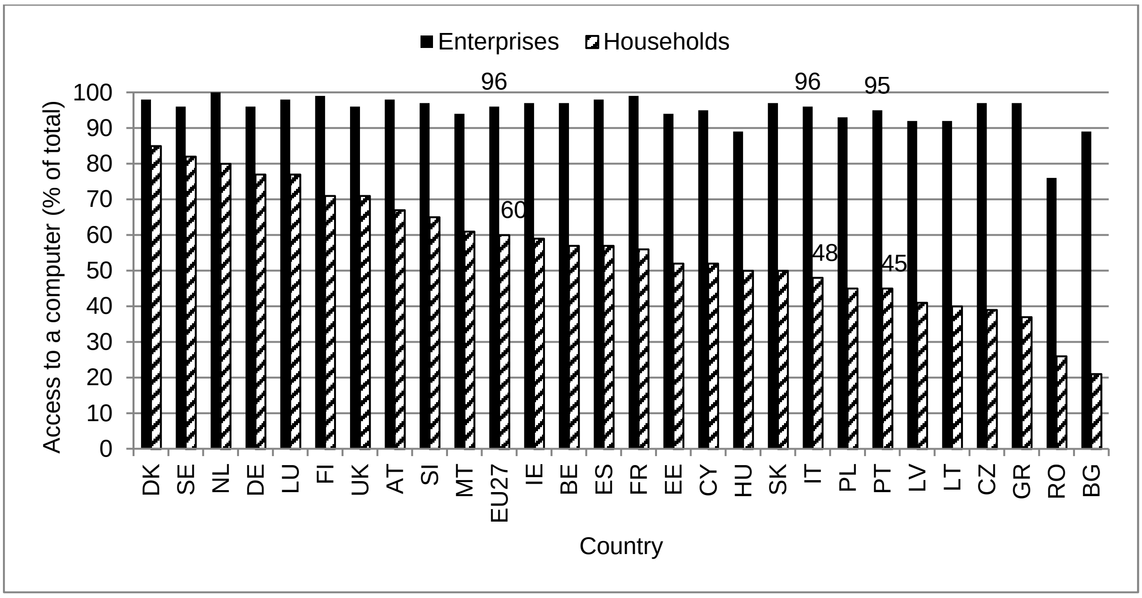
Source: Eurostat.
Note: All forms of internet use are included.

FIGURE 13 – Broadband penetration rate per 100 inhabitants (2010)



Source: Eurostat.
Notes: Broadband lines are defined as those with a capacity equal or higher than 144 Kbits/s. Several technologies are covered; ADSL, cable modem as well as other types of access lines.

FIGURE 14 – Availability of computers (% total) (2006)



Source: Eurostat.

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According to Furlani *et al.* (2009), Italian public policies for innovation continue to suffer from fragmentation, poor coordination, lack of strategic vision and dispersion of instruments and actors:

> The national innovation system, both in terms of policymakers and public-private innovation intermediaries, is characterised by a large number of actors […] However, the system is also very fragmented and sometimes there is an overlap and duplication of efforts. The system has been characterised by low levels of coordination and cultural barriers to public-private cooperation, mainly affected by the lack of links and interactions between the main players (universities, public research centres and industry).
>
> (Furlani *et al.* 2009: 28)

Finally, there is the issue of national culture. As discussed above, the NIS approach emphasizes the relevance of social institutions and cultural values. Drawing on this approach, Furlani *et al.* (2009: 13) make a noticeable statement: they argue that in Italy there is a 'lack of a meritocratic culture that pervades the Italian system'. The existence of a culture that promotes the best ideas and encourages creativity, hard work and perseverance may constitute a powerful incentive to entrepreneurship and innovation. However, according to the authors, this social incentive does not seem to work in Italy, which may help to explain the relatively poor performance of its NIS.

In short, we conclude that Italy continues to be characterized by a dualistic NIS: on the one hand, the country has dynamic and competitive SMEs operating both in traditional and 'made-in-Italy' sectors and in medium-technology industries; this is confirmed by the importance of trademarks and designs, the level of non-R&D innovation (Table 1) and the share of medium-technology goods in total exports. On the other hand, the formal R&D subsystem continues to suffer from several hindrances which make for a weak innovative performance: the insufficient knowledge base, which hinders the generation of research based innovations; flaws in the financial system and the endemic shortage of venture capital in the economy; the low level of technological cooperation and knowledge networks established among the key actors; and the lack of coordination and dispersion of public policies for innovation. Taken together, these make Italy a moderate innovative country despite being one of the largest European economies.

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4.2. The Portuguese national innovation system

A decade ago, the picture of the Portuguese productive specialization and S&T system was quite discouraging (Salavisa 2001). Indeed, Portugal presented serious weaknesses in terms of innovative performance, education level and venture capital (Salavisa 2001). These weaknesses, combined with a pattern of industrial specialization based on labour-intensive sectors characterized by low wages and low skilled workers, meant that the stage was set for a poor performance in the creation and development of high-technology sectors and production, diffusion and use of innovations.

In this section we will argue that although Portugal still exhibits major weaknesses in terms of innovation, a major shift has taken place in recent years – particularly since 2005 –, so that today we may actually speak of a national innovation system.

At the end of the twentieth century, Portugal did not have a real NIS, but only an incipient S&T system with a very modest performance (Salavisa 2001) combined with the hegemony of small companies and traditional sectors, characterized by low value added and low wages.

Both the domestic R&D effort and the number of researchers and personnel allocated to R&D were spectacularly lower than that of advanced countries. Firms' innovative performance was extremely modest, especially when compared to other EU and OECD countries. This was mainly due to a specialization based on traditional sectors and to the prominence of small businesses unable to carry out R&D. In 1997, Portuguese companies were responsible for just 23 per cent of total R&D compared to 63 per cent of the EU 15 and 69 per cent of OECD.

This situation led to a massive concentration of researchers in the universities, and to a residual presence in companies. In 1997, only 9 per cent of the Portuguese researchers were working in companies, compared with 50 per cent in the EU and more than 60 per cent in OECD. This, in turn, brought other undesirable consequences. The fact that the majority of researchers were working in academia led to 'a biased interest towards areas of low commercial applicability', which meant a very low capacity to patent (Salavisa 2001).

At the time, Salavisa (2001) identified five areas of industrial specialization: textile-leather (textiles, apparel and footwear); wood products, furniture, ceramics and glass industries; a group of sectors based on the exploitation of natural resources and scale economies, such as pulp and paper industries, oil refining and non-metallic mineral products; the beverages sector; and the

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electro mechanics area, related to the industry of electrical machinery and transport equipment, closely linked to foreign direct investment in the automotive industry.

Despite obvious progress, the Portuguese productive structure retains many of the above-mentioned features to this day, namely the great reliance on low-technology industries and the ubiquity of the micro and small companies.[4] Thus, as Salavisa (2001) pointed out, there was a severe problem of the quality of the specialization. This is where Portugal and Italy differ most. In the latter, traditional sectors have been sources of dynamism by competing via quality, differentiation, specialization, design, customization and incremental innovations. In contrast, the production of traditional sector SMEs in Portugal is generally unsophisticated and incorporates low value added, thus making these companies much more exposed to increased competition from NICs – whose competitiveness is based precisely on low cost. The crisis that the traditional sectors have gone through in the last years supports this idea.

Nevertheless, there has been a relevant renovation in some areas of the traditional industries, through the adoption of new technologies and organizational models. This is particularly the case of the leather footwear industry, which managed to improve its equipment and production methods while investing extensively in design and marketing. The resulting upgrade in quality has been rewarding in terms of a more prominent presence in the market. Technical textiles and the wine industry are further examples of using new technologies to renew an old industry, sometimes in collaboration with universities. This kind of strategy, which draws on a clear-cut distinction between sector and technology (see Von Tunzelmann 2007) has been successfully adopted by countries like Italy and may make its way in more and more Portuguese manufacturing companies in the near future.

As to Portugal's scientific and technological system, it has undergone dramatic change and progress in recent years. We may confirm this assertion through the evolution of the Portuguese positioning between 2001 and 2010 in the EU's composite indicator of innovative performance (Figure 1). In 2010, Portugal appears as the leader of the moderate innovators and ranks 15th among the Union's 27 countries. In 2001, Portugal ranked last among the 15 member states but have since surpassed Italy, Spain and Greece.

[4] According to data from Quadros de Pessoal (2009), 86 per cent of the Portuguese companies have less than 10 employees, all sectors considered.

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Between 2001 and 2010, Portugal not only ceased to be the country with the worst innovative performance growth rate (in 2001, Portugal belonged to the group of countries that were falling further behind) but became the fastest growing EU country. The Portuguese NIS performance has improved at an average annual rate above 8 per cent (8.3 per cent) from 2006 to 2010 (Figure 2 and 3).

We may conclude that the Portuguese NIS performance has undergone a dramatic change over the recent years. Portugal went from last place and worst rate of variation among the 15 EU member states in 2001 to the leading country in the moderate innovators group in 2010 and the absolute champion in terms of innovative growth performance among the EU 27 countries.

Indeed, from 2005 to 2009, Portugal's growth in 20 of the 24 indicators that constitute the composite indicator rose to above the EU average. The exceptions were venture capital as a percentage of GDP; the non-R&D innovation expenditures; the medium and high-technology exports as a percentage of total exports; and, between 2008 and 2009, the share of employment in knowledge intensive activities in total employment. Even in these cases – with the apparent exception of venture capital indicator – the Portuguese performance was not much below the European average.

But what are the current strengths and weaknesses of the Portuguese NIS? And in which direction have they evolved? This is what we will analyse below, based on the results from the IUS 2010 and other adequate indicators.

First, the importance of trademark and design protection contrasts with the incapacity to patent. Portugal was one of the EU countries with the fewest patent applications per billion GDP in 2007 (0.53 patents versus a European average of four) (Table 1 and Figure 15). Between 1990 and 2008, there was almost no growth in the number of EPO patent applications per million inhabitants – despite a certain timid progress from 2004 – or in the high-tech patent applications to the EPO per million inhabitants. As Simões (2009) noted in a PRO INNO Europe report, this reflects the characteristics of the Portuguese economic fabric. He states that trademark protection is essential for Portuguese companies that export consumer goods to other European markets.

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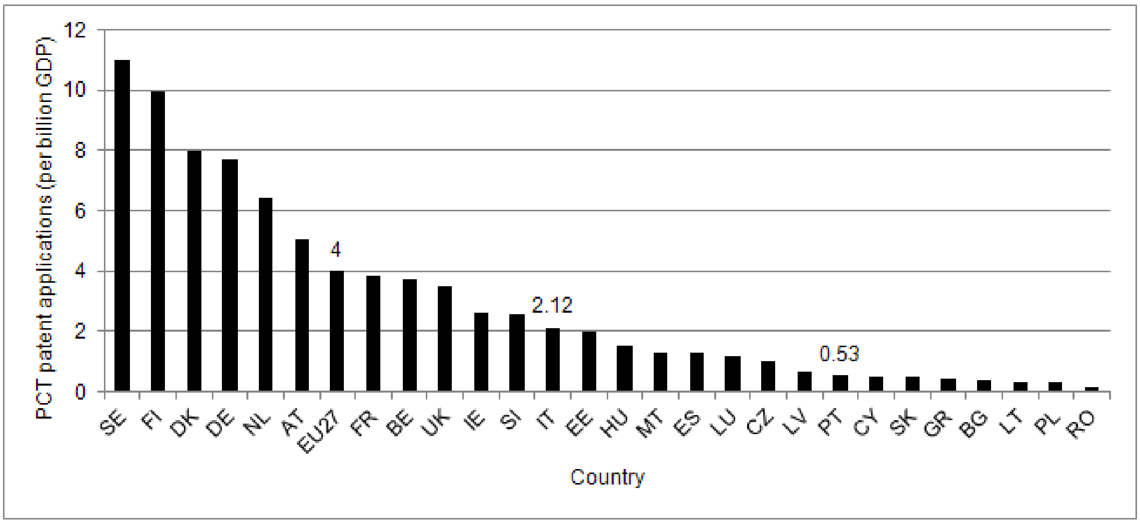
FIGURE 15 – PCT patent applications per billion GDP (in PPP €) (2007)

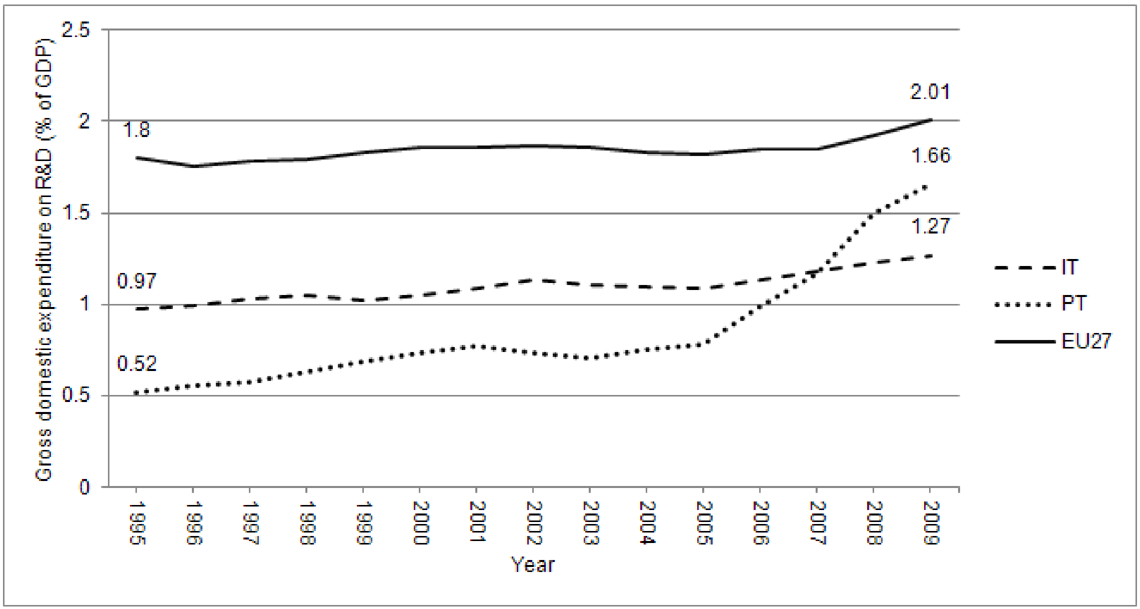


Source: Innovation Union Scoreboard 2010.

Secondly, it is crucial to highlight the most evident weakness. Although major developments have taken place in terms of R&D, this effort has not yet been translated into a substantial improvement in economic performance in areas such as high technology exports or employment in high technology sectors. This suggests that there are lasting and structural constraints, despite recent progress.

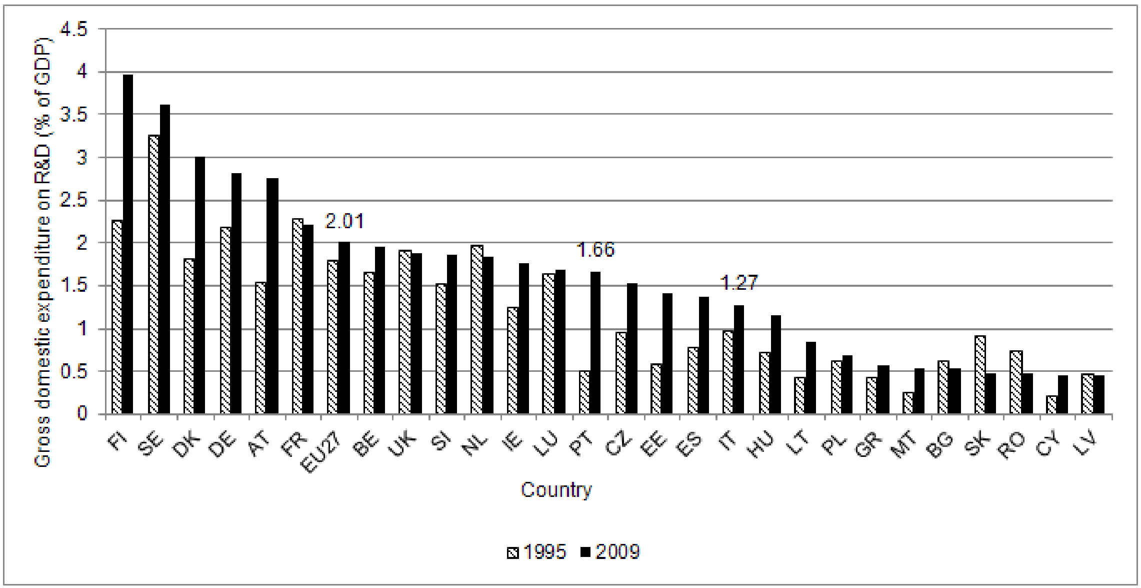
Indeed, expenditure on R&D has registered a remarkable growth, particularly since 2005 (Figure 16). The expenditure in R&D as a percentage of GDP increased from 0.52 per cent in 1995 to 1.66 per cent in 2009 (Figure 17), moving steadily closer to the European level (2.01 per cent in 2009). Likewise, the R&D business expenditures have increased substantially: whereas in 1999 they made up only 0.16 per cent of the GDP, in 2009 this figure had reached 0.78 per cent (1.25 per cent in the EU in 2009) (Figure 10). The number of researchers (Full Time Equivalent) per thousand employees in 2009 was well above the EU (9.1 versus 6.8) and OECD (Figure 7 and 8). The number of new doctorates between 25 and 34 years per thousand inhabitants in 2008 was more than twice the EU average (Table 1). Also, the share of young graduates and doctorates in science, technology and mathematics per thousand inhabitants is above the community average (Figure 6).

FIGURE 16 – Gross domestic expenditure on R&D (% of GDP) (1995–2009)



Source: Eurostat.

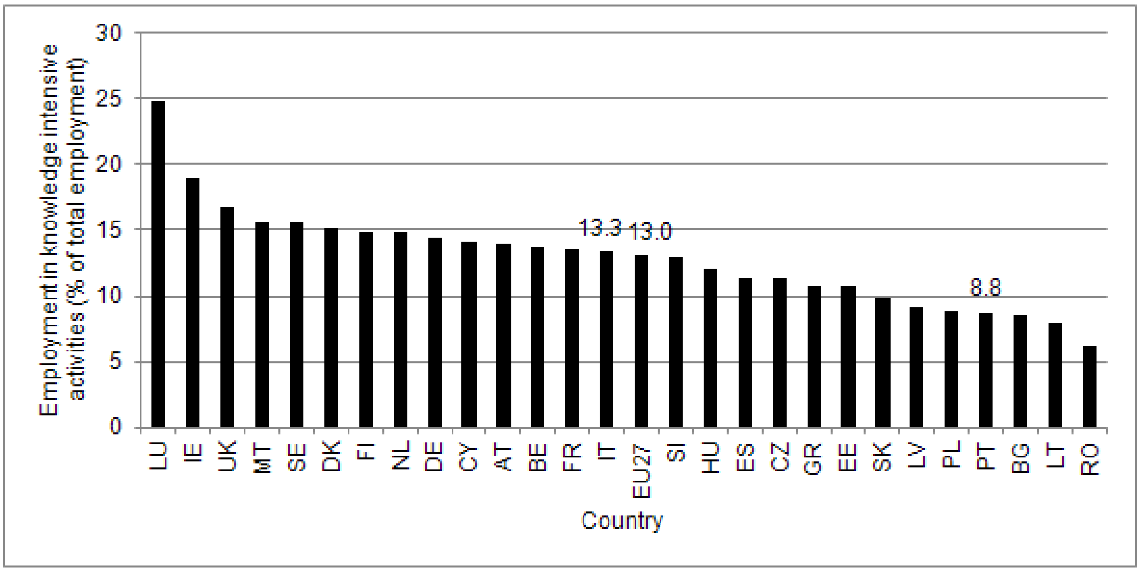
FIGURE 17 – Gross domestic expenditure on R&D (% of GDP) (1995 and 2009)



Source: Eurostat.
Note: Malta (2002; 2009); Luxembourg (2000; 2009); Estonia and Cyprus (1998; 2009); Greece (1995; 2007).

But in fact, despite all the effort that has been made, we find when we consider the IUS 2010 eight dimensions that the worst performance of the Portuguese NIS lies precisely in the 'economic effects' area, in which Portugal ranks 23rd among the 27 member states. Portugal is below the European average in terms of employment in knowledge-intensive activities (Figure 18), medium and high technology exports (Table 1 and Figure 4), knowledge-intensive services exports (Table 1) and licence and patent revenues from abroad (Table 1). Only the technology balance of payments was slightly positive in 2007.

FIGURE 18 – Employment in knowledge intensive activities (% of total employment) (2009)



Source: Innovation Union Scoreboard 2010.
Note: Knowledge-intensive activities are defined, based on EU Labour Force Survey data, as all NACE Rev.2 industries at 2-digit level where at least 33 per cent of employed persons have a higher education degree (ISCED 5 or ISCED 6).

It could be argued that there is only a medium/long term return on investment in science and technology given the structural nature of the changes needed to transform an economy based on traditional, labour-intensive and low-skilled sectors into a competitive and innovative economy. However, we cannot overlook the fact that, like in Italy, there are structural and 'qualitative weaknesses' in the Portuguese economy and society that block the necessary structural change.

One of these structural weaknesses is the low educational attainment of the Portuguese society. Simões (2009) also argues that the lack of systemic density in the Portuguese NIS – in other words, the lack of connections and linkages between the components of the system – contributes greatly to this blockage. In order to translate the effort in R&D, education and training into economic assets and stronger competitiveness, there must be greater interaction among the actors who compose the system. This strategy comprises two aspects: the promotion of intercompany technological collaboration and the strengthening of linkages between companies and research units. Social networks can play an important role in the former. As to the latter, research institutions will make a significant contribution. This last observation is strongly supported by the recent developments of the Portuguese university in terms of scientific advances and academic entrepreneurship.

Godinho (2007) noted that what characterizes the current historical moment in advanced countries is not so much the application of knowledge to economic activities – which has always happened – but the fact that the production and reproduction of new knowledge has become a strategic tool for these societies, to such an extent that increasing resources are allocated to this. Therefore, at this moment in history the potential of science as a source of economic growth has dramatically increased. In social terms, the disinterested search for truth has been replaced by the capitalization of knowledge (Etzkowitz 2003). These facts point to the new mission of the university, which now also plays an entrepreneurial role in society. In fact, this 'third mission' of the university is the basis of recent phenomena such as the patenting of academic generated technology and the incubation of academic spin-offs, which are essentially companies arising from the commercialization of scientific outputs developed in the context of academic research.

The new social role of the university is perhaps more prominent at the regional level. Universities are increasingly assuming the role of drivers of regional development and many institutions are being founded or redesigned specifically for this purpose. Acting together, the three helices of the system join forces to develop and boost the local economy and develop new skills in the region, creating, for example, new sectors and generating critical mass. As stated by Etzkowitz (2003: 298), 'the growth of industrial conurbations around universities, supported by government research funding, has become the hallmark of an entrepreneurial region'.

In Portugal, the idea of the university as a source of local development in collaboration with local authorities and businesses actually happens in regions and medium-sized cities such as Braga, Aveiro and Coimbra. The region of Aveiro, for instance, benefited from the synergies established between the local university (Universidade de Aveiro), a network of local companies (Inova Ria) and an association of public and private research institutions (Instituto de Telecomunicações) to establish itself as one of the most dynamic and innovative regions in telecommunications in Portugal. The most relevant Portuguese company producing software for telecommunications (Portugal Telecom Inovação) is located in Aveiro and originated from an advanced technology centre in telecommunications. Likewise, the high quality of academic research and healthcare institutions in Coimbra favoured the emergence of a cluster of biotechnology companies in the region.

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In terms of education and qualification, Portugal still lags quite behind the most advanced countries. Despite the remarkable progress achieved, this remains an anathema of the Portuguese society that has affected the country for decades.

In 2008, only 28 per cent of the adult population (25–64 years) had completed high school (71 per cent in OECD) and only half of those had attained an academic degree (14 per cent of the adult population versus 28 per cent in OECD). If we focus on young adults (25–34 years), we find that progress has been remarkable, albeit still clearly insufficient: 47 per cent of them have completed secondary education (80 per cent in OECD) and 23 per cent an academic degree (35 per cent in OECD) (Table 2).

The shortage of venture capital remains a traditional weakness (Table 1). In addition, this indicator has declined more sharply than in the EU.

Finally, there is the issue of the upgrading of the domestic economy. Two aspects should be stressed. First, in 2005, over a third (36.3 per cent) of the Portuguese exports of manufactured goods and primary products originated from low-technology sectors (15.6 per cent in OECD) and only 11.6 per cent came from high-technology sectors (22.6 per cent in OECD). Secondly, the low level of business expenditures on R&D persists (only 0.78 per cent of the GDP, compared to the EU's average of 1.25 per cent in 2009). The obvious conclusion is that it will take a long time for the Portuguese economy to achieve a new stage based on knowledge and innovation.

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5. CONCLUSION

We will conclude by comparing the Portuguese and Italian cases, analysing them in light of the challenges faced by moderate innovative countries.

The national contexts of Portugal and Italy have so far been examined separately. However, these two countries clearly share some features that go beyond geographical and cultural affinities.

First, both nations indisputably belong to the moderate innovative countries group. The two countries could also be defined as intermediate developed countries. However, though Portugal's membership in this group is beyond doubt, the inclusion of Italy – a country deeply marked by regional asymmetry – is problematic. While Southern Italy is a peripheral and less developed region, Northern Italy has distinguished itself as one of the most prosperous industrial regions in Europe. On the other hand, if we observe the Italian growth dynamics in the last two decades, we find that the country has gone through a process of economic decline. This is illustrated by the evolution of the GDP *per capita* (Table 3). In 1995, the GDP *per capita* in Italy was one of the highest in Europe vis-à-vis the EU 27 average (121 in relation to EU=100); but in 2009 this indicator had fallen and was almost equivalent to that of the EU 27 average (104).

Table 3 – GDP per capita in PPS (EU 27=100)

	1995	2009
LU	223	272
NL	123	131
IE	103	127
AT	135	124
DK	132	121
SE	125	119
BE	129	116
DE	129	116
FI	108	113
UK	113	113
FR	116	107
IT	121	104
ES	92	103
CY	88	98
GR	84	94
SI	74	88
CZ	73	82
MT	86	81

PT	77	80
SK	48	73
HU	52	65
EE	36	64
PL	43	61
LT	36	55
LV	31	52
RO	33	46
BG	32	44

Source: Eurostat.

Note: Romania (1996).

The fundamental problem of these countries is the fact that they are in a limbo on two counts (Salavisa 2007). On one hand, they cannot yet compete with the most advanced economies in the production of sophisticated goods and services, intensive in technological and scientific knowledge. On the other, they do not have the advantages of emerging countries for the production of labour-intensive and inexpensive goods and services. These countries therefore remain at a crossroads: either they converge rapidly towards the advanced economies, or they fall further behind. This is the framework that should be used to analyse the effort that Italy and Portugal – to a greater extent – have been making to meet the advanced scientific and technological capabilities that would allow them to structurally change their patterns of specialization and acquire the competitive attributes for operating within the new knowledge economy.

However, both Portugal and Italy have unbalanced national innovation systems and suffer from many hindrances and constraints that limit the renewal and strengthening of their competitiveness factors.

First, when compared to advanced nations their education and the qualification of human resources are backward. The percentage of the population with higher education in these countries is very low. This is a particularly serious problem because it is not possible to make the transition to a knowledge economy without a skilled and educated population.

Secondly, the level of R&D expenditure in Portuguese and Italian companies is still lower than is normally found in advanced economies. The shortage of companies operating in high technology sectors means that a large share of the R&D expenditure is still carried out by public laboratories and academic research units, contrary to what happens in the advanced NIS.

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Thirdly, the still high share of traditional sectors and the ubiquity of small scale companies in the economic fabric combine to constrain the reconversion efforts of these two countries. The importance of traditional sectors such as clothing, textiles and footwear, particularly open to the competition of emerging countries, goes hand in hand with the omnipresence of SMEs which lack the scale to invest in R&D and training. This means that the technological reconversion of these economies and the change of their specialization patterns are being hindered. The great importance of the trademarks and design protection and the poor patenting performance in both countries is symptomatic of this.

Portugal and Italy even share weaknesses in relation to the transition to the knowledge society. While it is true that the use of ICT is quite high in both countries at corporate level (and is in line with the EU average), Portugal and Italy are still far from the Union's most advanced countries regarding households whether it is in terms of level of internet access, broadband penetration rate or availability of computers (Figure 14). The level of maturity of the knowledge society in these countries is still low. This can be proved by examining the attitude of Portuguese and Italian citizens towards S&T – often an underused indicator in this type of study (Godinho 2007). But it is certainly important to study the general attitude of individuals towards S&T given that the acquisition, use and creation of knowledge are fundamental processes in the knowledge society. The transition to a knowledge society is not possible without an informed and interested audience in the new scientific and technological developments, actively participating in the new paradigm. The famous astronomer and science communicator Carl Sagan once wrote that the prevalence of indifference and ignorance about science in a civilization which is based on science and technology is a recipe for disaster. Unfortunately, according to a recent (2010) Eurobarometer survey, Portugal and Italy are two of the EU countries with the lowest public interest in scientific discoveries and new technological developments (Figure 19).

Obviously there are also great differences between the two cases. In terms of innovative performance, the Portuguese NIS – which started from a much lower level – has experienced strong growth while that of Italy has been poor and there has even been a process of divergence in relation to the more advanced countries.

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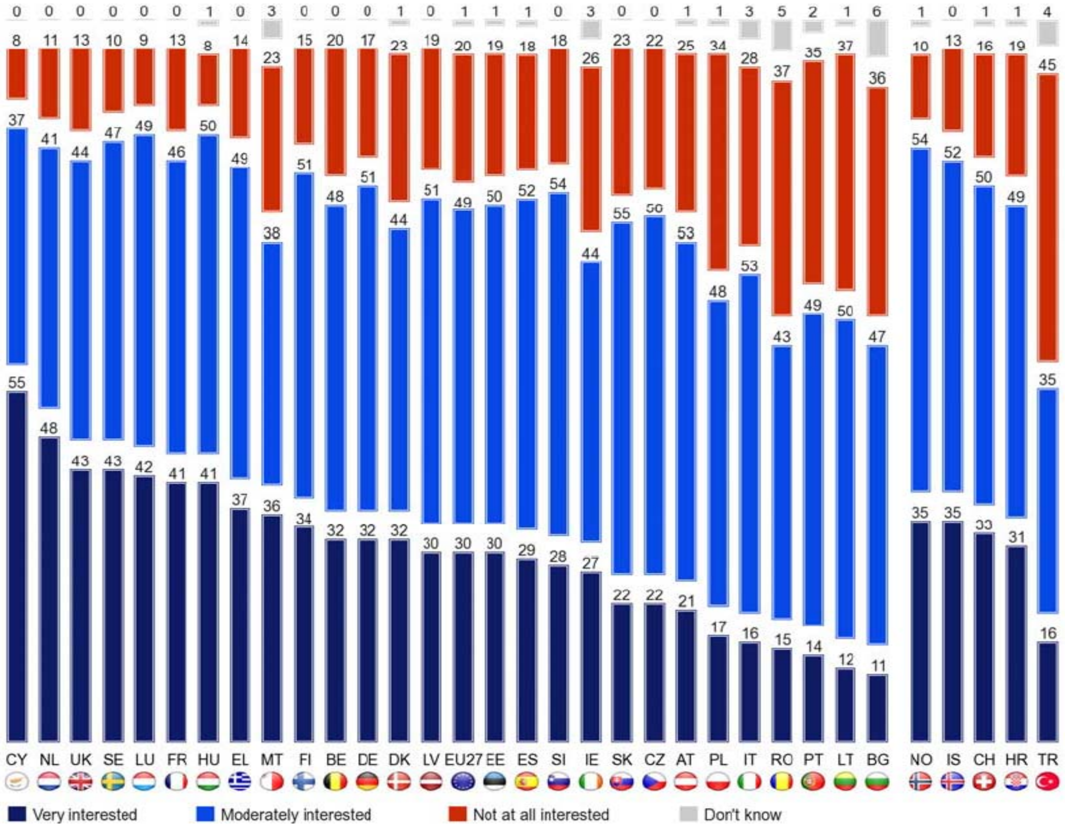
FIGURE 19 – Interest in new scientific discoveries and technological developments (2010)



Source: Eurobarometer, Science and Technology Report, June 2010.

On the other hand, Italy possesses a solid medium-technology industrial base and the 'made-in-Italy' sectors (especially the textiles, clothing, footwear and furniture) are a source of dynamism, competing through differentiation, quality, creativity and design. Until the 1990s, Italy successfully implemented the strategy for intermediate countries put forward by Nick von Tunzelmann (2007). This author argued that the traditional catching-up strategy followed by the intermediate countries, based on the creation and expansion of high-technology sectors,[5] is often inadequate. He suggests that a much safer and more attractive strategy for these countries is the adoption of rapidly developing technologies and high technology *activities* in the low and medium technology sectors and traditional industries in which these countries have already acquired skills and comparative advantages. According to the author, 'intermediate countries strategies must be built around their idiosyncratic "dynamic capabilities"' (Tunzelmann 2007: 33). This is done through the application, permanent adaptation, dynamic use of new technologies – that may be developed domestically – and continuous innovation (in order to

[5] According to the OECD typology (2003), the high-technology industries include Aircraft and spacecraft, Pharmaceuticals, Office, accounting and computing machinery, Radio, television and communication equipment and Medical, precision and optical instruments.

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generate processes of dynamic appropriability) in segments of low and medium technology industries where intermediate countries hold competitive advantages and greater market knowledge.[6]

As we have seen, much of the Italian success and dynamism is based on the SMEs operating in traditional sectors and in medium technology industries such as mechanics and equipment supply. Portugal, despite progress in some areas, does not possess to the same extent these competitive attributes, showing much more unsatisfactory results in terms of the economic effects of the innovative process.

Even in terms of education and qualification of the human resources, the Portuguese backwardness is much more evident than that of Italy, especially at the pre-tertiary levels of education. The huge percentage of Portuguese who only have primary or lower secondary education (72 per cent) and the low proportion of people with upper secondary education as highest level attained (14 per cent) is striking (Table 2).

The conclusion is that these two countries still have a long way to go towards achieving the transition to the knowledge economy and society. This can only be accomplished by overcoming the barriers, constraints and weaknesses of their national innovation systems.

The creation and development of high-technology and science-based sectors may make a decisive contribution to this purpose, especially when producing technologies applicable to many fields and based on domestic scientific and technological skills. This is the case of the biotechnology and software sectors. They may and indeed have contributed to the technological upgrade and the increase of competitiveness of other industries. Their development should therefore be encouraged by stimulating their basis of knowledge, by promoting scientific and technological entrepreneurship and by encouraging partnerships and the mobilization of formal and informal social networks with companies, universities and other organizations of the innovation system. This strategy can be applied broadly to the knowledge-based society and is a better fit for countries with moderately innovative, incomplete or poorly articulated national systems of innovation and with a shortage of large companies operating in the dominant high technology sectors.

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[6] The author mentions Portugal as an example:

> A country like Portugal, which has managed to establish itself as dominant in a market like Port wine – hard to replicate elsewhere – may focus its efforts on the improvement of technologies such as biotechnology, to ensure its development trajectory through these industries. [Authors' translation]
>
> (Tunzelmann 2007: 22)

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REFERENCES

AMABLE, B. (2003) *The Diversity of Modern Capitalism*, Oxford: Oxford University Press.

AMABLE, B., BARRÉ, R. and BOYER, R. (1997) *Les Systèmes d'Innovation à l'Ère de la Globalisation*, Paris: Economica.

ASHEIM, B.T. and GERTLER, M.S. (2005) 'The geography of innovation. Regional innovation systems', in J. Fagerberg, D. Mowery and R. Nelson (orgs) *Oxford Handbook of Innovation*, Oxford: Oxford University Press.

DAHLMAN, C. and FRISCHTAK, C.R. (1993) 'National systems supporting technical advance in industry: the Brazilian experience', in R. Nelson (org.) *National Innovation Systems: a comparative analysis*, Oxford: Oxford University Press.

EDQUIST, C. (2005) 'Systems of innovation: perspectives and challenges', in J. Fagerberg, D. Mowery and R. Nelson (orgs) *Oxford Handbook of Innovation*, Oxford: Oxford University Press.

ETZKOWITZ, H. (2003) 'Innovation in innovation: the Triple Helix of university-industry-government relations', *Social Science Information*, 42.

ETZKOWITZ, H. and LEYDESDORFF, L. (2000) 'The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university-industry-government relations', *Research Policy*, 29.

European Commission (2011) *Innovation Union Scoreboard 2010. The Innovation Union's performance scoreboard for research and innovation*, Brussels: PRO INNO Europe.

FAGERBERG, J. (2005) 'Innovation: a guide to the literature', in J. Fagerberg, D. Mowery and R. Nelson (orgs) *Oxford Handbook of Innovation*, Oxford: Oxford University Press.

FREEMAN, C. (1995) 'The "National System of Innovation" in historical perspective', *Cambridge Journal of Economics*, 19: 5–24.

FURLANI, A., VULCANO, A. and LUCAS, R. (2009) *Innovation Policy Progress Report: Italy*, Brussels: European Commission, PRO INNO Europe.

GIBBONS, M., LIMOGES, C., NOWOTNY, H., SCHWARTZMAN, S., SCOTT, P. and TROW, M. (1994) *The New Production of Knowledge: the dynamics of science and research in contemporary societies*, London: Sage.

GODINHO, M.M. (2007), 'Indicadores de C&T, inovação e conhecimento: onde estamos? Para onde vamos?', *Análise Social*, 182: 239–74.

KENNEDY, P. (1988) *The Rise and Fall of the Great Powers: economic change and military conflict from 1500 to 2000*, London: Unwin Hyman Limited.

LUNDVALL, B-Å. (1992) *National Systems of Innovation: towards a theory of innovation and interactive learning*, London: Pinter Publishers.

MALERBA, F. (1993) 'The national system of innovation: Italy', in R. Nelson (org.) *National Innovation Systems: a comparative analysis*, Oxford: Oxford University Press.

MALERBA (2005) 'Sectoral systems. How and why innovation differs across sectors', in J. Fagerberg, D. Mowery and R. Nelson (orgs) *Oxford Handbook of Innovation*, Oxford: Oxford University Press.

MORISHIMA, M. (1984) *Why Has Japan 'Succeeded'?: Western technology and the Japanese ethos*, Cambridge: Cambridge University Press.

MORISHIMA, M. (2000), *Japan at a Deadlock*, Basingstoke: Palgrave Macmillan.

MOWERY, D.C. and SAMPAT, B.N. (2005) 'Universities in national innovation systems', in J. Fagerberg, D. Mowery and R. Nelson (orgs) *Oxford Handbook of Innovation*, Oxford: Oxford University Press.

NELSON, R. (1993) *National Innovation Systems: a comparative analysis*, New York and Oxford: Oxford University Press.

OECD (2003) *OECD Science, Technology and Industry Scoreboard 2003,* Paris: OECD Publishing.

OECD (2007) *OECD Science, Technology and Industry Scoreboard 2007,* Paris: OECD Publishing.

OECD (2009), *OECD Science, Technology and Industry Scoreboard 2009*, Paris: OECD.

OECD (2010a) *Education at a Glance 2010*, Paris: OECD Publishing.

OECD (2010b) *Main Science and Technology Indicators*, Volume 2010/2, Paris: OECD Publishing.

OECD (2010c), *Science, technologie et industrie: Perspectives de l'OECD*, Paris, OECD.

SALAVISA, I. (2001) *Mudança Tecnológica e Economia – crescimento, competitividade e indústria em Portugal*, Oeiras: Celta.

SALAVISA, I. (2007) 'Os países intermédios na encruzilhada: globalização, sociedade do conhecimento e suas consequências', in I. Salavisa, W. Rodrigues and S. Mendonça (orgs) *Inovação e Globalização – estratégias para o desenvolvimento económico e territorial*, Porto: Campo das Letras.

SIMÕES, V.C. (2009) *Innovation Policy Progress Report: Portugal*, Brussels: European Commission, PRO INNO Europe.

TUNZELMANN, N. (2007) 'As indústrias de alta tecnologia e os países de desenvolvimento intermédio', in I. Salavisa, W. Rodrigues and S. Mendonça (orgs) *Inovação e Globalização – estratégias para o desenvolvimento económico e territorial*, Oporto: Campo das Letras.

TYLOR, E. (1871) *Primitive culture: researches into the development of mythology, philosophy, religion, art, and custom*, Cambridge: Cambridge University Press, 2010.

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