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An assessment of research system and policies

Italy

Bianca Poti, Emanuela Reale and Valentina Pierantozzi

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Contact information
Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)
E-mail: jrc-ipts-secretariat@ec.europa.eu
Tel.: +34 954488318
Fax: +34 954488300

IPTS website: http://ipts.jrc.ec.europa.eu
JRC website: http://www.jrc.ec.europa.eu
DG RTD website: http://ec.europa.eu/research/

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ERAWATCH Network - CERIS – CNR

Bianca Poti and Emanuela Reale

and

Joint Research Centre
Institute for Prospective Technological Studies (IPTS)

Valentina Pierantozzi

Joint Research Centre

Directorate-General for Research

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Executive Summary

Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are at the heart of the Lisbon Strategy. The strategy reflects this in guideline No.7 of the Integrated Guidelines for Growth and Jobs which aims to increase and improve investment in research and development, in particular in the private sector. The report aims at supporting the mutual learning process and the monitoring of Member States efforts. The main objective is to characterise and assess the performance of the national research system of Italy and related policies in a structured manner that is comparable across countries. In order to do so, the system analysis focuses on key processes relevant for system performance. Four policy-relevant domains of the research system are distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. This report is based on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

The overall performance of the national research system has suffered of a scarce mobilisation of financial resources: the recognition of the relevant role of the R&D investments in the policy documents has not been followed by a substantial increase of resources allocation. A dramatic decrease of the annual average rate of growth of GBAORD is observed during the period 2000-2005, compared to the previous five years (1995-2000). The new fiscal incentives introduced for supporting SMEs' R&D have produced a positive reaction from private actors; however the available resources for implementing such a measure have been under-dimensioned. New measures have been adopted for reducing “brain drain”, but no perspective of job continuity is offered to the coming back scientists; last but not least measures for the valorisation of scientific careers are still lacking.

The role of private stakeholders as drivers of knowledge demand remains low, due to the structural problems (low dimension and lack of growth) of the country’s industrial sector. The public side of knowledge demand, represented by the GBAORD, has experienced improvement as for the coordination among the institutional actors, however a weak linkage exist between the results of research evaluation and the allocation of resources.

As to knowledge production, the country is characterised by a low total number of researchers (3,0 per thousands total employment in 2007, compared with 5,8 for EU(27)) with a scientific output of good quality, but two types of gaps are still present: a stronger quantity (4th position within EU(25)) than quality recognition (10 position within EU (“%) in terms of ratio between citations received and given); a gap between scientific and technological specialisation, given the country structural characteristics.

Public, scientific sector has shown a renewed interest towards playing an active role in the knowledge circulation and transfer, but results are still scarce. As to human resources circulation, the researchers leaving are more than the incoming ones demonstrating the low country attractiveness.

In sum, the evolution of the country research system has been characterised by a higher attention of policy makers to problems under the four dimensions (see below), mostly for compliance with the European policy, but the historical and structural

problems are persistent, since there hasn't been an adequate investment of resources.

An example can be seen by referring to a major policy action: a better linkage between academic research and industrial users has been addressed through many different instruments, but with a reduced efficacy. The combination of low resource mobilisation and structural problems represents a relevant constraint to reaching satisfying results.

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	Research is a widely recognised policy priority but R&D expenditures have not grown substantially.
	Securing long term investment in research	Capability to mobilise resources for European research initiatives is strong, but securing national long and short term investment through institutional funding suffered for the lack of continuity from one year/government to the next.
	Dealing with barriers to private R&D investment	R&D private investments as well as innovative financial instruments to R&D are weak.
	Providing qualified human resources	Lack of career perspectives for researchers and for attracting foreign scholars.
Knowledge demand	Identifying the drivers of knowledge demand	Good capacity of society and research sector as drivers of knowledge demand. Scarce participation of private stakeholders in knowledge demand articulation and low level of public procurement
	Co-ordination and channelling knowledge demands	Strong central set of policy instruments aimed to coordinate and channelling knowledge demand, go with weak links between assessments/evaluations and inputs into knowledge demand.
	Monitoring of demand fulfilment	Weak tradition of evaluation and foresight practices can be overcome through the recent policy initiative of ANVUR. Delay in the implementation of the reform could affect its timely and effectiveness.
Knowledge production	Ensuring quality and excellence of knowledge production	Good quality of scientific production, but there is still a difference between quantity and quality recognition; Good openness to international collaboration.
	Ensuring exploitability of knowledge	Gap between scientific and research specialisation on one side and technological/economic specialisation on the other.
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	Scientific community has shown interest for TT incentives Growing participation in international research programmes.
	Profiting from international knowledge	The international mobility of researchers is low.
	Enhancing absorptive capacity of knowledge users	SMES absorbing capacity is still low.

Two good opportunities for improving the situation are the new Agency for the Evaluation of University and Research (ANVUR), together with the on going rationalisation of the policy instrument portfolio, but a good implementation is function of the invested resources.

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	Measures as tax incentives for private R&D, additional R&D funding and implementing the strategic planning of structural funds represent good new opportunities.	Opportunities may be counterweighted by the absence of sustainability of public finance, and corresponding difficulty of achieving the Lisbon target; absence of policy measures to increase human resources, including the lack of measures for improving the attractiveness of the research career; new measures promoted by Regions for sustaining a larger role of financial market can be counterbalanced by the persistent inertia of the private sector in this respect.
Knowledge demand	Assessment of research results by the newly created National Agency (ANVUR), and a portfolio of funding mechanisms coordinated into a unified framework could improve efficiency and effectiveness of resource allocation.	Scarce government public procurement as well as discontinuity in the implementation of the instruments devoted to monitor the demand fulfilment are the main risks.
Knowledge production	New interest and measures promoting quality of research and participation in public-private and international networks.	The risk that recent research policy changes, more oriented towards excellence, do not support a reduction of the present gap between national industrial structure and the scientific research
Knowledge circulation	Incentives for scientific institutions towards the third mission and incentives for SMEs R/D collaborations can improve university-industry relations	Lack of initiatives towards national and international researchers' mobility.

Finally the idea/aim of a European Research Area is present in many policy documents and the better results are registered for large scale facilities and participation to Era-net, which nonetheless needs to be further improved.

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1 - Introduction and overview of analytical framework

1.1 Scope and methodology of the report in the context of the renewed Lisbon Strategy and the European Research Area

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are at the heart of the Lisbon Strategy. The strategy reflects this in guideline No.7 of the Integrated Guidelines for Growth and Jobs. This aims to increase and improve investment in research and development (R&D), with a particular focus on the private sector. One task within ERAWATCH is to produce analytical country reports to support the mutual learning process and the monitoring of Member States' efforts.

The main objective is to analyse the performance of national research systems and related policies in a comparable manner. The desired result is an evidence-based and horizontally comparable assessment of strength and weaknesses and policy-related opportunities and risks. A particular consideration in the analysis is given to elements of Europeanisation in the governance of national research systems in the framework of the European Research Area (ERA), relaunched with the ERA Green Paper of the Commission in April 2007.

To ensure comparability across countries, a dual level analytical framework has been developed. On the first level, the analysis focuses on key processes relevant to system performance in four policy-relevant domains of the research system:

1. Resource mobilisation: the actors and institutions of the research system have to ensure and justify that adequate public and private financial and human resources are most appropriately mobilised for the operation of the system.
2. Knowledge demand: needs for knowledge have to be identified and governance mechanisms have to determine how these requirements can be met, setting priorities for the use of resources.
3. Knowledge production: the creation and development of scientific and technological knowledge is clearly the fundamental role of a research system.
4. Knowledge circulation: ensuring appropriate flows and distribution of knowledge between actors is vital for its further use in economy and society or as the basis for subsequent advances in knowledge production.

These four domains differ in terms of the scope they offer for governance and policy intervention. Governance issues are therefore treated not as a separate domain, but as an integral part of each domain analysis.

Figure 1: Domains and generic challenges of research systems

Resource mobilisation	Knowledge demand	Knowledge production	Knowledge circulation
• Justifying resource provision • Long term research investment • Barriers to private R&D funding • Qualified human resources	• Identification of knowledge demand drivers • Co-ordination of knowledge demands • Monitoring of demand fulfilment	• Quality and excellence of knowledge production • Exploitability of knowledge production	• Knowledge circulation between university, PRO and business sectors • International knowledge access • Absorptive capacity

On the second level, the analysis within each domain is guided by a set of generic "challenges" common to all research systems that reflect conceptions of possible bottlenecks, system failures and market failures (see figure 1). The way in which a specific research system responds to these generic challenges is an important guide for government action. The analytical focus on processes instead of structures is conducive to a dynamic perspective, helps to deal with the considerable institutional diversity observed, and eases the transition from analysis to assessment. Actors, institutions and the interplay between them enter the analysis in terms of how they contribute to system performance in the four domains.

Based on this framework, analysis in each domain proceeds in the following five steps. The first step is to analyse the current situation of the research system with regard to the challenges. The second step in the analysis aims at an evidence-based assessment of the strengths and weaknesses with regard to the challenges. The third step is to analyse recent changes in policy and governance in perspective of the results of the strengths and weaknesses part of the analysis. The fourth step focuses on an evidence-based assessment of policy-related risks and opportunities with respect to the analysis under 3) and in the light of Integrated Guideline 7; and finally the fifth step aims at a brief analysis of the role of the ERA dimension.

This report is based on a synthesis of information from the European Commission's ERAWATCH Research Inventory[1] and other important publicly available information sources. In order to enable a proper understanding of the research system, the approach taken is mainly qualitative. Quantitative information and indicators are used, where appropriate, to support the analysis.

After an introductory overview of the structure of the national research system and its governance, chapter 2 analyses resource mobilisation for R&D. Chapter 3 looks at knowledge demand. Chapter 4 focuses on knowledge production and chapter 5 deals with knowledge circulation. Each of these chapters contains five main subsections in correspondence with the five steps of the analysis. The report concludes in chapter 6 with an overall assessment of strengths and weaknesses of the research system and governance and policy dynamics, opportunities and risks across all four domains in the light of the Lisbon Strategy's goals.

[1] ERAWATCH is a cooperative undertaking between DG Research and DG Joint Research Centre and is implemented by the IPTS. The ERAWATCH Research Inventory is accessible at http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.home. Other sources are explicitly referenced.

1.2 Overview of the structure of the national research system and its governance

In Italy the Ministry for Education University and Research (MiUR) coordinates national and international scientific activities, distributes funding to universities and research agencies, and establishes the means for supporting public and private research and technological development (RTD) funding. The centre-left coalition government led by Romano Prodi separated the competences of the Ministry of Research and University (MiUR) from those of the Ministry of Public Education, but the new centre-right coalition led by Silvio Berlusconi merged again the two Ministries (DL 85/2008).

MIUR coordinates the preparation of the triennial National Research Programme (NRP), the main governmental document for R&D planning that sets the strategic lines for the national system. It does this by interacting with all other interested stakeholders, including other Ministries.

The National Research Programme is in the last instance approved by CIPE- the high level inter-ministry committee for the economic planning. Every year, in combination with the preparation of the national Document of Economic and Financial Policy (DPEF), CIPE defines the strategic directions as well as the financial resources devoted to R&D activities. The DPEF is submitted to the Council of Ministers and to the Parliament for approval.

The Ministry for Economic Planning (previously called Ministry for Production Activities) supports and manages industrial research.

Other Ministries (Health, Agriculture, etc) manage research funding in their specific fields.

Research activity in Italy is mainly carried out by universities (30,2% of total R&D national expenditure in 2005): there are 89 universities in Italy, of which the majority is public (54 State universities).

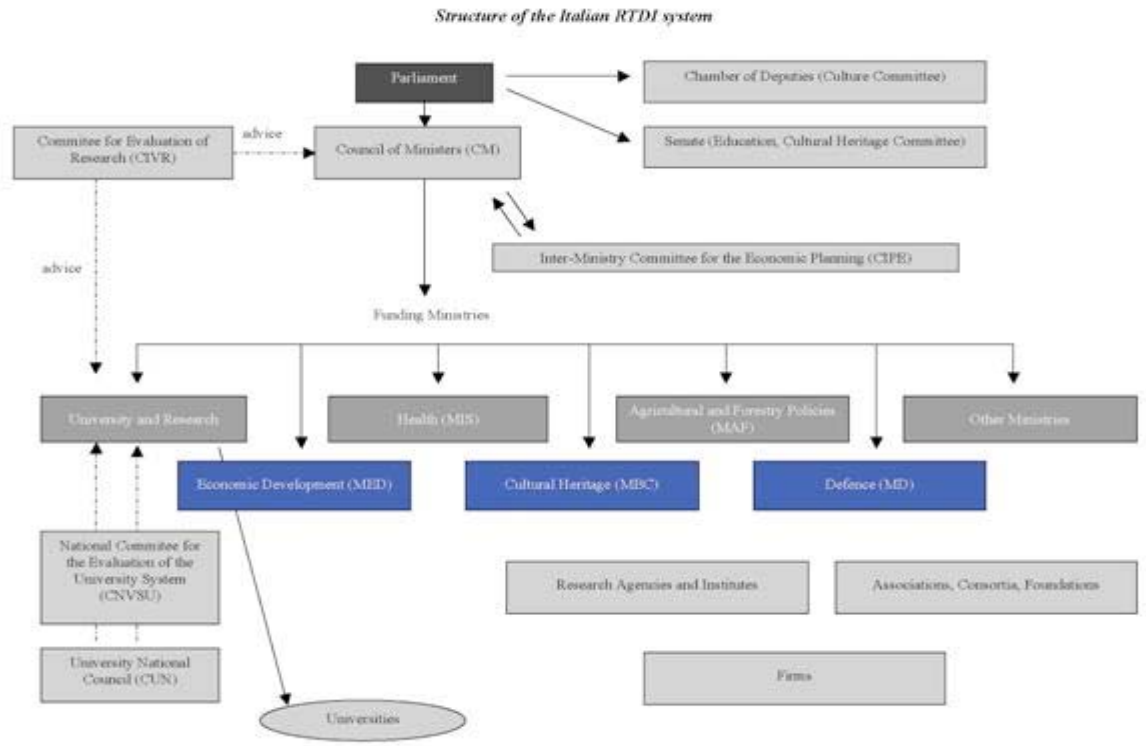
Public Research Organisations (PROs) play a very significant role in the research sphere. There are ten PRO's acting in the Italian scenario with a major role, out of which the most significant are:

- The National Research Council (CNR), the main national research organisation working in all scientific disciplines, which acts both as research performer and funder (although its funding role has considerably diminished after 1989, when MIUR became the main actor in R&D). Until 1989 CNR had also a formal policy advisory role. CNR operates through 107 Institutes and it has undergone a significant organisational reform in 2003, aiming at improving the scientific quality of its research and at enhancing results' exploitation.
- The National Agency for New Technologies, Energy and Environment -ENEA-, operating in the fields of energy, the environment and new technologies to support national competitiveness and sustainable development.
- The National Institute for Nuclear Physics -INFN- dedicated to the study of the fundamental constituents of matter and conducting theoretical and experimental research in the fields of subnuclear, nuclear, and astroparticle physics. It manages large scale equipments and participates in CERN activities.

- The Italian Space Agency -ASI- in charge of coordinating all national efforts and investments in the space sector.

Public research institution expenditure in 2005 was equal to approximately €2,701m.

Figure 2: Main institutions of the Italian Research system



Source: European Commission 2007: ERAWATCH Research Inventory, http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.content&topicID=35&countryCode=IT&parentID=34

The national committee for the evaluation of the university system (CNVSU), belonging to MIUR, is an advisory body in charge of the evaluation of the university system; the committee for evaluation of research (CIVR) is an independent body in charge of the evaluation of research. CNVSU and CIVR committees will be replaced in their role and functions by a National Agency for the Evaluation of the University and Research (ANVUR), established by the 2007 Financial Law with a budget of €5m. The Agency's regulation and operational functioning have been recently defined by the Decree n.64/2008.

The division of competences between State and regions in the R&D field is based on the concurrency principle: both central and regional authorities can legislate, however a series of interventions are exclusive competence of the central State, namely:

- Support to public research institutions (Universities and public research organisations);
- R&D national Mission oriented Programmes;
- Creation of large national public-private laboratories;

- Co-ordination of the national scientific system participation to European and International R&D programmes;
- Support to national-international research infrastructures.

Within this division of competences, regions have acquired more responsibility through a change in the Italian Republic's Basic Law (L. 3/2003), which enables them, along with the State, to adopt autonomous Science, Technology and Innovation (STI) policies.

Co-ordination between State and regional policy activities is ensured through the work of a permanent State-Regions committee.

Regional policies at national level, including R/D activities as critical component (horizontal measures for competitiveness), are additional to ordinary budget and consist of co-funding of structural funds (national and regional operational programs, PONs and PORs) and a fund for under-exploited areas, FAS (recently included by the 2007 Financial Law within a new larger “Fund for competitiveness and development”).

The National Strategic framework for the regional policy (QSN 2007-2013), which has been approved by CIPE in December 2006, is the product of a long process of two years of inter-institutional debate and interaction among central Administrations, Regions, other Local authorities and representatives of socio-economic stakeholders, followed by a formal negotiation with the European Commission (the QSN final version is of 12 June 2007). This regional policy governance includes actions of strategic coordination between State and Regions and activities of monitoring, evaluation and strategic reporting. One of the aims is to avoid effects of crowding out or competition between geographical areas or incentives.

The QSN regional policy is promoted through “projects”, where a combination of policy measures (incentives, regulations, infrastructures) contributes to the realization of sustainable processes of innovation. This model of intervention, different from a simply “incentive based” one, has been followed by the 2007 Financial Law also when tracing the lines of a new industrial policy for innovation (Industria 2015).

Regions manage directly three types of policy instrument, all including R/D activity support, even if with different weight: the co-funded instruments (PORs see above), the regional based measures and the transferred from the State measures (established by national laws, such as the case for the R/D fiscal credit, L. 140/ ’97) with State attribution of financial resources. The three types of measures are mainly oriented towards a general sustain to the local industrial system consolidation and have a diversified range of instruments (promotion of new entrepreneurs, access to bank credit, infrastructures) but with a low amount of funding. These high number of different “region based” instruments ask for a rationalization of the incentives and some regions have produced a legislative Act (Testo Unico).

2 - Resource mobilisation

The purpose of this chapter is to analyse and assess how challenges related to the provision of inputs for research activities are addressed by the national research system. Its actors have to ensure and justify that adequate financial and human resources are most appropriately mobilised for the operation of the system. A central issue in this domain is the long time horizon required until the effects of the mobilisation become visible. Increasing system performance in this domain is a focal point of the Lisbon Strategy, with the Barcelona EU overall objective of a R&D investment of 3% of GDP and an appropriate public/private split as orientation, but also highlighting the need for a sufficient supply of qualified researchers.

Four different challenges in the domain of resource mobilisation for research which need to be addressed appropriately by the research system can be distinguished:

- Justifying resource provision for research activities;
- Securing long term investment in research;
- Dealing with uncertain returns and other barriers to private R&D investment; and
- Providing qualified human resources.

2.1 Analysis of system characteristics

2.1.1 Justifying resource provision for research activities

The need to maintain and possibly to increase the Italian system's competitiveness in Europe and in the world is an argument present in all the policy documents supporting resource mobilisation (PNR, 2005-2007; DPEF 2005-2008 and DPEF 2008-2013). The main rationale of resources provision for research activities is based on the assumption that investing on research development and innovation would enhance the economic system and wealth creation. According to this view, actions toward the reinforcement of the research base as well as toward pursuing stronger linkages between public and private knowledge producers (universities, public research organisations and firms) in order to assure a better exploitation of scientific results and the mobility of high qualified human resources are all interventions considered as priorities of the economic policy.

Also stakeholders' opinions showed a large convergence towards the aforementioned rationales, with a particular emphasis on the need to better the public policies for supporting industrial R&D activities and to promote a high education system more adapt to the supply of high level competencies in science and engineering.

Although the policy documents put in evidence strong justification for increasing resource mobilisation for research, the importance of this activity compared with other government objectives is not really effective. The share of GBAORD as percentage of GDP in 2005 was 0,65, a value which is significantly lower that the EU25 average (0,74). Moreover, if we observe the evolution over time of this indicator, we can highlight a dramatic reduction of the annual average growth rate between the two periods of 1995-2000 (+9,6) and 2000-2005 (+3,6). Although a

similar reduction affected also other European countries due to huge public budget constraints, it did not allow Italy to reduce its gap with respect to the European average value. The main explanation is the persistent problem of the Italian government to reduce the total amount of the public expenditure. This general objective of the economic policy affects the effectiveness of all horizontal policies, including the resource provision for research activities.

The public understanding of science and research is considered by the government as one of the factors that can help the justification for resource mobilisation. This action was enhanced through the constitution by the Prodi Cabinet of an Inter-ministerial Task Force for the diffusion of the scientific culture, joining high level politicians, scientists and stakeholders representative of four Ministries, namely MiUR, the Ministry for Innovation, the Ministry for the Cultural Heritage and the Ministry for Education.

The Task force addressed few critical dimensions for enhancing the reinforcement of the scientific culture of the country, such as functioning of scientific labs within the schools, science museums as places for education and research, reform university curricula in science and engineering, public awareness of science and technology within the young generation. For each domain specific recommendations were expressed by the task force, based on explorative empirical analyses of the different strength and weakness carried out through surveys or case studies.

Other existing activities aimed to promote public understanding of science were also maintained, such as the “Week of Science and Technology”, organised yearly by the MiUR, with the participation of schools, universities, public and private research organisations, as well as the financing of a specific funding instrument, the Fund for the promotion of the scientific culture”, based on law 6/2000, aimed to support actions toward a more effective participation of young generation to the public debate on science and technology.

2.1.2 Securing long term investment in research

The key actors for securing long-term investment in fundamental research and generic research infrastructures are located at the central government level. The leading actor is the Ministry for Education, University and Research (MIUR), but a significant role is also played by other Ministries (Economic Planning, Health, and Agriculture).

Few non for profit organizations also have a prominent role, at least in some research fields such as medicine and environment (examples are Telethon, the Italian Association for Research against Cancer AICR, and the Italian Association against Blood Diseases AIL). Nevertheless public budget constraints and problems of coordination between different government actors still affect the system.

The weakness of Italy securing long term investment in research can be easily described by using few indicators.

University research is financed by national government through the “Ordinary Fund for Higher Education” (FFO), assigned yearly through the financial law. A percentage of 30% of this Fund is direct to sustain research activities and related infrastructures, but the low growth of the total amount of FFO along the last five years (from €6.010m in 2001 to €6.894m in 2005) give a very small support to long term R&D investment of Universities. This amount is complemented by the government project funding, but

even in this case we face a decrease of the R&D funding: from €537m in 2001 to €416m in 2005 (CNVSU, 2007).

A similar trend can be observed in the financing of public research organizations: the government block grant funding[2] grew from €1.575m in 2002 to around €1.618m in 2006.

The implementation of the long term financing for research in government budgeting process is linked to DPEF, which provides core government R&D funding on an aggregate level. Then, multi annual resource commitments on the basis of different national funding instruments are established by the national laws, but their effectiveness must be assured by the yearly budget law. This mechanism implies the need to get into hard negotiating processes in order to guarantee the R&D annual budget, and the possibility to achieve significant increases in public funding is not too easy, for the possibility left in the hands of the government to redirect a part of the public funding to other policy priorities.

European funding from Framework programs and Structural funds are highly relevant for ensuring long term investment on R&D. The VI EU Framework had a large participation of public and private Italian institutions with a success rate of 18,6% of projects admitted to the negotiation process. The estimation of the share of the total budget for Italy is 8,9%, while the ratio covered by the national government financing on the total budget is 9,9%. Both data show a reduction comparing with resources of the V EU Framework (the percentages were respectively 9,4 and 10,5).

The Quadro Strategico Nazionale (QSN) is the document for the strategic planning of Structural Funds in Italy submitted to the Commission on March 2007. Four macro objectives were identified along with ten thematic priorities devoted to enhance productivity, competition and innovation. For each priority different ways are foreseen in order to harmonize regional policies with the ordinary national policy. Interestingly enough, knowledge development and the related priorities are considered the most important achievements comparing with the other macro objectives

Italy has both its own research infrastructures as well as participation and access to international research infrastructures in some disciplinary fields, mainly through the activity of some public research organizations and private institutions, as, for instance, the infrastructures of the Nuclear and Sub-nuclear Physics of INFN (Gran Sasso, Virgo, in Italy and CERN, DESY, FERMILAB at international level), the multi disciplinary infrastructures for the Science and Technology of Materials, Bio-materials and Nano-structures (CNR-INFM, consortium INSTM and Sincrotrone Trieste: Laboratorio Elettra in Italy and access to international large scale facilities ESRF, ILL, ISIS). According to the European Strategy Forum on Research Infrastructures (ESFRI) recommendations, each country should assure about €5-6m as contribute for sustaining the dedicated European budget. Italy DPEF 2008-2013 includes securing of long term investment for research infrastructures according to these recommendations. Annual budget laws implemented this measure accordingly.

[2] The main tool for financing public non university R&D in Italy is the Fondo ordinario per ricerca e sviluppo (Ordinary Fund for R&D) which represent the core funding of the non university institutes. The Fund is a framework included in the national yearly financial law, for programming R&D, by areas, domains, themes and institutions.

2.1.3 Dealing with uncertain returns and other barriers to business R&D investment

Markets failures are a serious constraint of the Italian system providing sufficient business investment in R&D. This is due to different factors, among which the most relevant are the structure of the national business sector, dominated by small firms in traditional sectors, with a low propensity toward R&D investment and innovation. More precisely, in Italy 98% of firms are small (from 1 to 49 employees) and 1,8% are medium sized (from 50 to 250 employees); as to the dimension, there is a stable characterisation of the firms: from 2000 to 2005 no significant changes emerged in the distribution of firms by size; business enterprise expenditure on R&D in 2005 accounted for 50,4% of the total GERD, while the average value of EU27 is 63,3%.

BERD financed by industry dropped from 78,2% in 2001 to 75% in 2004, while BERD financed by government went from 14,9% to 13,8% over the same period, and it is significantly higher than the average EU27 (7,8).

The role of multinationals in business R&D can be interpreted by using BERD funding from abroad, that seems to have taken on greater importance (from 6,6% in 2001 to 11,1% in 2004) although it remained low compared with an EU 27 average of 9.8% (Eurostat, 2004). The growing importance of funding from abroad is confirmed also by looking the types of participants to the VI EU Framework programme, where firms accounted for about 40% of the Italian participants, with a success rate of 22% for large firms and of around 15% for SMEs. Thus, it is not easy to understand if the growth of R&D funding coming from abroad highlighted by the official statistics can be attributed to foreign investment, or to a tendency of firms being more active towards attracting EU funding, or a combination of the two trends.

Other sources of funding for private R&D include also public subsidies (6%) and fiscal incentives (5%), bank loans and Government backed loans (5% and 3% respectively), while venture capital has a very marginal role representing only around 1% of total funding. Interestingly in Italy, venture capital tends to be involved in business expansion and replacement activities, rather than early stage growth (European Commission, 2007). Large companies tend to find funding relatively easier to acquire, whereas it can constitute a serious barrier for small sized firms.

When looking at the business research system one important element that emerges is that private research activities are mostly concentrated in large firms: in 2002 around 82% of intra-muros R&D expenditure was by enterprises with over 250 employees, and this value remains stable in 2005 (ISTAT, 2006). The top five private Italian R&D investors are: Fiat, Finmeccanica, ENI, Pirelli, Telecom Italia.

CIS data 1998-2000 show that one-third of SMEs in Europe developed some innovation in house (and not only incorporate innovations developed abroad), also in collaboration with other firms. Italy has a position close to the European average value as to the quota of SMEs innovating in house, but it has a weak position as to SMEs involved in innovation co-operation (Innovation Scoreboard, 2005).

The 2007 Financial law approved by the Parliament in December 2006 has introduced a tax allowance for firms performing R&D equal to 10% of the cost of research (15% in the case of a contract with a university or public research agency). The ceiling is set at €15m per year. The foreseen budget for these incentives is €300m per year over a period of three years.

MiUR introduced special incentives for SMEs and for research collaboration between firms and between firms and research organisation in the national law for funding R&D projects developed by the business sector (DM 2/1/2008)

Finally, the total state aid to R&D was €726m in 2006 for Italy, showing a slight upward trend in the most recent years (+1,1%) but lower than the average EU25 (+1,8%). State aid to R&D represents a relatively small quota of public funding (0,05% of GDP in 2006), similar to the EU25 average value (0,06%). The new Community Framework for state aid for R&D and innovation entered in force on January 2007 allowing for new types of intervention and introducing a more refined economic approach for large amount of aid.

In Italy the financial market is less developed than in other industrialized countries. This is partly due to specific features of our industrial system, characterized by a strong cultural resistance of firms to enlarge or open their ownership structure, while it should be necessary to complement the policy measures with other initiatives favoring a better development of financial markets as support to a size growth of firms. These structural aspects constrain the firms' innovation level In 2005 the bank credit intensity, measuring the bank credit support to non financial firms and given by the percentage ratio between bank credits and GDP was 50% (ISTAT), while investment in risk capital (early stage) as percentage of GDP was 0,002. The low availability of market risk capital represents an important constraint for new innovative firms (start-up) and it is partially compensated by some Regions' policy focusing in recent years on risk and seed capital financing.

The impact of Regional policy measure favoring the access of SMEs to the bank and risk capital has not found enough interest from firms. In particular in South regions the demand has been very low, while in the North Center regions the measures have been used only at 50%. Moreover the reform of the public incentive system at national level, which foresees the active participation of the private banks in the system of access to credit, has not produced better bank-business relations. The propensity of firms to growth (and to innovate) remains low.

2.1.4 Providing qualified human resources

One of the major challenges of government R&D policy is to enhance University capabilities to produce researchers and post-graduates, mostly in science and engineering sectors, which are supposed to be able to sustain to competitiveness of the national economy.

University system in Italy is under pressure as many others in Europe, with continuous processes of reform addressing mainly funding mechanisms, organisation of teaching courses, reform of doctoral courses and doctoral schools, research evaluation and mechanisms for recruitment of researchers and professors. Government policies challenged Universities to supply a large number of graduates and a sufficient number of highly qualified post graduates, according to the priorities defined in the Lisbon strategy. Government initiatives were linked to different decrees, modifying the incentive system and the mechanisms for determining the level of FFO in order to get the policy objectives. Universities tried to adapt to the new requirements, but the results are far from the planned objectives (CNVSU, 2007).

The role of private sector is ambiguous. On the one hand Confindustria, the main Italian representative of firms, highlights the need to enhance the production of high qualified human resources in S&T fields. On the other hand, the number of graduates hired by firms is one of the lowest in Europe. In 2005, business enterprise R&D personnel per thousand employment in industry is 3,9 in Italy, 7,1 in UK, 11,2 in Germany and 5,4 in Spain.

The number of Italian graduates is increasing: from 175.000 in 2001 to more than 300.000 in 2005. The percentage of graduates in science and engineering is 23% in the year 2005, with a significant distance with respect to other large European countries such as France, Germany and UK. Foreign students in percentage of total students were about 2% in 2003, while the same value was over 10% in France, Germany and UK. The average age of university professors is about ten years higher than the aforementioned European countries. The total expenditure for tertiary education in percentage of GDP is 1% in 2002, lower than the average EU27, as well as the financing of the tertiary education demand through bursaries and loans: 0,14% of the GDP (Education at a glance, 2005).

In the 2003-2004 academic year, the total number of PhD students was about 37,000, with a relative concentration in the medical field. In 2001, the situation in the Science and Engineering fields showed the weakness of Italy's position, when measured by the ratio of new PhDs per thousand population aged 25-34. While the EU 15 average was 0.55, the Italian ratio came to just 0.18.

The Centre-left coalition encouraged with special incentives the setting up doctoral schools within universities, aimed to favour a semplification of the Phds courses supply, their internationalisation, and the involvement of the private sector. The new centre-right coalition is supposed to follow the same policy.

The total number of researchers per thousand total employment figures out the weakness of Italy (3,0) compared to, for instance, Spain (5,5), France (8,0), or EU27 (5,8) (CNR, 2007).

The number of foreign researchers who choose Italy as a place to do research is still less than the number of Italian researchers who decide to go abroad. The number of foreign researchers in the Italian system is approximately 1.8% of the total, although in some cases their presence is more significant (e.g. The National Institute for Physics). The share of foreigners among doctoral students is particularly low: in 2001 29,000 foreign students were enrolled on Italian PhD courses, compared with 40,000 in Spain, 226,000 in the UK and 475,000 in France (MiUR, 2005). This seems to be largely due to the fact that courses are mainly given in Italian, but also to the scarcity of interaction with private actors, which makes PhD courses less attractive to foreign researchers.

Italian government is very sensitive to the problem of human resources availability for science and technology, since the number of “vocations”, measured in terms of students enrolled, decreased, in particular in hard sciences (mathematics, physics and chemistry) and engineering. Although there are signs of recovery in the last two or three years, they are mainly in absolute values and not in percentage with respect to the total number of enrolments.

In order to enhance the number of students with insufficient notions of mathematics and science before the year 2010, several actions have been undertaken (EC, 2004). The aim is that of renewing the teaching of scientific disciplines in the schools and to

involve students in experimental pilot projects. Another initiative was the Progetto Lauree Scientifiche (Projects for Scientific degrees), promoted by MiUR, Confindustria and the National Conference of the Deans of the S&T Faculties, which funded training activities in 38 universities aimed to enhance competences of graduates in S&T fields.

A special support is also given by the Ministry of Education, University and Research (MIUR) to the diffusion of the scientific culture and to the development of scientific museums through the specific funding instrument of the l. 6/2000.

2.2 Assessment of strengths and weaknesses

Resource mobilisation for R&D is considered in policy documents as one of the key priorities for the economic and cultural development of the country. Along the last ten years, many initiatives have been taken in order to reinforce public awareness about the importance of investing in research, and public participation to the debate on science policy.

Despite the declaration of intents and the efforts towards public understanding of science, there was not an increased share of government budget devoted to research, and long term investment in research is mainly secured through the strategic planning of structural funds, the European funding for Framework Programs, and the participation to international research infrastructures.

Italy traditionally faced the problem of low business R&D investment, highly concentrated in large firms. Government policy addressed this weakness through special incentives for SMEs, public-private research collaborations as well as measures aimed to favour firms located in less developed regions. A small reinforcement of the state aid can also be observed. Firms level of innovation is also constrained by a low developed financial market.

As to human resources, Italy is sensitive to the problem of the availability of human resources in science and technology, and measures aimed to better the number of S&T graduates, students enrolment and a higher quality of University courses have been developed. Nevertheless the number of researchers on total labour force is one of the lowest in Europe, and initiatives in favour of researchers career and foreign researchers attraction are still limited.

The main strengths and weaknesses of the Italian research system in terms of resource mobilisation for R&D can be summarised as follows:

Main strengths	Main weaknesses
• Research is a widely recognised policy priority • Capability to mobilise resources for European research initiatives (EU FPs, structural funds) • Securing investment for shared research infrastructures • Initiatives for enhancing graduates and students in S&T fields	• R&D expenditures have not grown substantially • Securing long term investment through institutional funding suffered for the lack of continuity from one year/government to the next • Weak R&D private investments as well as innovative financial instruments to R&D • Low career perspectives for researchers and for attracting foreign scholars

2.3 Analysis of recent policy changes

The 2007 Financial Law underlined the strategic role of research policy for the economic growth of the country by including for the first time the Ministry of University and Research within the CIPE, the high level inter-ministerial committee for economic planning. The 2008 Financial Law did not introduce significant new provisions for R&D, apart from establishing the overall budget for public funding and upgrading the R/D tax allowance for firms performing research activity in collaboration with University to 40% (instead of 15%) and upgrading the ceiling of tax reduction to 50 millions per firm per year (instead of 15 millions)[3].

The progress report on implementation of the Italian National Reform Programme, submitted to the European Commission in October 2006, set a quantitative target for R&D spending to be achieved by 2010. This report presents a clearer strategy as well as defines quantitative targets, which were lacking in the original National Reform Programme document. Through new initiatives and a bolstering of existing instruments, the new, more ambitious, target is set at 2.5% R&D spending/GDP by 2010, 2/3 of which is to be financed by the private sector.

As far as the programming of Structural Funds is concerned, the new S&T related national operational programme for convergence regions is called "National Operational Programme-Research and Competitiveness" and foresees an EU contribution of €3.1b. It is jointly managed by the Ministry of Universities and Research and the Ministry of Economic development.

Challenges	Main policy changes
Justifying resource provision for research activities	The role of research is recognised in the policy documents (NRP and DPEF 2008-2013).
Securing long term investment in research	Restructuring research system and the funding mechanisms set up by the 2007 Budget Law. Structural funds and funding of research infrastructures are the main instruments for securing long term research.
Dealing with barriers to private R&D investment	Slight upward of the state aid for research and development Special incentives for R&D developed by SMEs and for research collaboration in business R&D projects. An upward of fiscal credit for R/D when firms collaborate with university.
Providing qualified human resources	Changes in funding instruments and allocation mechanisms toward increasing the number of graduates in S&T fields. Government encouraged the setting up of doctoral schools aimed to favour simplification of Phd courses and internationalisation processes.

The negotiation of the new operational document, as well as its detailed budget is currently on-going.

Actions that could improve the system's quality are:

- Rationalisation of various existing funding instruments, by creating a single Fund for investment in scientific research and development (FIRST), which

[3] See also the clarification for the R/D tax credit application given by the Agenzia delle Entrate, circolare N. 46/E (13/06/08).

was supposed to add €300m per year for 2007 and 2008 and €360m for 2009. Due to public budget constraints, the amount for the year 2007 was not yet assured.

- Reform of the system for recruiting PhD students (high quality selection criteria, more focus on excellence, increased presence of international evaluations in the recruitment panel, for example). The proposed reform is still under discussion.

A new DPEF (2009-2013) passed the 18 June 2008, with no relevant policy changes.

A new three year Plan for the Development passed [4] also the 18/06/08; as a relevant measure for innovation, it stated an enlargement of fields coverage of the Industria 2015 intervention.

2.4 Assessment of policy opportunities and risks

As to resource mobilisation, the European R&D policies and priority setting are an essential part of the national R&D policy. This implies a strong attitude toward justify investments according to the rationale of the Lisbon strategy.

In the long term the lack of securing an adequate flow of institutional resources to R&D could undermine the research base of the country. Moreover, the possibility to sustain the Lisbon strategy as planned in the government policy documents is likely to be ineffective.

Potential blocking mechanisms to the implementation of policy initiatives could be the unavailability of public resources and/or the delay in their implementation. In general, measures foreseen in the financial law are followed up by actions for which the relevant Ministry is responsible. In some cases, a delay in implementation or the negative opinion from the Ministry of Economy and Finance may put these resources on hold or, in the worst case, reassign them to another budgetary item.

In the context of the Lisbon Strategy, the main opportunities and risks for resource mobilisation in Italy arising from recent policy responses can be summarised as follows:

Main policy opportunities	Main policy-related risks
• Tax incentives for private R&D • Additional R&D funding, e.g. through twelve strategic programmes for research and Industry 2015 initiative • Implementing the strategic planning of structural funds	• Sustainability of public finance and corresponding difficulty of achieving the Lisbon target • Lack of policy measures to increase human resources and attractiveness of research career • Low response by private sector to new measures promoted by Regions

2.5 Summary of the role of the ERA dimension

The national research policy pays attention to the ERA development. The European Framework Programmes is a key reference for establishing research priorities within the National Research Plan. National and regional sources of funding follow the

[4] See http://www.governo.it/GovernoInforma/Dossier/piano_triennale_sviluppo/

research priorities established within ERA. Italy contributes with continuity to the European research, with the aim of gaining the maximum benefit from the participation to the research programmes. ERA, in sum, represents a rational for the national R/D investments.

3 - Knowledge demand

The purpose of this chapter is to analyse and assess how research related knowledge demand contributes to the performance of the national research system. It is concerned with the mechanisms to determine the most appropriate use of and targets for resource inputs.

The setting and implementation of priorities can lead to co-ordination problems. Monitoring processes identifying the extent to which demand requirements are met are necessary but difficult to effectively implement, due to the characteristics of knowledge outputs. Main challenges in this domain are therefore:

- Identifying the drivers of knowledge demand;
- Co-ordinating and channelling knowledge demands; and
- Monitoring demand fulfilment

Responses to these challenges are of key importance for the more effective and efficient public expenditure on R&D targeted in IG7 of the Lisbon Strategy.

3.1 Analysis of system characteristics

3.1.1 Identifying the drivers of knowledge demand

The demand structure of the Italian research system can be analysed by making reference to three main drivers, namely the economy, the society and the research sector itself.

As to the former, the sectoral structure of the Italian economy is characterised by the large number of small firms; the low value added accounted for by the high tech sector, and its small contribution to overall employment; the low level of technology transfer and patent production. Looking at shares of total value added, the sectors with highest figures are social and personal services, manufacturing and real estate.

The demand structure in Italy can be sketched out by using some basic data highlighting the percentage of R&D spending of the private *vs* spending of public sector. BERD vs HERD shows a value of 1.42 in 2005, significantly lower than the EU27 (6.27) and of other countries of the Euro area (6.95). Again, if we look at BERD *vs* GOVERD, the Italian value for 2005 is 2.42, while the EU27 value is 8.26. Moreover, from 2004 to 2005 BERD *vs* GOVERD in Italy decreased (from 2.87 to 2.42), while in the same period the average value of EU27 show a strong increase (from 5.96 to 8.26).

R&D intensity (R&D expenditure as percentage of GDP) remained stable from 2000 to 2005 (1.05 in 2000, 1.10 in 2005) and the intensity of scientists and engineers (expressed as percentage of labour force) in 2005 was 3.1 (4.8 the average EU27).

The manufacturing sector is characterised by the highest R&D intensity, although it is still low compared to other countries: 2.1% in Italy against for instance 7.4% in Germany. The lack of R&D intensity in mature and traditional sectors provide a good explanation of the decreased level of competitiveness of the Italian system, particularly for sectors such as textiles or clothing that account for a large share of Italian exports. (MiUR 2005)

Specialisation of business spending on R&D (BERD) changed in the last 10 years (from 1993-95 to 2001-03). As to high-tech sectors, Italy on the one hand maintained its specialisation in some sectors (pharmaceutical, aerospace and R&D), and, on the other hand, lost specialization in motor vehicles, where it had a long tradition. Italy remained non-specialised in all high-technology sectors (except chemicals), although in some cases it shows a scientific specialisation (such as in pharmaceuticals) or a high concentration of patents (such as in other machinery and electrical equipment, ERAWATCH, 2006).

The increased internationalisation of high tech firms in Italy is a signal of the raising importance of external drivers of knowledge demand. In 2004, 384 Italian firms in high tech sectors had foreign participation (14.8% of the total); the number of foreign investors was 281 (19.7% of the total foreign investors). The comparison among European countries of the added value generated by these high tech firms highlighted a very good performance of Italy (27.6%) higher than France (25.6% and UK (21.2%). Nevertheless the number of high tech firms with foreign participation on the total is decreasing in the last ten years (from 21.1% to 14.8%) and their contribution to the industrial added value is lower than in other European countries.

As to the public demand expressed by GBAORD, it is mainly concentrated in research financed by general university funds (GUF), industrial production and technology, and protection, improvement of human health, and exploration/exploitation of space (respectively 37.7%, 12.8%, 9.3% and 7.5%). A significant quote is also devoted to non-oriented research (9.7%).

The relevant concentration of government funding on aerospace, health and industry is also reflected on government funding of business expenditures on R&D, which represent more than 12% of BERD. Among the sectors, aerospace attracts the highest share amounting to 29% of the total government funding, while pharmaceuticals is at the sixth position with 4.3%. Although scientific specialisation (expressed by publication in SCI journals) is compatible with government funding, it does not fit with BERD and industrial specialisation.

Public spending can be also analysed by distinguishing between basic and applied R&D. In 2005 basic research represents a percentage of 27.7% of the total R&D expenditure, applied research is the 44.,4% and experimental development is a share of 27.9%. Public research institutes (university not included) and non for profit organisations are both more oriented towards applied research (respectively 53.8% and 53% of their R&D expenditure) than to basic research (39.5% and 43.3%). On the contrary, University is more oriented toward basic research (56.7% of total R&D expenditure) than to applied research (33.4%), while firms have similar percentages for applied research and development (47% each).

Table 1: GBAORD distribution by socio-economic objective, 2005

Nomenclature for the analysis and comparison of scientific programmes and budgets (NABS)	Millions Euros	% of total
01 Exploration and exploitation of the earth	257.55	2.7
02 Infrastructure and general planning of land-use	91.03	1.1
03 Control and care of the environment	250.59	2.7
04 Protection and improvement of human health	743.59	9.3
05 Production, distribution and rational utilization of energy	373.47	3.8
06 Agricultural production and technology	328.23	4.6
07 Industrial production, and technology	1128.73	12.8
08 Social structures and relationships	454.44	4.6
09 Exploration and exploitation of space	767.04	7.5
10 Research financed from general university funds (GUF)	3863.5	37.7
11 Non-oriented research	540.43	9.7
12 Other civil research	0	0.0
13 Defence	353.73	3.4
99 Total appropriations	9152.33	100

Source: Eurostat

The growing importance of EU Framework programme and the relevant participation reinforce the importance of Europe as driver of knowledge demand for both public and private sectors.

Different mechanisms tried to identify the drivers of knowledge demand.

The most important was the large consultative process, which was linked to the setting up of the National Research Plan. It involved all the components (economy, society, scientific community), which act as drivers of the knowledge demand. By the way, this process could be modified in the implementation of the next National Research Plan, which is expected as one of the first output of the new centre-right coalition.

The government is seeking a more efficient involvement of the private sector by managing the complexity of the national innovation system with its multiple levels of decision making and the absence of adequate coordination among regional and state initiatives. The *Decree for Economic and Financial Planning 2007-2009* provided recommendations for improving multi-level governance in Italy. In recent years, both sides have made an effort to increase collaboration, searching for greater leverage from investing in the research public sector, developing research networks and creating joint initiatives in priority action fields. Nonetheless, the main type of interaction remains advisory. As for other kinds of stakeholders (trade unions, other social representatives), their involvement in the policy process was mainly linked to events, such as conferences and debates, with the participation of scientific, social and industrial delegates. These events are designed to maintain a dialogue among the parties and to collect suggestions and proposals for the presentation of political documents or to build consensus on reforms or political choices. Such practices are largely adopted by regional governments, as well as some ministries strongly committed to research and development.

Other advisory bodies from the public side are: the Conference of Rectors, CRUI, which gathers all the Deans of Italian universities and the National Committee for Universities, CUN, which is the general body composed by elective representatives of all the Italian universities. Both institutions play a significant role in higher education policy; their involvement for advice is formalised in MiUR decrees for some

issues, but it is generally carried out in informal ways (meetings, conferences, seminars, consensus groups).

Foresight is not particularly widespread in Italy, despite some sporadic but important national examples, which have also produced significant inputs to document preparation and policy shaping. Apart from national exercises, some regions have incorporated the foresight approach into their policy developments practices. Some leading examples of this are the regions of Lombardy and Emilia Romagna.

3.1.2 Co-ordinating and channelling knowledge demands

Research policy decision making is mainly a responsibility of the public sector, an efficient planning and evaluation system being a key instrument to ensure that research policy gives appropriate contributions to the benefit of both the private and the public sides. Coordination and channelling within Government and between different sectoral and societal domains in the last two years was carried out by CIPE (see par. 1) through the National Research Programme (NPR) 2005-2007. The up-to-date of this document for the period 2008-2010 is not yet completed.

The implementation of the NRP was developed through the DPEF (2009-2013) and the Annual Budget Laws (2007 and 2008). Thus, Italy has a typical top-down culture for coordinating knowledge demands. This culture is partly mitigated through the large consultative process which accompanied the formulation of the NRP (see 3.1.1).

At the MIUR level, the main instrument for co-ordinating knowledge demands is an articulate project funding portfolio. At the moment the Italian project funding instruments under the MIUR responsibility are waiting for the implementation of the reform foreseen in the financial law for the year 2007, which merged all the instruments within one single framework, with different dedicated priorities.

The response to knowledge demands in priority setting processes can be also controlled through the data on GBAORD percentage shares of socio-economic objectives (Fig.2).

The role of public procurement as factor shaping the knowledge demand is still low, due to the scarce demand for innovative services, which is more driven by consumers than by firms and Public Administration needs. Government foresee to design two measures in order to enhance public procurement in some promising sectors (ICT, e-government, health and environment): to easy the setting up of innovative firms and to favour the diffusion of innovation in the PA.

A supplementary role is played by the national business association “Confindustria” and also by its AIRI (Italian association for the promotion of industrial research), as body representative of the demand coming from the national productive system.

A major role is also played by regions at the local level, channelling knowledge demand which is more linked to the socio-economic priorities of the local environment.

3.1.3 Monitoring demand fulfilment

The National Research Programme is the key instrument in order to monitoring demand fulfilment and to identify priorities. It is conceived as a framework build up with the contribution of all the relevant actors able to shape the knowledge demand.

Italy has a weak tradition of evaluation practices. The Ministry of University and Research, which is the main actor responsible for evaluation of research activities, regularly collects information on participation in various instruments (funding, number of applications, etc). However, there is no systematic assessment of policy impact which feeds back into the preparation of National Research Programmes or resource allocation strategies.

In 2003, for the first time, the Ministry of University and Research established a triennial evaluation exercise covering the years 2001-2003 and assessing the research results achieved by Universities and PROs. The results have been published in 2006 by the CIVR Committee for the Evaluation of Research – CIVR conducting the exercise on behalf of MiUR. Some of these results have been used as an input to university funding allocation (FFO, Ordinary Fund for Higher Education). The full and systematic incorporation of assessment results into policy planning is not yet a stable and widespread practice. Another evaluation exercise covering 2004-2006 was planned, but not yet realised.

The far-reaching debate on the need for more effective evaluation practices led to the establishment of the National agency for the evaluation of the university system and research (for short, ANVUR), through Law-decree 3-10-2006 no. 262. Recently, the internal regulatory scheme passed (Decree n. 64/2008).

ANVUR will be in charge of carrying out external evaluation of universities and research agencies' research; it will set out guidelines for the units responsible for the internal evaluation of these bodies; it will provide results on which the allocation of public funds for research and innovation projects is to be based; and approve PhD courses.

When ANVUR becomes operational, other important agencies that previously dealt with evaluation will be suppressed; the most important of these are the Steering committee for research evaluation (CIVR) and the National committee for the evaluation of the university system (CNVSU) (ERAWATCH 2007).

ANVUR is supposed to be in charge also for the evaluation of public funded research projects developed by firms. At this time, such evaluation is carried out through the assessment reports made by experts appointed by the MIUR.

3.2 Assessment of strengths and weaknesses

The main drivers of R&D knowledge demand are and stay the society and the research sector itself. The mechanism through which the demand is largely identified is linked to the setting up of the National Research Plan.

Coordination mechanisms are favoured through the involvement of different ministries at the higher political level (CIPE, see paragraph 1.1) combined with specific instruments for the implementation of research policy as a sector integrated in the economic policy of the country (DPEFs and National Budget Laws).

European Union importance is growing up rapidly for both public and private sector.

Due to the structure of the national economy, knowledge demand from private is still weak and concentrated in few sectors. Also the participation of the business sector to the R&D decision-making process is still characterised by merely advisory interactions.

Monitoring and evaluation practices scarcely affected the policy design, and a strategic intelligence toward R&D policy is not well developed by the government both at national and regional level.

The main strengths and weaknesses of the Italian research system in relation to knowledge demand can be summarised as follows:

Main strengths	Main weaknesses
• Good capability of society and research sector to drive knowledge demand. • Strong central set of policy instruments able to coordinate and channelling knowledge demand.	• Scarce participation of private stakeholders in knowledge demand articulation • Low level of public procurement • Weak links between assessments/ evaluations and inputs into knowledge demand. • Weak tradition of evaluation and foresight practices.

3.3 Analysis of recent policy changes

Among recent policies to support the articulation and channelling of knowledge demand is the creation of the National agency for evaluation of research (ANVUR), to promote the quality of universities and research organisations through evaluation activities, data collection, training and promotion of a cultural change within the system.

The Agency will also help to coordinate two previously separate components, namely the evaluation of teaching and the research activities carried out by universities and PROs. The reform is supposed to allow a better understanding of the knowledge demand coming from the research system itself and, indirectly, the demand coming from the business sectors, through the analysis of the contractual relationships between public institutes and firms.

Challenges	Main policy changes
Identifying the drivers of knowledge demand	Government set up diversified measures in order to support the role of economy as driver of knowledge demand.
Co-ordination and channelling knowledge demands	The top-down system for coordinating and channelling knowledge demands was implemented through the up to date of DPEF (2008-2013) and the annual budget laws 2007 and 2008.
Monitoring of demand fulfilment	Decree 64/2008 established the internal regulatory scheme of the National Agency for Evaluation of University and Research.

The Agency is not yet operational and its establishment is taking longer than expected. In order to ensure maximum benefits, the newly created independent body will require a light and non-bureaucratic structure, as well as full autonomy and transparency in carrying out its tasks.

A new Decree (Decreto Direttoriale 29/04/08 prot. N. 484/Ric/2008) attempts to link private non profit research organizations to the Ministry of Research. It sets a new funding instrument for pre-competitive research developed by non profit organizations, such as foundations. This measure is still to be implemented.

3.4 Assessment of policy opportunities and risks

According to the existing structure of knowledge demand and priority setting processes, main opportunities are linked to the implementation of ANVUR and the possibility to better the integration of results coming from monitoring and evaluation practices into the policy process for both public and private sectors.

Risks are mainly linked to the lack of implementation of the foreseen policy changes, which could undermine the capability to coordinate and channelling knowledge demand, as well as to impede a substantial part of the economy (mainly SMEs) to affect the knowledge demand.

In the context of the Lisbon Strategy, the main opportunities and risks for knowledge demand in Italy arising from recent policy responses can be summarised as follows:

Main policy opportunities	Main policy-related risks
• Assessment of research results by the newly created National Agency, to help efficient allocation of resources • Possibility to develop a portfolio of funding mechanisms coordinated into a unified framework	• Scarce demand from public administration as source of public procurement. • Discontinuity in the implementation of the instruments devoted to monitor the demand fulfilment.

3.5 Summary of the role of the ERA dimension

A systematic assessment of the impact of ERA on the knowledge demand has not been performed jet.

Nevertheless the collaboration with European partners, in particular in the context of the Framework Programme for research, is very active and strongly pursued. With reference to the preparation of the various EU Framework programmes, over the years Italy has played a significant role in areas such as support to SMEs, transport or cultural heritage, and collaboration between Mediterranean countries.

European debate and priority settings influence the elaboration of national thematic priorities. The National Research Programme 2005-2007 is a key instrument in the country's commitment to realising the European Research Area and in strengthening its scientific basis and competitiveness. In many cases the priorities set by the European Union has shaped national documents.

Italy participation in ERA-NETs is about 5% of the total funded ERA-NETs of the VI European Framework Programme (43 participations) in different disciplinary domains.

ESFRI, the European Strategy Forum on Research Infrastructures, which is a strategic instrument to develop the scientific integration of Europe and to strengthen its international outreach, is chaired by Italy.

4 - Knowledge production

The purpose of this chapter is to analyse and assess how the research system fulfils its fundamental role of creating and developing excellent and useful scientific and technological knowledge. A response to knowledge demand has to balance two main generic challenges:

- On the one hand, ensuring knowledge quality and excellence is the basis for scientific and technological advance. It requires considerable prior knowledge accumulation and specialisation as well as openness to new scientific opportunities which often emerge at the frontiers of scientific disciplines. Quality assurance processes are here mainly the task of scientific actors due to the expertise required, but subject to corresponding institutional rigidities.
- On the other hand there is a high interest in producing new knowledge which is useful for economic and other problem solving purposes. Spillovers which are non-appropriable for economic knowledge producers as well as the lack of possibilities and incentives for scientific actors to link to societal demands lead to a corresponding exploitability challenge.

Both challenges are addressed in the research-related Integrated Guideline and in the ERA green paper.

4.1 Analysis of system characteristics

4.1.1 Ensuring quality and excellence of knowledge production

The university system is characterized by good performance indicators (the weight of SCI publications on the total publications is grown up between 1995 and 2002, differently from the other large European countries), and the presence of important isles of excellence, but it suffers for a low mobilization of financial and human resources. Interesting changes are driven by the diffusion of an evaluation culture that nonetheless is constrained by the academic corporation resistance to a deeper change in the system governance and specifically to a move from an academic system based on the power of the bureaucracy and the professorship, to a system where the power is exerted at the institutional level for identifying research strategies and for managing the areas of autonomy guaranteed by the latter (CRUI, 2004). Here in the following there is a more detailed analysis.

The Italian university system is characterized by a low degree of differentiation in education (absence of technical universities, differently from Germany; absence of a supply of high quality education, differently from France) and by few research specialised universities. It has continued to expand and has reached a very diffused presence: 89 universities, of which 54 public institutions (MiUR/ Cineca, 2005). Better performance in terms of scientific productivity (CRUI, 2004) and degree of internationalization (VTR-CIVR) are not correlated with the universities size: some small sized universities are disciplinary specialized and represent “excellence” cases (L.Bocconi; S. Anna, Pisa), other medium sized universities, with a high presence (number of researchers) in highly internationalized disciplines are involved in international network of excellence: Politecnico of Torino; Politecnico of Milano (E.

Reale, 2008). But it remains also true that the Italian academic system is weak in terms of financial and human resources (see chapter 2) in comparison with European average (HERD as % GDP in 2004 was 0,36 for Italy and 0,41 for EU 15) and there aren't signs of change: HERD variation in the last three years if deflated is negative. This is why, even if the weight of GERD performed by HE system in Italy is stronger than the EU average (Italy 30,2%, EU27 21,7%, 2005), given the structural weak R/D orientation of industrial system, the performance of the academic system in terms of scientific publications on population is lower than for the European average.

A channel for an increasing orientation towards academic quality of knowledge production is represented by the growth of competitive funding of academic research expenditure, through State funded projects (PRIN; FIRB) and European or international organization funded projects, which follow an evaluative process. (VTR-CIVR); they represent respectively the third and the fourth source of funding different from the State ordinary Fund (FO).

Other indicators of quality or excellence orientation are represented by the international collaborations and the international researchers' mobility within the academic system. Both are strongly influenced by the type of disciplines involved and are more important for the universities localized in the North of the country (Bressan, Reale, Primeri, 2008). International collaborations represent still a minor component of the total R/D financial resources (different from ordinary fund) for universities and non academic research organizations and they are relatively more important for medium and small universities.

The process of evaluation has a special position, as an instrument devoted to assure control of the scientific performance of the research organizations, both in terms of excellence and relevance. In Italy the first three years evaluation exercise (VTR 2001-2003) managed by CIVR on the whole system of research (universities and non academic research organisation) has produced the following impact at the institutional level

- a large cultural change within all the academic research institutions, linked to a new awareness of the need to improve accountability, quality, and competitiveness of research effort;
- the introduction of a self assessment within universities managed by internal units of evaluation, which were not involved in decision-making processes in most cases; within the public research institutes the "internal" units of evaluation have been in effect composed by "external" actors, without any linkages with internal researchers;
- but no relevant changes in policies (internal funding allocation) neither rewards (external fund allocation linked to evaluation results).

Italy is involved in the "Bologna process" since 1998, but the formal adoption of an evaluation system of education and research has not jet found a full realization; in particular there is a gap in Italy between legislation and its implementation (Report from a working group appointed by the Bologna Follow-up Group to the Conference of European Ministers Responsible for Higher Education, Bergen, 19-20 May 2005).

Enabling and supporting specialization of knowledge creation and accumulation

Scientific specialisation (as expressed by bibliometrics) is compatible with the R/D public funding policy (Erawatch Country specialisation report, 2006), in particular the concentration of government funding (GBAORD) on aerospace and health is rather coherent with the scientific specialisation profile, with EU 15 as reference: pharmacology, space, physics, engineering, clinical medicine, which seems to fit enough well with the scientific citation specialization profile.

Nevertheless performance indicators show that the low level of resources (Italy has the lowest number of researchers for unit of GDP among industrialised countries and the lowest percentage of researchers on the active population, see chapter 2) impacts on the gap between the quantity of the knowledge produced (4th position within EU (25)) and the quality recognition, in terms of ratio between citations received and given (10 position within EU (25), above the EU average) (CRUI, 2005).

Ensuring openness to new scientific opportunities

New scientific opportunities are often at the cross border of disciplines and of technologies; the National Research Plan (PNR 2005-2007) and the new incentive system give large place to collaborative actions between different actors and competences. A recent opportunity has been given to Italian researchers who participated to the ERC selection with high quality and open to new opportunities proposals and who were selected but didn't get the grant. The Fund for Basic Research (FIRB) has now opened its evaluative procedure to these kinds of projects.

A good indicator of openness to scientific opportunities is the international co-authorship in which Italian scientists are involved: their weight on the total of national publications for Italy is not far from that of other European countries such as Germany or UK (National Science Foundation, S&E Indicators, 2008, Tab 5-44). These collaborations are mainly established with colleagues working in national systems who are positioned at the frontier of R/D in many fields.

4.1.2 Ensuring exploitability of knowledge production

The system of public research is connected in different ways with the small bulk of large industrial firms, thanks to past S/T policies sponsoring collaborative R/D programs, but also to direct informal relations, while the basis of our productive system made by small firms remains far from scientific research. The problem of better exploiting and connecting public research and these industrial actors is still a relevant open question. Between quality and exploitability of scientific research there is still a differentiation as to the main responsible actors: the self governance of Universities and PROs assures the first one, while Government steering and policy measure help to reach the knowledge exploitability goal. In the next future the Government will have a stronger role also for quality knowledge production through the evaluation process.

Processes facilitating the matching of scientific knowledge production specialization with economic specialization

Scientific and industrial R&D specialisations are not too far, even if Italy has not changed its de-specialised position in chemicals and telecommunication, while it has improved its position in traditional sectors.

The separation between scientific and industrial research doesn't concern large firms and the presence of a long lasting participation of scientific inventors in industry owned patents is a good example of this collaboration.

As to SMEs, various technology transfer activities try to fill the gap (see the chapter 5) while the new incentive system (L 297/99 and DM 593/2000) has a number of measures rewarding small firms that collaborate with university or public research organizations or hire researchers; moreover the law includes measures for promoting the creation of new high tech companies (spin offs).

The promotion and strengthening of S/T excellence poles is a relevant aim in the National Research Programme 2005-2007, to be realized through two kinds of initiatives, Technological districts and Public-private laboratories, in key sectors, with the aim of attracting investments and excellent human resources. At October 2007 38 projects had been accepted for funding and technological districts were under realization within 18 Regions. in the North-Centre and in the South of the country. These are complex initiatives which have to balance an international level of research capacity and competences with collaboration and embedment in local productive contexts. They have been supported by a mix of ordinary national budget for research and additional resources for regional policy, deriving from the European budget (structural funds) and the national budget (co-funding of structural fund and fund for under-exploited areas- FAS). Their aim is to realize research and innovation networks territorially embedded, on specific technologies with the collaboration of small and large firms, and with a strong orientation to the socio economic valorisation of results. Many technological districts have been promoted in the North Centre and in Southern Regions.

The other instrument is the creation of joint labs between Italian and foreign institutions, attracting foreign direct investments (FDIs) for strategic research; bilateral international agreements have been signed in 2004 and 2005.

The aim of the internationalization of the productive system has found another support in a new policy instrument: the technological platforms. They are new organizational models, with a concentration of resources on critical technological sectors, cooperation between public and private actors and State and regions, training of human resources and support to patenting and result valorisation. The national technological platforms should have to be connected with the EU FP. Among the platforms proposed by the PNR 2005-2007 are: new production systems (thought for largely increasing the technological level of the country productive system); nano-electronics and bio-nanotechnologies; bioinformatics; and new materials.

In recent past Italy has also increased the protection of intellectual property rights (IPR), for strengthening the research results appropriation by firms:

- setting up 12 Intellectual Property Tribunals under Law Decree 168/2003;
- adopting the EC Directive 29/2001 on the harmonisation of some aspects of copyright ;in May 2002 the Italian
- Parliament granted the Government law making powers to reorganise and up-date the current patent and trademark rules into a single law (Testo Unico).

Other more recent (2006) measures include:

- a re-organization of the national patent office;

- the development of a methodology of economic evaluation of patents in agreement among public administration, industrial firms and public research.

Incentives and mechanisms to drive knowledge production for societal purposes

One of the mechanisms to ensure the exploitability of knowledge production for societal purposes is the valorisation of the socio-economic participation/partnership for the definition of (regional/local) projects, their implementation and their on-going and ex-post evaluation.

Private actors can participate in the design and management of a public R&D project or in the ex-ante evaluation and selection of a publicly financed research project. In Italy we can distinguish two types of implementation:

1. The Ministry of University and Research organises events, such as conferences and debates, with the participation of scientific and industrial representatives. These events are aimed to maintain a dialogue among the parties and to collect suggestions and proposals, in occasion of the presentation of political documents (i.e. the three years National Research Plan) or for building consensus on reform or political choices (i.e. general conference). These practices are largely adopted by the Regional governments, as well as by the other Ministries, with important commitment to research and development (mainly the Ministry of Health, the Ministry of the Productive Activity and the Ministry for the Coordination of the Agricultural Policies);
2. Independent committees participate to the selection of research projects through an ex-ante technical and financial evaluation; this is the case for the bottom up industrial projects financed through law 46/82 and for a recent -2001- MIUR instrument, the Fund for basic research (FIRB). FIRB's targeted beneficiaries are Universities, public and private research organisations, firms, individual researchers. Each FIRB project passes an ex-ante evaluation, which is carried out by an independent Committee, on the basis of general criteria established by the MIUR together with CIVR (National Committee for the Evaluation of Research). FIRB projects should be submitted also to ex-post evaluation.

4.2 Assessment of strengths and weaknesses

Looking at the relation between the quantity of national scientific products as percentage of world scientific production and the level of citation impact compared with the world average (CRUI, 2005), it doesn't appear a great number of scientific areas where a high number of results produce a very low impact. Therefore a waste or a low relevance of the devoted resources is not signalled (in particular this seems the case for pharmacology, chemistry and oncology). But, more in general, our country is better positioned in terms of quantity of scientific products than of balance between received and given citation. This can be due to a mix of factors influencing the quality of knowledge production and its recognition, among which the low level of resources seems to be relevant.

The main strengths and weaknesses of the Italian research system in relation to knowledge demand can be summarised as follows:

Main strengths	Main weaknesses
• Good quality of scientific production. • Good openness to international collaboration.	• Gap between scientific and research specialisation and technological/ economic specialisation.

A relevant weakness of our research system is the distance between public and private R&D specialisation on one side and the technological and productive specialization on the other. For achieving better results in terms of knowledge exploitation and economic growth it should be necessary to use a complex of measures aimed at changing our industrial structure.

4.3 Analysis of recent policy changes

Strategic mission oriented programmes, included in the National Research Plan (2005-2007), have been launched since 2005, with the double aims of widening basic research and at the same time developing new technologies and a new knowledge based entrepreneurship. These programmes are articulated by projects where the passage from inventions to market should be visible and are targeted to promote a better integration between public research institutions and industrial system.

Italian participation to Technological platforms, proposed by the European Commission, was included in the National Research Plan (2005-2007); these are large fora where long term research strategies are defined, focused on technologies relevant for the economic growth and opened to stakeholders' participation, including SMEs.

In 2005, the Italian Institute for Technology (IIT) was created, a foundation established at the request of the Minister for Education, University and Research and the Minister for Economics and Finance to promote Italy's technological development and training in high technology, thus encouraging the development of the Italian production system. To this end, the Foundation establishes relations with similar bodies in Italy and ensures the contribution of Italian and foreign researchers working at research centres of excellence abroad. A Law Decree (DL 112, 25/06/08), which represents a first step towards the next 2009 Financial Law, has enlarged the property of IIT by transferring the IRI Foundation[5] assets to it.

The same Law Decree (DL 112, 25/06/08) introduced the possibility for University of transforming into Foundations on a voluntary basis, remaining under the MIUR control. This measure is still to be implemented.

The 2007 Financial Law has established the empowerment of the evaluation of the academic and research system through the creation of a new National Agency (ANVUR) . ANVUR should do an external evaluation of the quality of research activity of universities, public research organizations and private beneficiaries of public funding and, differently from the previous practice, would be charged of addressing, coordinating and monitoring the internal evaluation (self assessment) of universities and PROs.

IPRs regulation concerning public institutions' inventions is relevant, since it assures the firms' appropriability of scientific research results. In 2005 a new regulation has re-affirmed the public institutions' ownership of invention produced with external

[5] IRI has been abolished the 1 of July 2008

public funding, leaving open the possibility of inventor's ownership only when the inventions results from research funded with institutions' own fund. Moreover public research performers are exempt from paying registration tax duties on patents, while for all other actors they have been re-introduced by the latest financial law (they had previously been abolished).

Challenges	Main policy changes
Ensuring quality and excellence of knowledge production	• The empowerment of the evaluation of academic and research system. • The Italian participation to European Research Council (ERC) • The national strategic programme FIRB-IDEAS aimed at financing national projects positively evaluated by ERC-IDEAS programmes but not funded
Ensuring exploitability of knowledge	• Promotion of mission oriented programmes. Participation to European technological platforms.

4.4 Assessment of policy opportunities and risks

In the context of the Lisbon Strategy, the main opportunities and risks for knowledge demand in Italy arising from recent policy responses can be summarised as follows:

In sum, the problem is that the promotion of research quality and excellence remains an opportunity for a few, while the gap with the large industrial population is not changed. It asks for strong industrial policy programmes, and the previous Government had designed (see 2007 Financial Law) a large innovative programme (Industry 2015), to which has been confirmed the support of the new Government.

Main policy opportunities	Main policy-related risks
• There is an evident new interest in promoting quality of research and participation in public-private and international networks.	• The risk remains open that the gap between national industrial structure and the scientific research is not overcome, since the recent policy changes are mainly oriented towards excellence.

4.5 Summary of the role of the ERA dimension

The ERA dimension strengthens the quality of knowledge production and there is a growing structural effect of the European Framework programme, through the participation in public and private networks. Signs of these effects are:

- the inclusion of the participation to the Framework Programme among the criteria for public resource allocation;
- the growing participation of research Institutions to the Framework programme, in order to enhance the quality of the research projects.

5 - Knowledge circulation

The purpose of this chapter is to analyse and assess how the research system ensures appropriate flows and sharing of the knowledge produced. This is vital for its further use in economy and society or as basis for subsequent advances in knowledge production. Knowledge circulation is expected to happen naturally to some extent, due to the mobility of knowledge holders, e.g. university graduates who continue working in industry, and the comparatively low cost of the reproduction of knowledge once it is codified. However, there remain three challenges related to specific barriers to this circulation, which need to be addressed by the research system in this domain:

- Facilitating knowledge circulation between university, PRO and business sectors to overcome institutional barriers;
- Profiting from access to international knowledge by reducing barriers and increasing openness; and
- Enhancing absorptive capacity of knowledge users to mediate limited firm expertise and learning capabilities.

Effective knowledge sharing is one of the main axes of the ERA green paper and significant elements of IGL 7 relate to knowledge circulation. To be effectively addressed, these require a good knowledge of the system responses to these challenges.

5.1 Analysis of system characteristics

5.1.1 Facilitating knowledge circulation between university, PRO and business sectors

The need to ensure knowledge circulation among Higher Education, Government and Business sectors emerged over the 1990s, when the national and European debate brought up an increased emphasis on results valorisation and exploitation.

This new emphasis is true for many European countries and it is driven by various factors: a decline in public research funding, and a consequent stronger need to look for alternative financial resources; the identification in many strategic documents of lack of innovation and technology transfer practices as weaknesses of the European system.

Towards the end of the 1990s, the major public research centres started discussing and designing significant reforms (e.g. the National Research Council and ENEA), that among other objectives aimed at enhancing the orientation of their scientific results towards the market and industry. The National Research Council has set up a series of initiatives to link its activity to the private sector: collaboration with consortia, companies, foundations, spin offs, increased number of patents generation and filing.

Many Italian universities have set up technology transfer offices and started promoting circulation of knowledge into the private sector. The first technology transfer office was created in 1997

The valorisation of the scientific activity has two main components: intellectual property rights use for scientific inventions (patents and licenses) and the creation of public research spin-offs, which are high tech companies including almost one scientist and where the academic or public research organization participate to the equity. In Italy, starting from 1993, there have been a regular yearly creation of spin offs, which increased since 2000 (the number of new spin offs have doubled, from 22 new spin offs in 1999 to 43 in 2000), linked to the new incentive system, which introduced a Government support for spin-offs creation. In the last three years the number of new spin offs have been 75 in 2004, 63 in 2005 and 65 in 2006 (NETVAL, 2006). At present there are in Italy 454 spin offs, mainly localized in the North (62.1%) and Centre (24.01%). As to sectors, 40% is in value added services such as informatics, multimedia, energy and environment services for the innovation. Other spin-offs are involved in products and technologies such as electronics (12.2%), biotechnologies (10.3%) and biomedicine (5.9%). Among the sources of spin-offs, in the first positions are the Politecnico of Torino (11.1%), the INFM (National institute for new materials) (10.6%), the University of Bologna, the University of Padova, the S. Anna of Pisa, University of Perugia and CNR. On average these new companies have 8 employees, with important sectoral differences.

Starts up are firms created with some sustain by the university and sometimes localised in university incubator, but without the other above indicated conditions.

In Italy the attention to the valorisation of scientific research of university and PROs increased in the last years, as shown by the active participation of the public institutions, the debates within industrial associations and local bodies and by new regulation. Technology transfer offices and incentives for technology transfer started to be operative at the end of ‘90s, but with a fast increase. The TTO functions are mainly IPRs management (83% of TTO), spin offs creation (80.9%) followed by the management of R/D collaborations with industry (57.4%), which is a traditional function of the university Departments. One problem is represented by the low number of licenses on public patents, therefore the effective valorisation and transfer of R/D results. Licenses are mainly with national firms.

Incentives given to academic personnel for the technology transfer activity vary among Universities. On average the academic personnel can: participate to a spin offs equity; take a quota of the research contracts; receive an economic reward for teaching in programs of “ training”; receive financial incentives for spin offs creation; much less diffused is a linkage with the progression in scientific career.

The weight of the industrial funding of High Education R/D activity is not changed and it is much lower than the EU 27 or EU 25 average (% of HERD funded by business is 1,4 for Italy and 6,3 for EU in 2005; it is 14,1% for Germany). Slightly higher is the quota of Government R/D funded by industry (2,4% in Italy, 8,3% EU(27) and 8,1% in EU(15). But this is only a partial indicator of the university-industry linkages, since informal relations and consulting activities, which are relevant channels of inter-institutional cooperation, are not included.

The international researchers’ mobility (more than 3 months) from and to University is on average low. In the period 2001-2003 there has been a total mobility of 1.059,8 year/person for the 14 disciplinary areas; in scientific disciplines the inward mobility has been higher than the outward, demonstrating a positive visibility and recognition at international level.

5.1.2 Profiting from access to international knowledge

The central government has always strongly pursued openness towards all European and non European countries through scientific bilateral agreements and through financial support for joint international scientific projects.

Until now the Ministry for University and Research has signed 70 scientific bilateral agreements. These agreements cover both scientific and financial collaboration with the main research institutes of countries such as United States, India, Japan, Russia, and China for example.

Despite the low presence of foreign researchers within the national territory, the number of scientific publications carried with foreign colleagues is considerable: 37% of SCI publications, most of which is with USA and UK (National Research Programme, PNR 2005-2007)

The participation in European and international programs is a way for sustaining our areas of excellence.

The participation in the EU research Framework Programme is also highly successful, considering that Italy is -after France Germany and UK– the country with the highest number of projects under Sixth Framework Programme. (NResP)

The number of funding demands presented by Italian researchers in the VI Framework Programme has been very near to Germany and UK; the accepted proposals have been 420 for Italy, 448 for UK, 452 for France and 538 for Germany; the number of researchers involved in the VI FP Integrated projects is at the third place after Germany and France.

Italy has played a very active role in the Eureka programme, a European network, involving private and public actors, oriented to a direct commercial use of research result: it has been third for participation in now concluded Eureka projects (since 1985) and it had 80 new projects open in 2007.

The national R/D policy includes incentives for foreign owned firms to invest in Italy, not only allowing their access to financial aid for applied research projects, but also offering higher support in terms of type of incentive (weight of grants in comparison with refundable loans) and level of supported costs of the project.

5.1.3 Absorptive capacity of knowledge users

The Italian industrial structure is largely composed of small and medium sized firms, which represent over 95% of the total number of enterprises.

A special attention has therefore always been devoted to the enhancement of their R&D activities.

The law decree 297/99, the main national instrument for supporting industrial research, foresees additional financial contribution whenever a project proposal is submitted by small and medium enterprises.

The re-organization of the incentive system put a special attention to financially support (automatic fiscal measures) SMEs which:

- collaborate or commit research activity to scientific institutions;
- hire qualified research personnel and their attendance to Ph.D courses.

These measures have received large interest by SMEs: the demand for fiscal support have been higher than the resources availability.

At decentralised level, regions have introduced a large number of support measures for to foster both research and innovation-related activities within SMEs. For example, in Lombardia there is a measure to support participation of SMEs in EU Framework Programmes; or in the region of Veneto there is a measure to support feasibility studies preliminary to research projects (similar to the Exploratory award funded within EU schemes).

5.2 Assessment of strengths and weaknesses

Despite the proliferation of initiatives and legislative changes occurred in the past few years, the dialogue between research and industry is still not satisfactory in Italy, given the large number of SMEs.

The need to increase private-public dialogue and partnership is indicated as strategic for the country in many documents and declarations; however, many barriers are still connected to cultural resistance.

Moreover the new measures for sustaining SMEs collaboration with scientific institutions have found a large acceptance, mainly given their automatic character, but SME's demand for fiscal support has not found enough coverage by the available public resources.

The scientific community participation to international collaborations and networks, the collaboration to the international knowledge production certainly contribute to the quality and recognition of our national knowledge production. There is a large participation of scientific community in international programs.

The national financial incentives for attracting foreign investment in R/D don't appear really effective, given the characteristic of uncertainty in terms of up and down financial resources availability an, strictly dependent on that, the low efficiency of the process in terms of time between the company's demand presentation and the public agency decision. Notwithstanding the success in being selected if foreign firm, multinational companies, so as national firms, have had to face a long block in R/D public funding (2002-2005), with the only availability of resources for R/D projects from regional policy.

The main strengths and weaknesses of the Italian research system in relation to knowledge demand can be summarised as follows:

Main strengths	Main weaknesses
• A tradition of informal relations between large firms and scientific institutions • Scientific community's interest for TT incentives. • Growing participation in international research programmes.	• SMEs absorptive capacity is still low; • The international mobility of researchers is low.

5.3 Analysis of recent policy changes

In September 2006 the Italian government has designed a new initiative to re-launch the Italian industrial policy. The initiative is called Industry 2015 and it is led by the

Ministry for Economic Development, in collaboration with the Ministry for University and Research and the Ministry for Innovation and reform in the public administration.

There are several key elements of this initiative: a concept of industry that goes beyond the productive system and expands to highly advanced services and technologies, a forward looking analysis and planning strategy (hence the "2015" in the name); instruments to foster the re-positioning of the Italian industrial system such as network of enterprises, innovative finance mechanisms and industrial innovation projects.

The 2007 Financial Law has established the Fund for competitiveness and development, with the objective to finance Industrial innovation projects ("Progetti di innovazione industriale") in technological areas considered strategic to re-launch the competitiveness of the Italian industrial system.

So far, the Ministry has launched three Industrial Innovation Projects in the following areas: energy efficiency, sustainable mobility and new technologies for the "made in Italy", by consulting the industrial world and collecting project ideas in the respective fields to support identification of priority themes and characteristics of projects to be funded.

The next step will be the identification of the specific projects as well as their financial volume.

All these projects see the participation of large and small enterprises, universities, research centres, industrial districts and financial institutions which team up to create long term partnerships and foster competitiveness of the national industry.

Challenges	Main Policy Changes
Facilitating circulation between university, PRO and business sectors.	National and Regional policy initiatives which favour knowledge circulation;
Profiting from international knowledge	Financial incentives (Funding applied research projects) for attracting MNCs investments

Another strategic element of Industry 2015 is the support to Network of enterprises. The government will adopt specific decrees to define criteria for creation and operation of network of enterprises over the national territory, their juridical and fiscal status, collaboration with foreign enterprises.

In 2006, the financial law has foreseen the creation of a national Agency for diffusion of technologies for innovation. The Agency will have the objective to identify and diffuse knowledge, technologies, national and international patents, among enterprises, with a special focus towards SMEs.

The purpose is to strengthen the dialogue between industry and research world. The agency's headquarters will be in Milan; however it is not yet operational.

5.4 Assessment of policy opportunities and risks

In the context of the Lisbon Strategy, the main opportunities and risks for knowledge demand in Italy arising from recent policy responses can be summarised as follows:

Main policy opportunities	Main policy-related risks
• Presence of incentives towards the third mission of scientific institutions. • Presence of incentives towards SMEs' networks, which can improve industrial participation to high tech Research programmes	• Lack of initiatives for enhancing national and international researchers mobility.

5.5 Summary of the role of the ERA dimension

Funding for R/D projects in Italy is open to European researchers, provided that the project is performed in Italy or it is under the responsibility of an Italian research institution. Research institutions favour the access of foreign researchers by setting specials positions.

MIUR funds "brain gain" instruments devoted to attract foreign researchers together with Italian researchers working abroad.

6 - Overall assessment and conclusions

6.1 Strengths and weaknesses of research system and governance

The main strengths of the national research systems can be summarised in:

- the good quality of scientific production;
- the large openess to international collaborations;
- the strength of the central policy institutions and the emerging role of some well performing local governments;
- the good resource mobilization for European research initiatives.

The main weakness affecting the country research system deals with resource mobilisation: in particular the system doesn't assure enough resources for long and short term research investment. The unavailability of adequate new resources from public actors, the stop and go in financially supporting the new policy instruments, summed with the correlated delays in the instruments implementation produce uncertainty and distrust within private actors, who are mainly SMEs, which cannot include public incentives among the trustable sources of funding for new R/D investments. The mix of these behaviours produces blocking effects on the system and reduces both the quality and the exploitability of knowledge production.

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	Research is a widely recognised policy priority but R&D expenditures have not grown substantially
	Securing long term investment in research	Capability to mobilise resources for European research initiatives is strong, but securing national long and short term investment through institutional funding suffered for the lack of continuity from one year/government to the next
	Dealing with barriers to private R&D investment	R&D private investments as well as innovative financial instruments to R&D are weak
	Providing qualified human resources	Lack of career perspectives for researchers and for attracting foreign scholars.
Knowledge demand	Identifying the drivers of knowledge demand	Good capacity of society and research sector as drivers of knowledge demand. Scarce participation of private stakeholders in knowledge demand articulation and low level of public procurement
	Co-ordination and channelling knowledge demands	Strong central set of policy instruments aimed to coordinate and channelling knowledge demand, go with weak links between assessments/evaluations and inputs into knowledge demand
	Monitoring of demand fulfilment	Weak tradition of evaluation and foresight practices can be overcome through the recent policy initiative of ANVUR. Delay in the implementation of the reform could affect its timely and effectiveness
Knowledge production	Ensuring quality and excellence of knowledge production	Good quality of scientific production, but there is still a difference between quantity and quality recognition; Good openness to international collaboration.
	Ensuring exploitability of knowledge	Gap between scientific and research specialisation on one side and technological/economic specialisation on the other.
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	Scientific community has shown interest for TT incentives. Growing participation in international research programmes.
	Profiting from international knowledge	The international mobility of researchers is low
	Enhancing absorptive capacity of knowledge users	SMES absorbing capacity is still low

6.2 Policy dynamics, opportunities and risks from the perspective of the Lisbon agenda

Policy makers have shown interest in modifying the structural weakness of the national R/D system and in promoting R/D quality and exploitability, through the introduction of many instruments. But the implementation of these well designed measures is always poor.

Positive aspects are related to an improved coordination among different policy actors, a rationalization of funding instruments and to the support to the evaluation culture.

A better coordination of different Ministries can create new opportunity for channelling knowledge demand and for a rationalization in the public R/D expenditure.

The necessity of overcoming the gap between the scientific community and few large firms on one side and the large productive system should ask for a persistent and coordinated effort, that hasn't been assured by the different Government coalitions.

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	Measures as tax incentives for private R&D, additional R&D funding and implementing the strategic planning of structural funds represent good new opportunities.	Opportunities may be counterweighted by the absence of sustainability of public finance, and corresponding difficulty of achieving the Lisbon target; absence of policy measures to increase human resources, including the lack of measures for improving the attractiveness of the research career; new measures promoted by Regions for sustaining a larger role of financial market can be counterbalanced by the persistent inertia of the private sector in this respect.
Knowledge demand	Assessment of research results by the newly created National Agency (ANVUR), and a portfolio of funding mechanisms coordinated into a unified framework could improve efficiency and effectiveness of resource allocation.	Scarce government public procurement as well as discontinuity in the implementation of the instruments devoted to monitor the demand fulfilment are the main risks.
Knowledge production	New interest and measures promoting quality of research and participation in public-private and international networks.	The risk that recent research policy changes, more oriented towards excellence, do not support a reduction of the present gap between national industrial structure and the scientific research
Knowledge circulation	Incentives for scientific institutions towards the third mission and incentives for SMEs R/D collaborations can improve university-industry relations	Lack of initiatives towards national and international researchers' mobility.

6.3 System and policy dynamics from the perspective of the ERA

ERA, as common shared space of research in Europe, has become a key reference for research policy in Italy and its concepts are largely present in the national policy discourse.

A set of priorities are indicated as most important in the policy documents, such as the provision of an adequate flow of competent researchers with high levels of mobility, the realisation of world-class research infrastructures, integrated, networked and accessible, an effective knowledge-sharing notably between public research and industry, a well-coordinated research programmes and priorities (joint programmes, common priorities, coordinated implementation and joint evaluation).

Excellence is another key word for R&D investment, as the need to have excellent research institutions engaged in effective public-private cooperation and partnerships, mostly specialised in interdisciplinary areas and attracting a critical mass of human and financial resources.

Italy participation in ERA-NET is about 5% of the total funded ERA-net of the VI European Framework Programme (43 participations) in different disciplinary domains.

Apart from the emphasis put on the ERA dimension by the policy documents, lot of work is still to be done for ERA, particularly to overcome the fragmentation of research activities, programmes and policies as well as to guarantee continuity in policy choices and growing R&D investment from both public and private sectors.

Within these premises, funding of large scale facilities at European level seems a relevant instrument for the ERA purposes, while a high priority is to better the contribute of attractive research conditions for European researchers and enhancing the European mobility.

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List of Abbreviations

BERD	Business expenditure in Research and Development
DPEF	Documento di Programmazione Economico Finanziaria = Economic-financial Plan
ERA	European Research Area
FAS	Fondi per le aree sottoutilizzate = Funds for underexploted areas
GERD	Gross expenditure in Research and Development
IPR	Intellectual property rights
ISTAT	Istituto italiano di Statistica= National institute of statistics
MIUR	(ex MiUR) Ministry for University and Research
NPR	National Research Plan
PIA	Pacchetti Integrati di Agevolazione= Support integrated measures
PRO	Public Research Organisation
PON	Programmi operativi nazionali= National operational programs
QSN	Quadro strategico nazionale= National strategic frame

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Abstract

The main objective of ERAWATCH country reports 2008 is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. The reports are produced for each EU Member State to support the mutual learning process and the monitoring of Member States' efforts by DG Research in the context of the Lisbon Strategy and the European Research Area. In order to do so, the system analysis focuses on key processes relevant for system performance. Four policy-relevant domains of the research system are distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The reports are based on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.
This report encompasses an analysis of the research system and policies in Italy.

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