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Executive Summary

Italy is a large industrialised country in continental Europe, which is characterised by low R&D expenditure when compared with its economic profile. In 2009, GERD/GDP was 2.01 in EU-27 while only 1.27 in Italy, and in 2010 human resources in science and technology as share of the labour force were 33.8% compared to an EU-27 average of 40.5%. **The main trends** in education, research, and innovation funding show continuity with the country's recent past.

In Higher Education there is persistent low mobilisation of financial and human resources (Eurostat data 2010 and 2011). The structure of the Italian HE system is characterised by a low degree of differentiation (absence of professionally oriented universities, differently from Germany; absence of universities specialising in the supply of high quality education, differently from France) and by few research-specialised universities (CNSVU, Report 2011).

In R&I, the country still displays a low share of R&D performed by business firms. BERD as % of GDP, giving the intensity of R&D expenditure of the private sector in Italy, was 0.54 in 2002 and 0.65 in 2009, while the EU-27 values were 1.20 in 2002 and 1.25 in 2009; the highest level of GERD financed by firms (0.48) was reached at the end of 1990s (1997). The share of Government funding of GERD is higher than the EU average (42.1% in Italy vs. 34.9% in EU-27, 2009, source: Eurostat 2011).

Notwithstanding the low mobilisation of financial and human resources (Eurostat data 2010 and 2011), the Italian university system is characterised by good performance indicators. For what concerns scientific publications within the 10% most cited publications worldwide as percentage of total scientific publications, Italy's performance is better than the EU average: 12.1 in Italy vs. 11.6 in the EU.

The **structural challenges** that the country faces are:

- **Insufficient investment in the higher education system**. The HE system in Italy is weak, in comparison with European average, in terms of financial and human resources, and there are no signs of change. Public expenditure on R&D as percentage of GDP was 0.57 in 2009, well below the EU level of 0.74; HERD as percentage of GDP was 0.4 in 2009; the share of researchers (FTE) per thousand labour force in 2009 was 3.8, versus 6.3 in Europe (IUC Report, 2011). Italy shows a limited capability to attract doctoral students from abroad.
- **Low level of S&E skills.** Italy scores below the average EU performance as to the population aged 30-34 having completed tertiary education (IUS report, 2010). In 2007 the number of S&E graduates per 1,000 population aged 20-29 was 13.4% at the EU-27 level, while only 8.2% in Italy.
- **Low Business R&D investment**. Italy traditionally faces the problem of low business R&D investment. This low level of business R&D intensity is partly linked to the structural composition of Italy's economy: the share of high-tech industry in total manufacturing value added is low. The percentage of employees in high-tech sectors is 7.6 in Italy, while it is 14.5 in EU-27. Therefore, an important challenge concerns moving towards a higher share of high-tech companies and research-driven clusters, through the development of innovative industrial sectors and new high-tech firms, which would require the development of innovation-oriented finance, i.e. venture capital funds (see

paragraph 3.1). Italy is in a weak position, given its unchanged industrial specialisation. In twenty years (from 1990 to 2009) the Italian percentage share of total world manufacturing value added decreased substantially (OECD/STI 2011 p.35).

- **Size distribution within the industrial population.** Problems are also due to size distribution within the industrial population. The Italian industrial structure is largely composed of small and medium sized firms, which represent over 95% of the total number of enterprises. Generally speaking, there is low propensity to innovate in smaller companies: only 30% are successful innovators (see CIS3 data). The large presence of SMEs impacts on the low percentage of GERD financed by the industry, including outsourced research activities (commissioned to external parties).
- Together with the lack of medium and large scale firms, in Italy there is also a **low presence of foreign-controlled firms**, whose number remained the same from 2001 to 2008 (OECD/STI 2011 p. 174). Multinationals are important to their host countries since they contribute to improving international competitiveness by being active in scale and capital intensive industries. Foreign direct investment (FDI) inflows are supposed to provide recipient countries with access to new technologies, generating knowledge spillovers and additional investments in R&D. In the last 15 years FDI flows have tripled and changed direction. There is a new geography of growth and countries not involved in this change, such as Italy, risk being emarginated.

National research and innovation priorities: a national strategy for R&D is designed within three-year programmes (the so-called National Research Programmes, PNRs, developed by the Ministry of University and Research- MIUR), while innovation priorities were detailed in a 2006 bill. In March 2011, the Inter-Ministerial Committee for Economic Planning (CIPE) approved the last PNR for 2011-2013. Its priorities are enhancing integration among public central administrations and with regions and a larger use of “centrally” driven policy instruments, such as strategic and priority projects, which can contribute to modifying industrial specialisation. Other aims targeting national structural challenges are supporting SME innovation and focusing policy aid to the Southern Ob. 1 Regions on research and competitiveness, producing innovation effects. The creation of public-private partnerships, such as technological districts and clusters, which has been a successful policy, is also confirmed.

As for innovation, the MISE outlined a multi-annual innovation strategy in its “Industria 2015” Programme of 22nd September 2006. This document identifies the main drivers and instruments for a strategy of economic change based on innovation, to support a strategic repositioning of the Italian industrial system in a more competitive and globalised economy. This well-designed programme was affected by a gap between policy announcement, implementation, and concrete results, in terms of time for its operationalisation and availability of resources.

The 2011-2013 PNR displays convergence with the “Industria 2015” innovation programme on the idea that knowledge and innovation have to guide the reorganisation of the national economy towards leadership, sustainability, and participation of all the actors involved in innovation. There is clear convergence on three specific aspects: (i) a more active role of the government (i.e. in setting priorities and in the use of major top-down negotiated instruments); (ii) the relevance

of public-private partnerships; (iii) the importance of innovation-oriented finance, i.e. private funding for innovation investments, with public participation or guarantees.

The policy mix evolution has witnessed a growing number of measures devoted to supporting SMEs capitalisation and innovation. Public support still has many weaknesses in terms of simplicity and accessibility, but the trend is to enhance measures specifically tailored for SMEs and young companies. The balance among the main categories of policy measures has not changed since mid-2009. In 2010 the largest amount of budget for innovation policy measures was invested in "Research and Technologies" (Trend Chart Mini Country Report 2010). The Fund for the Promotion of Research (FAR) and public-private infrastructures received the largest budget. The promotion of public-private collaborations represents a relevant component of the national and regional policy mix. Grants and loans remain the favourite tool for innovation policy, compared with indirect measures, despite the addition of (temporary) fiscal measures. Even though fragmentation of R&D measures persists, there has been an increasing orientation towards targeted and mission-oriented programmes, through the introduction of new measures, such as the Technological Innovation Contract, the Fund for Greenfield Infrastructures, the National Technological Platforms (with the purpose of identifying medium and long-term scenarios of technological development), and the Agreement Contracts for Strategic Research (designed as negotiated funding of large scientific and technological investments, where an active role can be played by the public research system in the preliminary phase of bid definition). A weakness is the limited use of evaluation methods to adapt policy measures to their targets.

The awareness of ERA issues is now consolidated in Italy, as testified by the importance attached in policy documents to the internationalisation of research, to the promotion of brilliant young researchers, to the pursuit of excellence of institutions and programmes, as well as to the mobility of people around Europe. But, besides political rhetoric, major barriers to the implementation of ERA objectives in Italy are represented by: traditionally low investments in R&D, the financial crisis, the insufficient openness of the R&D system, and the lack of adequate funding resources to support a reform process toward higher integration of labour market, research infrastructures, research institutions, and national programmes. Current policies focus on reforming the public research sector (namely Universities and PROs), on changing the rules for resource allocation (financial and human resources) in order to eliminate inefficiencies, on avoiding duplication of research efforts, and on concentrating resources on the most promising initiatives in terms of integration at the European level. Moreover, both government core funding and project funding are expected to be driven by the search for excellence, using results from the Quality Research Evaluation Exercise (VQR). Nevertheless, the weaknesses of the monitoring system as well as scarce coordination among different Ministries involved in R&D policies are factors that can still prevent the achievement of good results.

The current policy mix needs to be supported above all by efficient and effective implementation, rather than by changes in the set of policy measures as they are designed: availability of resources, reduced time gaps between applications for funding and funding allocations, continuity of policies, and reviews based on systemic evaluations (regular, targeted on institutions and projects, and including an evaluation of the effects of measures devoted to similar aims).

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1 Introduction

Italy is a large industrialised country in continental Europe, which is characterised by low R&D expenditure when compared with its economic profile. Some figures can better explain this phenomenon.

In 2009 GERD/GDP was 2.01 in EU-27, while only 1.27 in Italy; GDP per capita was 25,700 Euro in 2010 (105% of EU GDP per capita). The effects of the economic crisis are visible in the trend of GDP per capita at PPP (Purchasing Power Standard), which decreased from 26,100 in 2008 to 24,600 in 2010 (source: Eurostat 2011; see also table 2 in the text).

Compared to EU-27, Italy has a lower share of R&D performed by business firms (BERD/GDP: 0.65 in Italy vs. 1.25 in EU-27 in 2009, see table 1), but a higher percentage of Government-funded GERD (42.1% in Italy vs. 34.9% in EU-27, 2009, source Eurostat 2011). R&D performed in the Government Sector (GOVERD as % of GERD) was not far from the EU level: 13.9% in Italy vs. 13.2% in EU-27 in 2009. The same is true for HERD, i.e. R&D performed in the Higher Education sector: 100.7 Euro per inhabitant in Italy vs. 111.1 Euro in EU-27 in 2009 (Eurostat, 2010[1]).

R&D committed by the State, GBAORD as percentage of GDP, was 0.64% in 2009 compared to 0.75% in EU-27; it represented 0.62% of the Italian GDP in 2010. Public demand as expressed by GBAORD mainly concerns research financed by general university funds (GUF), industrial production and technology protection, improvement of human health, and the exploration/exploitation of space (respectively 37.7%, 12.8%, 9.3%, and 7.5%). A significant share is also devoted to non-oriented research (9.7%).

The Italian R&DI system displays strengths and weaknesses. As to the former, Italy has traditionally concentrated its investments in large research infrastructures shared at the international level, such as the Nuclear and Sub-nuclear Physics facilities of the INFN (Gran Sasso, Virgo), and the multidisciplinary infrastructures for the Science and Technology of Materials, Bio-materials and Nano-structures (CNR-INFM, INSTM consortium and Sincrotrone Trieste: Laboratorio Elettra). As to the latter, investments in human resources in science and technology are low: human resources in S/T as share of the labour force were 33.8% in 2010 vs. an EU-27 average of 40.5%. The same is true for new doctorate graduates (ISCED 6): they were 12,591 in 2008, and the percentage of population aged 25-34 having completed tertiary education in 2010 was 19.8% in Italy vs. 33.6% in EU-27.

The Italian university system shows good performance indicators, such as publications in international journals, but it suffers from low mobilisation of financial and human resources. Although the GERD by HERD source of funding is higher in Italy than in EU-27 (1.3 vs. 0.9 in 2009), and HERD as % of GDP was similar in Italy and in EU-27 in 2009 (0.4%), in the same year the Higher Education expenditure per inhabitant was 96.9 Euro in Italy, vs. 118.8 Euro in EU-27 (Eurostat data). Moreover, low differentiation in education (absence of professionally oriented universities, differently from Germany; absence of universities specialising in the supply of high quality education, differently from France) and few research-specialised universities

[1] http://appsso.EUROSTAT.ec.europa.eu/-EUROSTAT-Data

are further negative characteristics. As a rule, the level of competition among Universities is very low, in terms of both students attraction and core funding allocation. The recent reform of Law 240/2010 and the effects of the VQR results on the allocation of government core funding are supposed to enhance the level of diversification based on merit (see Annex).

The current policy mix addresses some of the weaknesses of the national system. Nonetheless, it should be remarked that Italy is still far from the Lisbon (now "Europe 2020") targets, and this is why a proactive attitude by the Government is crucial. Said attitude should include mission-oriented programmes, an efficient implementation of policy measures, availability of resources, reduced time gaps between applications for funding and funding allocations, continuity of policies, and reviews based on systemic evaluations.

Structure of the national research and innovation system and its governance

In Italy, government bodies are also in charge of managing the implementation of policies. The 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 (R&D). The MIUR also coordinates the preparation of the three-year PNR, the main government document for R&D planning, which sets the strategies for the national system by interacting with all other interested stakeholders, including other Ministries and Regions.

The CIPE represents the highest level of S&T policy coordination and it mainly deals with inter-sector and medium-term interventions. Its role became more effective after a special section dedicated to research and education was created in the last decade. The CIPE also reviews the so-called Document for Economic and Financial Planning (DPEF).

The MISE (previously called Ministry for Production Activities) supports and manages industrial innovation. The Ministry is organised in Departments, corresponding to the its missions: promotion of competitiveness; development and cohesion; and market regulation. The Department for Competitiveness is in charge of technological innovation and responsible for industrial policy, industrial districts, energy policies, policies for SMEs, and instruments to support the production system.

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

The National Agency for the Evaluation of Universities and Research Institutes (ANVUR), established by the 2007 Financial Law and regulated by Decree no. 64/2008, has replaced the Committee for the Evaluation of the University System (CNVSU) and the Committee for the Evaluation of Research (CIVR). The new Agency assesses the efficiency and efficacy of education activities, HE and public research organisations, masters, doctorate schools, as well as the quality and results of research projects. Moreover, Decree no. 8 of March 2010 launched the Quality of Research Evaluation Exercise (VQR) to assess the research performance of Universities and Public Research Organisations (PROs) and of their Departments in the last seven years (2004-2010). The ANVUR also sets the minimum scientific performance requirements scholars must meet in order to be included in the national list of people qualified for recruitment in Universities (the so-called national scientific

habilitation). Only those included in the national list can apply for university selections.

A National Innovation Agency, envisaged in the 2006 Budget Law and established in January 2008, is in charge of evaluating (*ex-ante* and *in itinere*) industrial innovation projects related to "Industria 2015". The Agency works through dedicated workshops, forums, web services, and new media channels, and its purpose is to circulate innovation ideas among interested potential partners, with specific focus on regional policies. It also promotes the so-called Centres of Competences, belonging to Universities and PROs, created to provide a common arena for the Public Administration, research institutions, and SMEs or large firms.

The Agency also pursues its goals by developing seven programmes to enhance networking among various local actors (public research, public administration, and firms at the local level) and to provide support to innovation:

- Italy of Innovators
- Meet the Innovators
- Reti Amiche
- Vivifacile
- Foresight and Higher Education
- Regional Support to Innovation
- Evaluation of Policies

No assessment of the effectiveness of the Agency's activities is available yet, nor information about ongoing self-assessment activities.

The 2010-2013 PNR introduces a new organisation, the Technical Secretariat for Research Governance (ACR), coordinated by the MIUR. Its aim is to develop coordination of national research activities and to collect and communicate to the Ministry the demands coming from the scientific system and the institutions which finance R&D activities. This new organisation should involve members of the State-Regions Committee and several Ministries (MIUR, MISE, Agriculture and Forest, Environment, Health, Cultural Heritage, Public Administration and Innovation).

The role of regions in the governance process

The division of competences between the State and the Regions in the R&D field is based on the concurrency principle. Both central and regional authorities can legislate, but interventions concerning support to universities and public research institutions, as well as major strategic programmes and their co-ordination, fall within the exclusive competence of the central State. Co-ordination between State and regional policy activities is ensured through the work of a permanent State-Regions Committee.

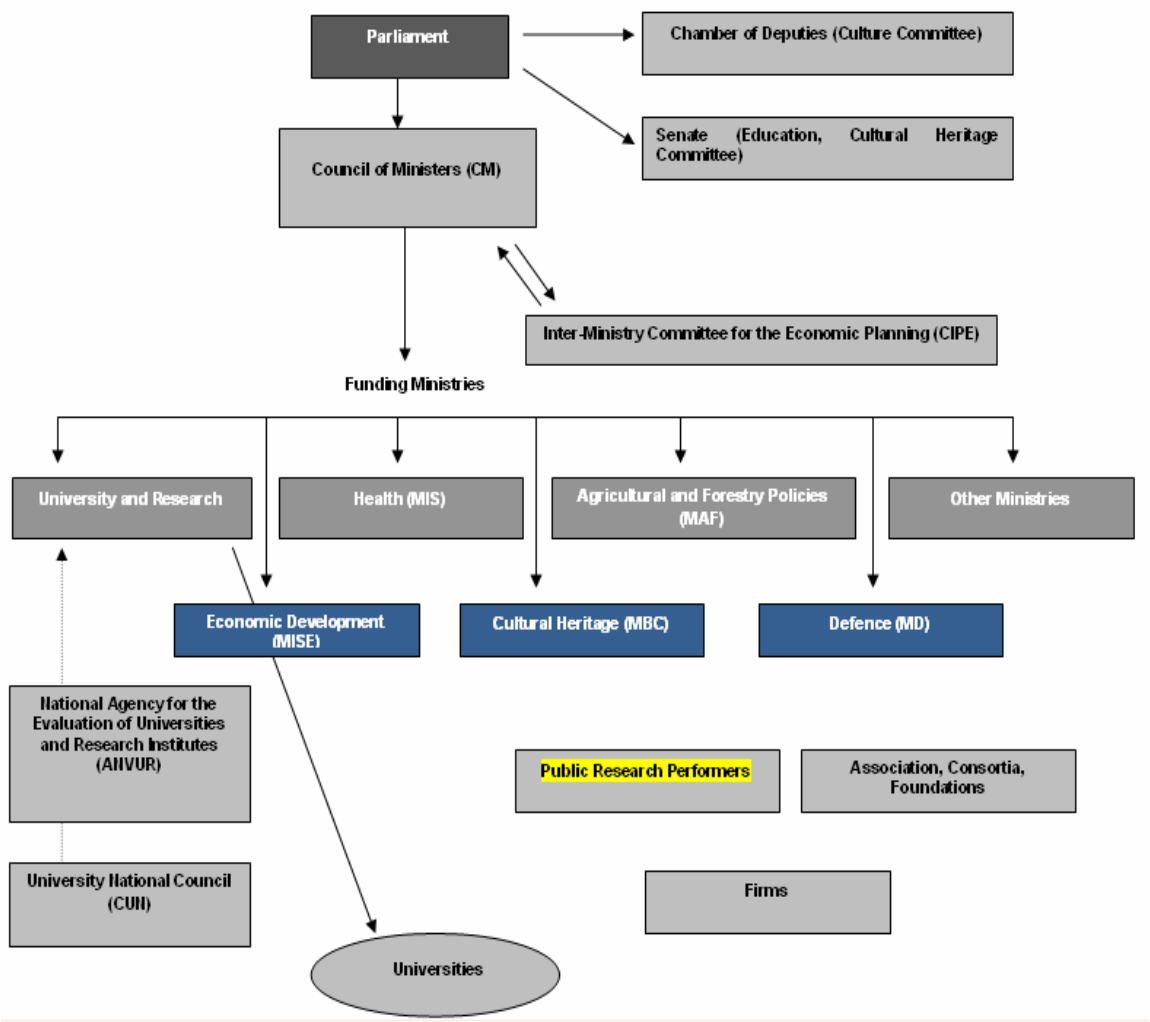
Regional policies at the national level, including R&D activities as a critical component (horizontal measures for competitiveness), are additional to ordinary budget and consist of co-funding of structural funds (national and regional operational programmes, PONs and PORs) and a fund for under-exploited areas, the so-called FAS.

Research performers

Universities and PROs play a significant role in the public research sector. Universities have continued to expand and have become highly diffused. Italy now has 89 universities, 61 of which are public institutions (MIUR/ Cineca, 2009). They have been recently reformed by Law 240 of December 2010, which reorganises their internal governance, reforming the rules for recruitment and careers and establishing new regulations concerning the status and role of university professors and researchers. The law encourages transparency in recruitment procedures, promotes budget efficiency, and distributes additional funding to the universities with the best research and training offer, based on the results of an ad-hoc research evaluation exercise developed by the ANVUR. The government decree reforming PROs under the supervision of the MIUR (Legislative Decree 213/2009) was implemented through the application of new internal Statutes, a governance reform, and a multiyear plan to pursue scientific excellence and integration with the private research sector. Both Universities and PROs are implementing the reform through the approval of new statutes and internal regulations.

Performers in the private sectors include firms and not-for-profit organisations. In both cases, R&D activities are carried out by few organisations.

Table 1: Structure of the Italian R&D system



2 Structural challenges faced by the national system

The structural challenges faced by Italy are in line with those mentioned by the Innovation Union Competitiveness (IUC) Report (2011, p.3), when Europe and the US are compared. They mainly concern the limited presence of high-tech sectors in the national economy and the low R&D intensity of these sectors. SMEs also face constraints related to difficulties in accessing the financial markets and high IPR costs.

The Innovation Union Scoreboard (IUS, 2010) ranks EU Member States based on their average innovation performance across 24 indicators, dividing them into four performance groups: Innovation Leaders, Innovation Followers, Moderate Innovators, and Modest Innovators. Italy is positioned within the group of Moderate Innovators, below the EU-27 average, together with the Czech Republic, Greece, Hungary, Malta, Poland, Portugal, Slovakia, and Spain.

Most Innovation Leaders perform very well in business R&D expenditure and other innovation indicators related to firm activities. All of the Innovation Leaders have higher than average scores in the public-private co-publications per million population indicator, i.e. they have good linkages between the science base and business. Moreover, all European top innovators excel in the commercialisation of their technological knowledge and have a balanced national research and innovation system.

All Moderate Innovators have grown faster than the EU-27 average, with the exception of Italy, which is a moderate growth country within the Moderate Innovators group (IUS Report 2010 p. 11).

If we jointly consider the data from the 2011 IUC report, the 2010 IUS report, and Eurostat data for 2010 and 2011, we understand that the Italian national system faces four main structural challenges:

- Insufficient performance of the Higher Education system.
- Low level of S&E skills.
- Low Business R&D investment.
- Size distribution within the industrial population.

Insufficient performance of the Higher Education system

The HE system in Italy is weak in terms of financial and human resources, in comparison with other European countries, and there are no signs of change. This is confirmed by some indicators from the Eurostat data and the IUC Report.

Public expenditure on R&D as percentage of GDP was 0.57 in 2009, well below the EU level of 0.74. Although HERD as percentage of GDP was 0.4 in 2009 (the same as in EU-27) and the GERD by HERD source of funding was 1.3 in Italy vs. 0.9 in EU-27 in 2008, in 2009 the Higher Education sector expenditure per inhabitant was 96.9 Euros in Italy, while it was 118.8 Euros in EU-27 (Eurostat data). As to human resources, Italy's weakness is evident: researchers (FTE) per thousand labour force in 2009 were 3.8, while in Europe the value was 6.3 (IUC Report, 2011).

The Italian university system is characterised by a low degree of differentiation in education (absence of professionally oriented universities; absence of universities specialising in the supply of high quality education) and by few universities specialising in research. It has continued to expand and there are now 89 universities In Italy, 61 of which are public institutions (CNVSU, Report 2011).

The number of new doctoral graduates (ISCED 6) per thousand population aged 25-34 is the same as in Europe (1.6, IUC Report 2011), and its annual average growth is consistent (12.5%, IUS, 2010). But attraction of non-EU doctoral students is weak, well below the EU average, although its growth is consistent (IUS, 2010). More generally speaking, Italy shows a limited capability to attract doctoral students from abroad. This is confirmed by data on the countries of origin of doctoral candidates in 2007: 95.7% were from Italy, 1.5% from EU-27, and 0.6% from other European countries (EC, 2010). Intra-EU inflow of doctoral candidates is very low (1% of the total number of doctoral candidates); as for the intra-EU outflow, the percentage share of the total number of doctoral candidates is 10%. Thus, the intra-EU "net gain" displays a negative sign (-12%). Major weaknesses of the Italian PhD programmes emerging from the CNVSU assessment are: fragmentation of courses, lack of resources available to PhD students (limiting, among others, participation in international conferences and visiting or work experiences abroad), and no clear focus on the acquisition of academic or professional skills (see Annex 1.1).

International scientific co-publications per million population are below the European level: 413 in Italy versus a European median value of 491 (IUC 2011). Scientific publications within the 10% most cited publications worldwide as percentage of total scientific publications in the country show a better performance that the EU average: 12.1 in Italy vs. 11.6 in the EU. The size of universities is not correlated with better performance in terms of scientific productivity and degree of internationalisation; indeed, there are examples of excellent scientific performance in many medium-sized universities. Here the structural challenge is due to the differences between the universities located in the North of the country and those in the South. The Academic Ranking of World Universities (2010) does not list any Italian universities among the top 100; 20 universities are included in the top 500: among them only 3 are located in the South of Italy.

Low level of S&E skills

Italy scores below the EU average for what concerns the indicator of population aged 30-34 having completed tertiary education (IUS, 2010). Also the percentage of young people aged 20-24 having attained upper secondary level education is below the European average.

In 2007 the number of S&E graduates per 1000 population aged 20-29 was 13.4% in EU-27, while only 8.2% in Italy. Also, the number of PhD students in the Science and Engineering field in 2007 was 36.5% of total PhD students, while the European average (EU-27) was 42.5%.

As to the labour market, in 2006 about 59 million people were employed in EU-27 within the science and technology sector (Eurostat, 2008), accounting for 31% of the total employed population in the EU. The relative weight of people working in S/T jobs in Italy was 32.2% of total employment in the 25-64 age bracket; this percentage, higher than the European average, is however still far from that of countries such as Denmark (41.5%) or Germany (38.2%). Moreover, in 2006 the share of individuals with a university degree who also worked in the science and

engineering sector was 18% of the total number of people aged 25-64 employed in EU-27, while in Italy this share was only about 10%.

Low Business R&D investment

Italy traditionally faces the problem of low business R&D investment and the R&D expenditure of business enterprises is far from the Lisbon objective (now "Europe 2020"). BERD as % of GDP, giving the intensity of R&D expenditure of the private sector in Italy, was 0.54 in 2002 and 0.65 in 2009, while the EU-27 values were 1.20 in 2002 and 1.25 in 2009. Private funding of GERD was 45.2% of the total gross R&D expenditure in Italy, while the average EU-27 value was 54.8% (2009); see table 2.

In 2009, intramural R&D expenditure in the business sector per inhabitant was 165.3 Euros in Italy vs. 294 Euros in EU-27. The private sector's demand for human resources for research is far lower than the European average: in 2007 33.9% of researchers were employed in the business enterprise sector in Italy, while in the same year they were 48.8% of the total number of researchers in EU-27.

The low level of business R&D intensity in Italy is partly due to the structural composition of its economy: the share of high-tech industry in total manufacturing value added is low. Italy remains non-specialised in all high-tech sectors (except chemical industry), although in some cases it shows scientific specialisation (e.g. in pharmaceuticals) or high concentration of patents (e.g. in other machinery and electrical equipment). A key challenge concerns moving towards a higher share of high-tech companies and research-driven clusters, through the growth of innovative industrial sectors and new high-tech firms, which would require the development of risk-oriented finance (venture capital, equity funds). In twenty years (from 1990 to 2009) the Italian percentage share of total world manufacturing value added decreased substantially (OECD/STI 2011 p.35). This is due to: (i) low weight of high-tech sectors: the number of employees in high-tech sectors as % of total employees is 7.6 in Italy, below the EU-27 average of 14.50 (Eurostat 2010); (ii) the limited presence of foreign-controlled firms, which remained the same from 2001 to 2008 (OECD/STI 2011 p. 174); and (iii) the lack of large firms: in Italy the number of individuals employed in non-financial business enterprises of the 250+ size class as share of total employment is well below the EU-27 average of 32.6 (Eurostat 2010, Tab.7.5).

The intensity of risk capital over GDP is another weakness: venture capital as % of GDP is particularly low in Italy (0.50) when compared with EU-27 (1.07) and with the EU leaders (3.04) (EIS 2010). This can be seen as an indicator of the country's low degree of innovation. The main challenges concern overcoming obstacles to the development of lead markets and to the establishment and growth of new firms. Other problems have to do with the weakness of the national oligopolistic industrial core and with the downsizing of large private research facilities.

Size distribution within the industrial population

The problems Italy is facing are also due to size distribution within the industrial population: the Italian industrial structure is largely composed of small and medium sized firms, which represent over 95% of the total number of enterprises. Special attention should therefore be devoted to the enhancement of their R&D activities and to R&D-based innovations. For what concerns the percentage of turnover of innovative enterprises from new or significantly improved products new to the market, Italy is only in 22nd place in the EU-27 country ranking (Eurostat 2010). The worst innovative performance is that of innovative small sized firms (10-49 size class); the

percentage of these firms having created product innovations new to market is 26.8 in Italy, lower than the EU-27 figure, i.e. 29.7 (Eurostat 2010). SMEs are concentrated in medium-low tech sectors and traditionally invest in process innovation. Generally speaking, there is low propensity to innovate in smaller companies: only 30% are successful innovators, while the percentages for medium and large firms are higher, respectively 53% and 68% (CIS3). The large presence of SMEs also impacts on the low percentage of GERD financed by the industry, including outsourced research activities (commissioned to external parties).

Among the main findings of the IUS 2010 report, it is worth noting that the performance of Italy is relatively low in relation to the Linkages & Entrepreneurship dimension. This dimension is composed of three indicators measuring the entrepreneurial and collaboration efforts of SMEs among innovating firms and with the public sector. The challenge is therefore that of increasing R&D linkages and collaborations among SMEs.

Italy has been a leading country in innovation not based on R&D, but this model of innovation without research is now entering a phase of decreasing returns, and the private component of R&D investments must be increased. This goal requires changes in the socio-economic conditions of the South of Italy, reducing differences in terms of R&D infrastructures, such as technological districts, excellence clusters, and innovative industries. Industrial districts have represented one of the most dynamic components of the Italian SMEs.

3 Assessment of the national innovation strategy

3.1 National research and innovation priorities

Italy has a multi-annual R&I strategy, mainly outlined in two types of documents: a three-year research programme (PNR) and the National Reform Program (NRP), a programming document in which the three-year strategy is updated yearly. This document does not deal with budget commitments.

The PNR starts with an analysis of strengths and weaknesses (S&W) at the national level. Major changes to the three-year national R&I priorities depend on this S&W qualitative analysis and on consultations held while the research programme is being prepared. Summing up, R&I priorities in Italy concern a stronger role for a top-down R&I strategy based on large, complex, and collaborative projects, a re-organisation of public research institutions and universities, and greater attention paid to SMEs and start-up companies. The national R&I document (i.e. NRP) also mentions an emerging topic, i.e. innovation in the public sector, based on performance and self-evaluation projects. Environmental and renewable energy sources are also increasingly relevant issues, but policies are mostly designed at the regional level (see Trend Chart Mini Country Report 2010). Unfortunately, the country lacks systematic evaluation and evidence-based policies, with the exception of the Cohesion and Competitiveness policy, in which monitoring activities are present. The national priorities are overall aligned with the country's structural challenges, but one of the main problems concerns their implementation.

The three-year programme focusing on Italy's national research strategy (PNR) is developed by the MIUR through a process involving consultations with a large number of stakeholders, such as public research organisations, the CRUI

(Conference of University Rectors), industrial associations, the State-Regions Conference, the Observatory on Regional Policies for Research and Innovation, and other ministries. The last PNR for 2011-2013 was approved by the CIPE in March 2011.

The most recent R&D strategy document was drawn up by looking at the interaction between research supply and demand. It is based on structured inter-institutional collaborations, thanks to the creation, in July 2009, of a consultation group that allows working through common discussions and elaborations. This government document details the R&D policy priorities, the governance framework, the instruments through which said priorities can be achieved, and the funding appropriations to be allocated to the various policy instruments for the next three years. The 2011-2013 PNR stresses the importance of coordinated institutional actions (i.e. greater integration among public central administrations and with regions) and of "centrally" driven policy instruments, such as strategic and priority projects. For what concerns the topic of innovation, the document through which a multi-annual strategy was designed by the MISE is "Industria 2015". This bill, passed on 22nd September 2006, identifies the main drivers and instruments of a strategy of economic change based on innovation, to support the strategic repositioning of the Italian industrial system in a more competitive and globalised economy. The 2011-2013 PNR displays convergence with "Industria 2015" mostly around the idea that knowledge and innovation have to guide the reorganisation of the national economy towards leadership, sustainability, and participation of all the actors involved in innovation. There is clear convergence on three specific aspects: (i) a more active role of the government (i.e. in selecting priorities and in the use of major top-down negotiated instruments); (ii) public-private partnerships; and (iii) innovative finance: private funding for innovation investments, with public participation or guarantees, and protection of the IPRs of SMEs. The 2011-2013 PNR stresses the need for a better distribution of risky investments (such as those in research and development) between the State and the market, with greater participation of private actors.

Another point of convergence between research and innovation strategies is the attention paid by the PNR to integrated complex systems of actors, such as Technological Districts, Excellence Centres, and National Technological Platforms. The previous PNR had already focused on public-private research integration, but the most recent one further acknowledges the strategic role of the above actors. As for innovation, "Industria 2015" develops a broader concept of industry, i.e. supply chains integrating manufacturing, advanced services, and new technologies.

The main macro-objectives of the 2011-2013 PNR are:

- growth of the country's competitiveness in pre-existing technological areas;
- quality and critical mass in public and private research;
- valorisation of human capital;
- promotion of technology transfer;
- strengthening of public-private collaborations;
- promotion and development of new high-tech firms;
- creation of R&D infrastructures and networks;
- introduction of methods for the evaluation of R&D policy measures.

"Industria 2015" is a well-designed innovation strategy and no relevant changes in priorities or instruments have been introduced since the document was presented. It includes the following areas of strategic intervention:

- energy efficiency;
- sustainable mobility;
- new technologies for the 'Made in Italy';
- new technologies for health;
- innovative technologies for cultural heritage goods and activities.

A shift in priorities has occurred within the energy policy with the introduction of programmes for the development of renewable energy sources. The DPS (MISE) focuses on demonstration projects, downstream from research, and specifically on three projects: carbon capture and storage, bio-fuels, and concentrating solar power. This shift in priorities is coherent with the outcome of the June 2011 referendum, which confirmed the low social acceptance of nuclear energy in Italy. The current National Action Plan for Renewable Energy Sources 2010-2020 was enacted in July 2010, in compliance with the guidelines of European Directive 2009/28/EC requiring stronger commitment in this field. Hence, it is too early to assess its application. The usual gap between policy aims and actual implementation is also detectable in environmental policy: the funding of a national plan for green purchases within the Public Administration (PAN GPP) – a national action plan implemented by the 2007 Financial Law and promoting the environmental sustainability of public procurement – is still under evaluation.

Considering the three documents that define Italy's R&I strategy (PNR; NRP; Industria 2015), the emerging policy mix is:

- improving the entrepreneurial environment, with policies focusing on SMEs and strategic programmes supporting access to private and institutional funding (venture and equity);
- promoting public-private partnerships (High-Tech Districts, Clusters, and Public-Private Laboratories), focusing on localisation within "convergence" regions;
- modernising the public administration and promoting public procurement (which is however mentioned only once in the 2011 NRP);
- transforming the environmental policy into an opportunity for the renewable energy industry (including SMEs and Italy's southern regions);
- mobilising Structural Funds and international agreements for investments in infrastructures.

The main R&D policy challenge is to trigger investments by private firms and move from specialisation in traditional sectors towards research-based innovation and sector specialisation. Thus, the importance attached to SMEs and to the commercialisation of their IPRs-based innovations is appropriate to target national structural problems. Nonetheless, policy effectiveness represents a "second level" challenge: coherent implementation and systematic policy evaluations are needed to support strategic priorities in line with the country's structural challenges.

3.2 Trends in R&D funding

Trends in R&D funding can be described using Eurostat data.

Government funding of GERD (all R&D activities) was 42.1% in 2009 (Eurostat, 2011), while it was 50.7 in 2005. On the other hand, business-financed GERD in Italy grew from 39.7% in 2005 to 45.2% in 2008, remaining however still far from the EU-27 figure of 54.7% in 2008.

As to performed R&D, the amount of GERD per capita declined from 2008 to 2009 in Italy. R&D performed by the business enterprise sector as % of GERD decreased too, from 0.53% in 2008 to 0.51% in 2009. A lower level of R&D expenditure by business firms (BERD/GDP) is also detected: 0.6 in Italy vs. 1.23 in EU-27 in 2010 (source Eurostat 2011).

Considering the mentioned trends, the 2011-2013 PNR establishes the need for: a redistribution of R&D investments between public and private funders, a simplification of funding instruments (fiscal measures), better relations between venture capital, technology transfer, and innovation, and collaborations between the Cassa Depositi e Prestiti - CDP (a joint-stock company under public control, with the Italian government holding 70% of its capital) and Bank Foundations to support R&D investments. The 2011-2013 PNR does not mention any precise national R&D target for GERD/GDP, BERD/GERD, or BERD/GDP.

Table 2: Basic indicators for R&D investments in Italy

	2008	2009	2010	EU average 2010
GDP growth rate	-1.2	-5.1	1.5	2,0
GERD as % of GDP	1.23	1.27	n.a.	2.0
GERD per capita	323.8	321	n.a.	490.2
GBAORD (€ million)	9,941,74	9,778,4	9,548	92,729.05
GBAORD as % of GDP	0.63	0.64	0.62	0.76
BERD (€ million)	10,173,1	9,924,3	9,881,7	151,125.56
BERD as % of GDP	0.65	0.65	0.64	1.23
GERD financed by abroad as % of total GERD	0.08	n.a.	n.a.	N/A[2]
R&D performed by HEIs (% of GERD)	0.1	0.1	n.a.	24.2
R&D performed by PROs (% of GERD)	n.a.	n.a.	n.a	13.2
R&D performed by Business Enterprise sector (as % of GERD)	0.53	0.51	n.a	61.5

Source: Eurostat

[2] 8.4 (2009), 9.04 (2005)

Here follows a brief overview of current public funding mechanisms, which display continuity with the recent past:

- Public research and academic institutions have been financed more through competitive funding rather than through institutional funding. The 2009 CNVSU report on Italian Universities states that in 2009 the MIUR increased funding to universities by 300 million Euros, which involved an increase of 100 million from the institutional source, the Ordinary Fund, and an increase of 200 million from targeted sources of funding, such as the FIRB and the PRIN, which are types of competitive funding.
- Subsidies continue to be the main source of funding, although tax incentives have been added. In 2010 the amount of tax credit for industrial R&D was 50 million Euros, a small percentage of, for instance, the total 2010 FAR (Fund for Research activities) funding (1,240 million Euros).
- Collaborative funding represents a growing type of funding, in particular within large R&D projects, such as the PIIs of "Industria 2015" or the Technological Innovation Contracts of the FIT. Public-private partnerships, in particular, are a relevant policy target, pursued also through instruments such as technological districts and excellence clusters, but an assessment of their ability to leverage additional funding is not available.
- Large negotiated R&D programmes, such as Industrial Innovation projects (PIIs), and large project funding for public research institutions and universities (FIRB) are theme-oriented. Compared with bottom-up projects, the public support for thematic/targeted projects is becoming increasingly important.
- Regional policies are extremely relevant in Italy. The national operational programme PON "Research and Competitiveness" received 2,817 million Euros for the 2011-2013 period. The funding from the ERDF and the ESF is respectively 19.88% and 20.11% of the total.
- Transnational funding is an increasingly important source, above all for public research institutions and universities. Yet, the amount of GERD financed by abroad is extremely small: 0.08% in 2008 (last available figure).

3.3 Evolution and analysis of the policy mixes

Considering the **six routes** to raise R&D investment levels (Guy et al, 2009, p. 30), the R&D policy mix in Italy is mostly characterised by efforts to stimulate greater R&D investments by R&D-performing firms; this can be achieved by stimulating public-private collaborations, since the orientation towards targeted and mission-oriented programmes has increased. An emerging route is the establishment of new domestic R&D-performing firms; in fact, a growing number of measures are devoted to support the capitalisation and innovation of SMEs.

Following policy categorisation within the **Research Inventory**, the balance among the main categories of policy measures has not changed since mid-2009. **Research and Technologies absorbed the largest amount of budget for innovation policy** measures in 2010 (Trend Chart Mini Country Report 2010). The FAR (Fund for Research) and public-private infrastructures received the largest budget. In particular, in 2010 the Technological Districts in the northern and central regions of Italy received 400 million Euros and the High-Tech Centres in the convergence regions 900 million Euros (Governance and horizontal research and innovation

policies). The promotion of public-private collaborations is one of the strengths of the national policy mix and a relevant component of regional policy. From 2010 to 2012, the national operational programme PON "Research and Competitiveness" allocated 282 million Euros to support existing High-Tech Districts, 107 million Euros to existing Public-Private laboratories, and 526 million Euros to new Public-Private laboratories and High-Tech districts in the Convergence regions. In comparison, FIRST, the Special Integrative Fund for Scientific and Technological Research managed by the MIUR, received much less financing (77 million Euros in 2010).

It is also evident that **grants and loans remain the main tool** for innovation policy, compared with indirect measures, despite the addition of a (temporary) fiscal measure, i.e. tax credit for industrial R&D (200 million Euros in 2010), and of a new measure (defined as experimental within the official documents), i.e. tax credit for R&D commissioned by industrial firms to Universities and PROs, which was activated in 2011 with a committed fund of 55 million Euros.

The Market and Innovation Culture category of policy measures – including Support and guidelines on innovative Green Public Procurement, Impact assessment of new legislation/regulations on R&D, and Measures to raise awareness and information on IPR – was still the least developed in 2010, just like in 2009 (last INNO-Policy Trend Chart update). Nonetheless, the new planning documents pay great attention to these measures.

A growing number of measures focus on supporting the capitalisation and innovation of SMEs: the **Italian Investment Fund**, launched in 2010, is a private equity fund dedicated to qualified investors, with State participation in its management company. The Jeremie (**Joint European Resources for Micro to Medium Enterprises**) Fund for the Mezzogiorno, established within the "Plan for the South" (Piano per il Sud) and endorsed by the Italian Cabinet in November 2010, is an over-regional equity fund for temporary and minority participation (under market conditions) in the equity capital of private companies. It is financed through public appropriations (national and European, coming from the funds for PONs and PORs) and through the money cyclically returned by industrial beneficiaries (this is why it is called "revolving"). It offers **credit and risk funding to SMEs and guarantees to Banks in the Southern regions,** helping the implementation of the Structural Fund policy. The **National Fund for Innovation**, launched in 2011, is devoted to innovative projects that make use of patents owned by SMEs. The Fund acts as a guarantee for banks and other financial institutions financing these innovative projects.

Even though R&D measures are still fragmented, there has been an increasing focus on targeted and mission-oriented programmes, through the introduction of new funding schemes. The **Technological Innovation Contract** is a new instrument of the FIT (Fund of Technology Innovation) established by the MISE (M.D. January 2011). Technological Innovation Contracts will support the carrying out of large projects (of around 10 million Euros) within a negotiated procedure between the Ministry and (private and public) national and international actors. They will be funded by the revolving Fund of the CDP (a joint-stock company under public control, with the Italian government holding 70%; www.cassaddpp.it), by the FIT, and by PON "Research and Competitiveness". Public funding will be complemented by bank funding at market rates, as guarantee of the value of the firms' investments. The budget of the **Fund for Greenfield Infrastructures,** launched in March 2011, is 1.5 billion Euros in 2012. The State has a share in its management company, which manages mutual funds for investments in new infrastructures. The two main

institutional agents are the Treasury and the CDP, which collects private savings and invests them in sectors such as energy and transport, research and innovation, and SMEs. The **National Technological Platforms** are an innovative instrument included in the PNR promoting collaborations among public administrations, the public research system, and industrial firms. Their purpose is to identify medium and long-term scenarios of technological development and priorities, as well as implementation instruments. They interface with similar initiatives at the European and international level. The **Agreement Contracts for Strategic Research** (the most recent instrument, launched by Legislative Decree no. 70 of 13th May 2011), are managed by the MIUR and use about 40% of the FAR (Fund for supporting Research) re-funded (by industrial beneficiaries) loans. They are designed as negotiated funding of large scientific and technological investments, in which an active role can be played by the public research system in the preliminary phase of bid definition. This instrument represents an update of the negotiated bids established by Legislative Decree 297/1999, but its implementation still has no clear boundaries and has not yet been initiated.

The identification of social needs requires demand-side innovation policies, which have no tradition in Italy. This is not only because said policies are strongly intertwined with the innovation policy, but also because there is a lack of culture and awareness about this policy lever. At present, the MISE is interested in developing a new approach to pre-commercial public procurement bids within regional POR programmes funding innovation and research. In this context, the technological foresight phase is very important, since it identifies technological priorities and critical developments by sector and by technological areas in order to support more competitive behaviours of enterprises or public administrations.

Here follows **an analysis of the Strengths and Weaknesses** of the current policy mix, developed on the basis of the Innovation Union self-assessment tool:

- The **role of research and innovation** within the overall national/regional policy mix is becoming more relevant, as established by official documents through multi-annual strategies (for both R&D and innovation policy), but the weakness of the national system persists, since private investments are still low. This weakness is considered critical, particularly in relation to the following priorities: investments in R&D by SMEs, the role of venture capital, the number of new high-tech firms, and industrial specialisation in high-tech sectors. Societal challenges are included in the PNRs, in particular health and environment, but investments in an innovation energy programme are very recent and public procurement, which could drive socially oriented innovation, is an underdeveloped instrument.
- The **quality of the governance** of research and innovation policies enjoys a stable centre-of-government structure, through the development of multi-annual strategies and the definition of priorities. However, there are still fragmentation and duplication of measures, along with a scarcely effective monitoring and review system (concentrated on regional policy) and inefficient implementation, affected by uncertainties in terms of availability of resources.
- The **scope of the innovation policy** has been broadened, including organisational and services innovation, as shown by the relevance given to innovation in the public sector (particularly in the Public Administration), but demand-driven innovation is weak and it has been addressed mostly by regions within environmentally oriented innovation.

- **Public funding in terms of leverage on private investment** is adopting innovative financing solutions, based on mobilising private savings towards targeted investments through public guarantees and public participation in special Funds, but the selection method for project funding based on market criteria (economic return) might penalise less well-known and more risky solutions.
- **The pursuit of excellence** in research and education policies is attained through a large use of competitive and project-based financing, but there is no clear rationale for the balance between institutional and project-based funding. The selection of projects is mostly based on input (quality of projects) instead of achieved output, with possible concentration effects. The evaluation of research institutions has followed internationally recognised criteria (past CIVR evaluations). The new ANVUR, established in 2008 but implemented in 2011, is supposed to cover quality assurance, accreditation, and research evaluation for universities. Major weaknesses include lack of opportunities for research careers and low incentives to attract leading international talent. The 2000s were characterised by decreasing resource mobilisation to support University research activities. Nevertheless, although cuts to resources are already in place, there are neither clear estimates of resource savings nor indications about priority actions.
- The ability of the education system to produce the **right mix of skills** is weak, due to low policy incentives to ensure the supply of enough (post) graduates in science, technology, and engineering. Moreover, Italy has a very limited tradition both in education and training curricula covering innovation-related, transversal competences and in the promotion of partnerships between formal education and other sectors.
- The promotion of **partnerships at all levels and between research and innovation** is one of the strengths of the national system thanks to: public-private collaborations promoted by several policy initiatives, IPRs regulation and transfer offices within Universities, legislation supporting spin-offs, and ease in setting up/operating transnational partnerships and collaborations. A key weak aspect is the low mobility of researchers and innovators between public and private institutions.
- Framework conditions **promoting private investment** in research and innovation are improving, thanks to a recently better implemented national system for the protection of IPRs and rules for starting up businesses; but the venture capital market is still not developed enough and recent measures in the policy mix tend to support risk-oriented financing mostly for existing firms.
- **Public support** still displays many weaknesses in terms of simplicity, quality, and accessibility, but there is a recent trend towards greater attention to measures specifically tailored for SMEs and young companies. A weakness is the scarce use of evaluation tools to adapt policy measures to their targets.
- **Public Procurement** driving innovation has not yet been developed, but the situation is slowly changing, as confirmed by the interest expressed by the MISE in developing a new approach to **pre-commercial public procurement bids within regional POR programs** funding innovation and research. Furthermore, the DIT[3] Department of the Ministry of Public Administration and Innovation has

[3] DIT= Digitalizzazione e Innovazione Tecnologica (Digilatisation and Technological Innovation)

recently started working on innovation procurement and **pre-commercial public procurement** (PCP) **within the P.A.**.

3.4 Assessment of the policy mix

R&I priorities and strategies are consistent with the structural challenges of the country's R&I system, but there are still difficulties in turning the priorities set in policy documents into a consistent, comprehensive, and efficient policy mix. The current policy mix introduces measures to support new R&D-oriented firms and large collaborative programmes, in order to mitigate the country's structural weaknesses. Nevertheless, other aspects require attention:

- the lack of a systematic method to assess policy measures as well as substitution or synergic effects among different policy instruments;
- the limited resources available to support the reorganisation of public research institutions and Universities;
- the slow, fragmented, uncertain implementation of a large number of policy measures.

These aspects threaten the effectiveness of the policy mix and of its ability to solve the country's structural problems.

The policy mix in place includes some instruments that might mitigate the country's weaknesses (low level of R&I investment by private actors, low level of S&E skills etc., see above in this report). The most interesting features are the **policy devoted to small firms**, complementary to the current industrial policy, aimed at supporting their capitalisation and innovation through specific Funds (Investment Fund, Innovation Fund), and the Innovation Package, supporting the IPRs expenditure of SMEs and the commercialisation of patented innovations. The Innovation Fund includes two lines of activity: risk capital funding (investment in corporations) based on patents, and debt funding based on patents and designs. Financial constraints have a relevant role in firm dynamics; it is crucial to verify and quantify the extent to which R&D investments, and ultimately innovation, are affected by these constraints. Difficult access to finance is among the top concerns of SMEs. Almost two-thirds (63%) of the SMEs in the EU that applied for a bank loan during the last six months of 2011 received the whole amount they asked for, but about one third did not get the requested financing. Indeed, financial constraints[4] exist whenever there is a wedge between the costs of obtaining internal and external funds, as stated by Kaplan and Zingales (1997). The theoretical explanation for this relation is mainly based on information asymmetries between firms and external financers and on the lack of appropriate collaterals. The new measure introduces a method for the selection of innovative projects based on the economic assessment of a firm's intangible assets (IPRs), which can mitigate credit and venture capital risks and steer the funding criteria towards focusing on economic returns from patent-based innovations. The key idea is to create a circle of relations between market and public policies and to favour small firms "bucking the trend", in order to stimulate the development of a more advanced entrepreneurial filière. The policy is still being implemented; therefore, an evidence-based assessment of its effectiveness cannot be provided.

[4] See a joint ECB/European Commission survey: http://ec.europa.eu/enterprise/policies/finance/data.

The other structural challenge that might be mitigated by the current policy mix is Italy's medium-low tech industrial specialisation, which can be dealt with by means of large projects/programmes involving different actors and R&D activities. The available instruments within the current policy mix are:

- the **Industrial Innovation Projects** (PIIs) of the "Industria 2015" programme, integrating: (i) government choice of strategic areas; (ii) a plurality of private and public actors; (iii) coordination among the MISE, the MIUR, and the Ministry of Innovation in the Public Administration, participating with their specific funds for research and development; and (iv) redesigning of the incentives, from one-to-one (incentive-activity to be funded) to an integrated package including a mix of instruments, based on specific projects and negotiated between the government and the involved actors;

- the **Technological Innovation Contract,** implemented in 2010, is a new, negotiated FIT (Fund of Technology Innovation) instrument managed by the MISE and devoted to very large innovation projects (investments up to 2 billion Euros) carried out through public-private collaborations;

- the **Agreement Contracts for Strategic Research,** managed by the MIUR (May 2011), concern the negotiated funding of large scientific and technological investment. The PIIs have financed – within three bids (Sustainable Mobility; Energy Efficiency; Made in Italy) – 232 projects presented by 1,745 firms (1,268 of which are SMEs) and 500 PROs and Universities, for a total investment of 2.2 billion Euros. However, no evaluation of their effectiveness/impact is available, since monitoring activities focusing on the progress of Industrial Innovation Projects started in May 2011. The available results show that, in 40% of the sample, progress in the scheduled activities is between 40% and 60%. A good result of the PIIs has been the creation of new collaborations.

A recent survey (2009-2010) on the state of Italian research was conducted by the Seventh Commission of the Chamber of Deputies (Parliament). Its results emphasise the critical situation of the public research system (PROs and Universities): limited available resources, scarce collaboration among public research institutions, lack of a general strategy, an inefficient/locked-up system of access and careers for researchers. For what concerns the funding instruments, the survey indicates a lack of complementarities both among national funds and among national and regional funds; the survey also identifies relations of competition, duplication, and substitution.

Table 3: Assessment of the policy mix

Challenges	Policy measures/actions[5]	Assessment in terms of appropriateness, efficiency and effectiveness
SMEs R&D developing and absorbing capacity is still low and the change needs a large set of coordinated instruments.	A policy tailored for SMEs including new Funds (Investment and Innovation fund), the innovation package supporting the patenting activity of SMEs and the introduction in the market of patented innovations, the tax credit for industrial firms committing R&D to Universities and PROs. A reduction of administrative costs for SMEs is part of the P.A reform.	In principle a policy specifically tailored for SMEs is necessary and appropriate. Nonetheless measures are too recent for having an evidence based assessment of their effectiveness or of their efficient implementation. A possible warning is that the new "market oriented" funding instruments could have a limited number of beneficiaries and a low impact on structural challenges, which include financial and capital market constraints.
Dealing with barriers to private R&D investment	Besides a SMEs tailored policy, the policy mix includes instruments for creating a positive circle of resource investments from market to public targets (guarantees and public participation in risk funds).	The state of realisation of the policy is still at an initial step.
Excellence of Research and Education system	The recent instrument is the Fund for the Merit, which in 2010 distributed 10% of the whole resources of University (in 2009 it represented 7%). This incentive is based for 2/3 on research and 1/3 on education results.	Given the decreasing of the Ordinary Fund the incentive distributed by the Fund for Merit doesn't work in an effective way, in fact even the best University on the whole in 2010 got less resources than in 2009. ANVUR research evaluation through VQR will support the FFO allocation, as well as other government incentives and premium for research.
Providing qualified human resources	No new specific instruments.	Career aspect and other context conditions don't make enough attractive the country.
Modifying industrial specialisation	Large Programs including collaboration among private and public actors and between large and medium-small companies, such as Industrial Innovation Projects of "Industria 2015". Other new instruments have been implemented recently (Contract of technology innovation and Agreement contract of strategic research)	PIIs have mobilised many (financial and human) resources, even if they suffered for a delay of funding during the crisis period. Their design looks like appropriate and innovative. At present only a monitoring activity on the state of their realisation has been developed, showing a partially positive result (not yet a fully realisation of established activities for 40% of the examined sample of projects). A coordinated policy devoted to sustaining the growth of high tech sectors and of a large sized companies group is essential to the Italian economy.

[5] Changes in the legislation and other initiatives not necessarily related with funding are also included.

Challenges	Policy measures/actions[5]	Assessment in terms of appropriateness, efficiency and effectiveness
Commercialisation and exploitation of research results	The new measures deal with supporting SMES in applying for patents and then getting funding for innovation projects exploiting their patents (Innovation package)	The new measures managed by MISE look appropriate and very well tailored for the challenge, but they are too recent for an assessment of their effectiveness.

4 National policy and the European perspective

The national policy mix is partially aligned with the European perspective: a large number of instruments regard the improvement of industrial research and innovation, with specific attention paid to policies for SMEs. A well-developed aspect concerns public-private R&D collaborations and infrastructures. Innovation is considered in a broad sense, including non-technical innovation (innovation in services, in the public sector, etc.).

Major weaknesses concern the public system of research and education. The labour market for researchers is still characterised by unattractive working conditions, low salaries, difficulties in obtaining permanent positions, and scarce relevance of merit. The supply for science and engineering is inadequate and, in some fields, the available training does not match market demand. Neither new nor relevant measures are present in the current policy mix. As to research institutions, Law 240/2010 included measures to modify the internal governance of the universities, to support the recruitment of young researchers in Universities based on quality, and to improve teaching and research activities. The implementation of the University reform should rationalise the costs and improve the quality of research and teaching performance, but cuts to resources might hinder the introduction of changes within the Italian universities.

The awareness of ERA issues is now consolidated in Italy, as testified by the importance attached in policy documents to the internationalisation of research, to the promotion of brilliant young researchers, to the pursuit of excellence of institutions and programmes, as well as to the mobility of people around Europe.

Besides political rhetoric, major barriers to the implementation of ERA objectives in Italy are represented by: traditionally low investments in R&D, the financial crisis, the insufficient openness of the R&D system, and the lack of adequate funding resources to support a reform process toward higher integration of labour market, research infrastructures, research institutions, and national programmes.

Since the economic crisis and the public debt crisis prevent the mobilisation of substantial resources, the Italian government addresses these constraints through policies mainly aimed at rationalising the system, promoting excellence of research organisations, and providing opportunities for young researchers based on their merit. The policies focus on reforming the public sector of research, namely Universities and PROs, on changing the rules for resources allocation (financial and human resources) in order to eliminate inefficiencies, on avoiding duplication of research efforts, and on concentrating resources on the most promising initiatives in terms of integration at the European level.

Moreover, both government core funding and project funding are expected to be driven by the search for excellence, using the results from the forthcoming VQR. Nevertheless the weaknesses of the monitoring system as well as the scarce coordination among different Ministries involved in R&D policies are factors that can still prevent the achievement of good results.

Table 4: Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA dimension	Main challenges at national level	Recent policy changes
1	**Labour Market for Researchers**	• The supply for science and engineering is not adequate and in some fields, the training do not match the market demand • Securing resource for project funding is discontinuous and the process for selecting beneficiaries too long • Overall low attractive working conditions for researchers, low salaries, difficulties to gain permanent positions, scarce relevance of merit; however the social security protection, including maternity leave is guaranteed	No relevant recent policy changes
2	**Cross-border cooperation**	• Capability of the research base to participate in EUFP programs is good as well as the participation in COST actions, ERANETs and joint programs. • Low mobility and openness of the researchers labour market, and lack of open programs	No relevant recent policy changes
3	**World class research infrastructures**	Development and implementation of the national Roadmap for RI is not yet completed	No relevant recent policy changes

	ERA dimension	Main challenges at national level	Recent policy changes
4	**Research institutions**	• The implementation of the University reform should rationalise the costs and improve the merit of research and teaching performance. • It is necessary to avoid that the excessive cut of resources become a strong constraint for introducing changes within universities • The new reform of the University is modifying the internal governance and the recruitment rules • The effects of the PROs reform are now starting. No dedicated resources are available for supporting the changes in the governance and the multiyear planning	• Law 240/2010 includes measures to modify the internal governance of the universities, to favour the recruitment of young researchers in Universities; to better teaching and research activities • ANVUR launched the VQR, which is supposed to support Universities showing good performance in terms of research and teaching performance impacting on the formula funding. ANVUR established the parameters for the evaluation of professors and researchers; set requirements for rationalize tertiary courses, I expected to determine special criteria for the setting up doctoral schools • The government decree reforming the PROs under the MIUR supervision produced the first effects through the approval of the PROs new Statutes (D.lgs 213/2009).
5	**Public-private partnerships**	• The existing separation between the transfer policy of public research institutions based on patents and the SMEs demand might inhibit the impact of public-private cooperation. • The absorptive capacity of SMEs should be further improved. • Dedicated policies for supporting spin off creation, and licensing of university patents, as well as incentives for public-private co-development of knowledge should be designed	PON- National Operative Program research and competitiveness 2007-2013, based on the Agreements of the Framework Programme (QSN) between Convergence Regions (formerly Ob.1 Regions) and the MIUR. The 2011-2013 PNR envisages concentrating resources on a small number of large interventions, where public and private actors could operate with shared objectives. Examples are the flagship projects. PNR is in line with European strategic objectives for Europe 2020.
6	**Knowledge circulation across Europe**	• Large interest of SMEs on the new measures: the demand for fiscal support has been higher than the resources availability. • Despite the proliferation of initiatives, the dialogue between research and industry is still not satisfactory	No relevant recent policy changes

	ERA dimension	Main challenges at national level	Recent policy changes
7	**International Cooperation**	2010-2012 PNR recognizes the need of strengthening international cooperation in science and technology in Europe	No relevant recent policy changes

Annex: Alignment of national policies with ERA pillars / objectives

1. Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers

1.1 Supply of human resources for research

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 the competitiveness of the national economy. Eurostat data show that in 2010, in the EU-27, the human resources employed in science and technology occupations were a share of 40.5% of labour force; this represented the 29.8% of total employment. Between 2007 and 2010 the increase in the relative importance of HRST within the EU-27 workforce was modest, as their share on total labour force and total employment rose by 0.98 percentage points in 2006 to 1.01 in 2008. Italy was one of the countries that in the same period registered a contraction in the growth in HRST (in relation to labour force), since the relative weight of people working in ST occupations was 34.6% in 2006 and 33.8% in 2010. This percentage, smaller than the European average (40.5% in 2010), is also far, in 2010, from other country such as Sweden (50.8%) or Germany (44.8%). The HRST 'core' – made up of people with a university level degree who also work in a science and technology occupation – amounted to 35.2 million persons in 2007 in EU-27 (i.e. 16.3% of the total number of persons employed). This indicator shows a more modest increase in Italy, going from 10% in 2004 to 12.1% in 2007, which is still far from the European average.

Mobility of PhD students during the doctorate is encouraged but it is not compulsory. Sometime University might not have enough resources for sustaining a period of students abroad. Also mobility of permanent staff is constrained by lack of specific investment for mobility at national level. CNR has short-term mobility instruments, with open call for senior and junior researchers, aimed at funding short stay in non-Italian European countries.

According to the recent EC study on mobility and career path (EC, 2010), in Italy the estimated share of International mobile HE researchers is 60% (56% EU-27), mainly concentrated in medical sciences and agriculture. The share of researchers that experienced at least once mobility to a new employer in another country in their research career is 32% (58% EU-27); the share of researcher that experienced at least one research visit to another country in their research career is 88% (78% EU-27). The estimated share of researchers that have worked in industry on a formal placement, internship, and apprenticeship or similar is 18% (28% EU-27), and the

share of those who have been employed as researchers in both the public and the private sector is 17% (EU-27 16%).

Intra-EU inflow of doctoral candidates is very low in Italy (1% among the total number of doctoral candidates); as to the intra-EU outflows the share in percentage among the total number of doctoral candidates is 10%. Thus, the intra-EU "net gain" has a negative sign (-12%). The areas of origin of the candidates confirm the low attractiveness of Italy: 95.7% are from Italy, 1.5% from EU-27, and 0.6% from other European countries. No data available on mobility of post-doctoral candidates. References to mobility to industry and post doc are not available. Other weaknesses of the PhD programmes are highlighted by the annual ex post assessment done by each university on the basis of the MIUR-CNVSU criteria; they are summarized in the annual Report of CNVSU. Among them, fragmentation of the courses, the differences between universities concerning the dedicated training activities and professors, the lack of resources available for PhD students (which inhibit, among others, the possibility of participating to international conferences and to have a period of stage or visiting abroad), and the absence of clear focus on the acquisition of academic or professional skills (which is proved by the scarcity of working experience in Italy or abroad of PhD students). Moreover, government funding covers only the 45.7% of the resources for PhD bursaries in 2009; other sources of funding are PROs and public bodies, while private organisations cover less than 10% (CNVSU, 2011). As to the working activities, 90% of the PhD holders (doctorate owned in 2006) are inside the labour market, but only a percentage of 38% has a permanent position.

The Government presented a new scheme for the reform of the Doctorate on September 2011, according to the reform of the University of December 2010; a consultation is now ongoing, involving the CUN (National Committee for the University), the CNSU (The Committee for the students representative) and the ADI (Association of the Italian Doctorate). All the mentioned bodies produced comments with criticism and requests of amendment to the scheme proposed.

1.2 Ensure that researchers across the EU benefit from open recruitment, adequate training, attractive career prospects and working conditions and barriers to cross-border mobility are removed

Italy has a low investment in R&D comparing with the EU-27 as to both the gross expenditure and the government expenditure. This weak investment goes with a very limited number of people entering the research lab our market. Italy has the lowest number of researchers for unit of GDP among industrialised countries and the lowest percentage of researchers on the active population. The low availability of research position in Italy affects more the private sector than the public one, given the low propensity of the business enterprise to hire graduates. Some data from national sources can help to describe the problems.

According to the survey made in 2009 by Almalaurea, a consortium including the Conference of the Dean of the Italian University, one year after graduation about 65% of the graduates entered the labour market, while 20% are unemployed.

The number of foreign researchers who choose Italy as a place to do research is still less than the number of Italian researchers who decides 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) The foreigners among doctoral students in the academic year 2008-2009 were 2,947 (MIUR, 2009). 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.

The University reform approved on December 2010 limits the maximum period of post-doc position and introduces a tenure track like path (6 years maximum contract and access to tenure after positive evaluation). A similar provision was introduced in the reform of the PROs: people hired with a temporary research contract (either post-doc positions, contracts or whatever) cannot stay in the same organisation for a period longer than 10 years.

Working conditions

Salaries: According to the EC Report on remuneration of researchers (EC, 2007) in Italy the average weighted total yearly salary adjusted of researchers is €36,201, rather lower than France (€50,879), Germany (€56,132) or United Kingdom (€56,048), and similar to Spain (€34,098). If we look at figures on net country yearly salary average of researchers in terms of PPS (Purchasing Power Standard), we find Italy at €22,372, and the distance with the values of France, Germany and UK. Considering the country total yearly salary average for researchers per level of experience, Italy is below the EU-25 average in all the level selected (0-4 years, 5-7, 8-10, 1-15, more than 15). The ranking of researchers remuneration averages in terms of PPS in Italy, comparing to the EU-25, show that the country has the lowest positioning for salaries of researchers with few years of experience (Italy ranks 25 for remuneration of researchers 0-4 years and 22 for 5-7 years of experience), while the ranking is higher (17) for researchers with more than 15 years of experience.

Remuneration of researchers is not so different between sectors of activity, although in all sectors it is lower than in France, Germany and UK. Researchers' remuneration can be considered as a proxy of the attractiveness of the country for other researchers, assuming that highest salaries are one factor benchmarking attractive research locations. Considering the total yearly remuneration average, Italy is a medium remuneration level country, while France, Germany, UK are high remuneration level countries. Thus, Italy appears an unattractive country due to the low salaries and the lack of dedicated facilities for incoming researchers.

Salary regulation at both national and institutional level does not encourage talented young individuals to pursue a research career. Incentives and premium for brilliant high performing researchers are lacking. An opportunity is given to Italian researchers who participated to the ERC selection with high quality and open to new opportunities proposals, which were selected but didn't get the grant. The FIRB has now opened its evaluative procedure to these kinds of projects. At national level, MIUR launched from 2009 a new funding instrument, FIRB Futuro in Ricerca (Future of research), dedicated to PhD holders, tenured and not tenured, aimed to fund on a competitive way three-years projects coordinated by early researchers or young researchers (respectively up to 32 years old and up to 38).

Charter for Researchers

All the most important research institutions in Italy accepted to commit themselves to introduce principles and measures of the Charter of researchers and the Code of conduct into their own regulations and statutes. This commitment was formalized

during a national congress organized in 2005 by the CRUI with the participation of the most important Italian public research organisations and foundations.[6] This act does not imply the obligation for the institutions to apply principles and rules, but it represents one step forward the implementation of the Charter and the Code. Roughly speaking, the institutions that have accepted to adopt the Charter and the Code represent the 47.5% of the total R&D expenditures in Italy (more or less the whole public sector of research).

The Government decree reforming the PROs (D.lgs 213/2009) explicitly recognised the principles of the Charter of the Researchers must inspire the revision of the internal Statutes, but no specific assessments or controls are in place about the effective implementation of the Chart.

Open recruitment

Permanent research positions in the public sector are completely regulated by law in the case of University professors and researchers. Researchers belonging to government labs are regulated in part by law and in part (economic conditions) by collective agreements. The law does not hinder the opening towards non-nationals, but there are not positive measures for encouraging it, although all the public research institutes must advertise their publicly-funded positions online on national websites.

Basically it is up to the research institutions (Universities and Pubic research organisations) to autonomously decide to set up measures aimed at encouraging the participation of non-nationals to competition for hiring researchers, but at this time the system appears basically close.

Universities and PROs can hire scientists working abroad from at least three years with specific fix-tem contracts, on the base of their own resources. The national law set a threshold for the number of contracts allowed. Law 1/2009 foresees the possibility to hire high-level scholars as permanent full professors. A specific proposal should be sent to the MIUR, which will authorize to hire the professors on the basis of the CUN advice. Moreover some Government project funding schemes (i.e. FIRB) foreseen the possibility to give a three-year contract to foreign eminent scholars, whose expenditures can be completely covered by the Government funding.

A clear system for the equivalence/validation of foreign academic degree is in place, with MIUR supplying all the relevant information and assistance in case of international applications or for research career purposes. A specific regulation has been approved in 2009 (DPR 189/2009) and it is operative from January 2010.

Research grant portability is still limited to another national institution, while it is not allowed to foreign institutions. Also transferability of social security and supplementary pension rights have not yet a dedicated website, although an information campaign have been launched in late 2009 (EU-SGHRM, 2009). Summing up, the Italian system does not provide explicit barriers to the open recruitment, but the whole system is characterized by a substantial endogamy and a recruitment practice for research, which largely privilege the local candidate instead of pursuing the merit and the openness. The last reform of the University system (l. 240/2010) is supposed to modify this tendency, intervening on the rules for the academic recruitment. Another source of change might be the ANVUR criteria for the

[6] see: http://www.fondazionecrui.it

assessment of the Universities: as far as the internationalisation is considered a key objective for enhancing the excellence of the universities, one can expect some impact on opening up of the recruitment of both stabilized and fixed-term researchers.

1.3 Improve young people's scientific education and increase interest in research careers

Policies and incentives affecting the supply of science, technology, engineering and mathematics (post) graduates are not relevant. Although the number of “vocations”, measured in terms of students enrolled decreased, in particular in hard sciences (mathematics, physics and chemistry) and engineering, from 2008 there are signs of recovery but they are mainly in absolute values and not in percentage with respect to the total number of enrolments.

In order to face the problem of students with insufficient notions of mathematics and science, from 2010, several actions have been undertaken with the aim of renewing the teaching of scientific disciplines in the schools and to involve students in experimental pilot projects. One 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 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

A strategy to encourage the return home of qualified Italian scientists working abroad is being pursued through specific measures (FIRB, FIRB Futuro in ricerca, Levi-Montalcini Programme), to favouring the recruitment in the public scientific sector of researchers living abroad; the effectiveness of these measures cannot precisely be evaluated yet.

The general career pattern of a young researcher in Italy considers the stay in foreign countries as an essential step of his/her training; universities encourage mobility during the graduation courses, and the Ph./post-doc period, but often do not have sufficient dedicated funds to support a stay abroad. Nevertheless a stay in foreign countries is not a requisite for obtaining a permanent research position in universities or public research agencies. As to the labour market of researchers, the flexibilisation is quite high: people get a tenured position generally at around at 35-40 years age. The precariousness of research workers is becoming a significant constraint for the permanence of brilliant researchers in Italy, due to the reduced capability of Universities and PROs to hire people. Since the private investment for R&D in Italy is very low in comparison with other large European countries, cutting the hiring possibilities of Universities and PROs has as a consequence on the one hand, the improvement of the number of researchers with non-tenured positions, on the other hand, a high outward mobility. Incentives have been recently introduced to encourage the recruitment of researchers by firms, but their effectiveness has not been assessed.

National policies to modify and adapt curricula to new (industrial) S&E needs, or to make a career in science, technology and engineering more attractive, or immigration policies geared to attract researchers/skilled S&E personnel are not implemented yet.

1.4 Promote equal treatment for women and men in research

Italy has a gender gap not really different form the other European countries. European Commission She figures 2009 show that in 2006 the proportion of female PhD (ISCED 6) graduates in Italy is 52% of the total (45% in EU-27); compound annual growth rates of PhD graduates in the period 2002-2006 is 29.2% for both female and male. The proportion of scientists and engineers in the total labour force in 2007 is 1.0 for women and 2.3 for men, and the percentage of female researchers in 2006 is 33%.

The gender gap in Italy is bettering also at the performance level. Female academic staff at grade A (the highest) of career position in 2007 was 19% (the same as in EU-27), but the percentage of grade 'A' staff among all academic staff is still low: 18% for women and 39% for men. Research funding success does not rate differences between women and men in 2007 in Italy were 5.1, but it is still under the EU level (6.4 in EU-27).

In many Universities and PROs a special Committee for the promotion of equal opportunities for women is in place aiming at promoting women's participation and career opportunities as well as to oppose any measures, which could create discrimination. The effectiveness of these Committees is more on the promotion of a cultural awareness than on impeding career's breaks.

2. *Facilitate cross-border cooperation, enhance merit-based competition and increase European coordination and integration of research funding*[7]

Cross-border cooperation at European level is important for the research performers, although Italy does not produce a dedicated policy for supporting joint programming and jointly funded activities.

At present Italy is involved in 144 ongoing initiatives within EU large programs in sectors such as agriculture and biotechnology (22 initiatives); Telecommunication and Information Science (22); Chemicals (14); Forestry (16) and Medical research (11). (Source: ERAWATCH Research Inventory Report For: ITALY, EC, 2010)

The MIUR, the Ministry of University and Research, plays the leading role in the management and the coordination of a number of instruments and amount of funds ensuring the financial support for Italian participation to initiatives as COST, EUREKA and European Framework Programmes. Other Ministries involved, with a limited participation as research funders, are the MISE, the MAP, and the Ministry of Health, this last mainly through the ISS ("Istituto Superiore di Sanità").

The participation in the EUREKA initiative is also relevant for Italy since its launch and has emerged as a meaningful instrument for funding international industrial research. Italy participates in 346 on the nearly 1,700 EUREKA projects launched from the beginning of the initiative. Italy's financial commitment in these projects amounts to 2,200 m €. 42.5% of projects with an Italian participation is concentrated

[7] Promote more critical mass and more strategic, focussed, efficient and effective European research via improved cooperation and coordination between public research funding authorities across Europe, including joint programming, jointly funded activities and common foresight.

- Ensure the development of research systems and programmes across the Union in a more simple and coherent manner.
- Promote increased European-wide competition and access of cross-border projects to national projects funding

on information technologies, 16% on robotics, 11.6% on the environmental disciplines. The breakdown of financial commitment by technological area shows an amount of 50% in information technologies, 16.3% in robotics and 14.7% in transportation (Source: ERAWATCH Research Inventory Report For: ITALY, EC, 2010).

Finally, Italy fully participates to EUFPs since their launch, through the MIUR, which also influence the priority-setting of the PNR. Italy also joins to important collaborative arrangements concerning infrastructural facilities, supporting the establishment and improvement, through financial contribution, of several research facilities of European and national interest.

At example, Italy participates to ESA –European Space Agency- activities with direct contributions from Italian government through the national space agency (ASI-Agenzia Spaziale Italiana). For the three years period 2009-2012 the percentage of Italy contribution to ESA for mandatory programmes represented the 12.7% over national incomes of the last three years and it was 15.41% for optional programmes (ESA annual report 2009).

Italy also contributes to several inter-governmental research infrastructures as the CERN (European Organisation for Nuclear Research), the IAEA (International Atomic Energy Agency) and EURATOM in the field of nuclear energy, EMBC (European Molecular Biology Conference), EMBL (European Molecular Biology Laboratory), the ICTP (the International Centre for theoretical Physics) and the IIAS (International Institute of Administrative Sciences).

The participation to several the international collaborative agreements can be also assessed. Italy participation to the EFDA, an agreement between European fusion research institutions and the European Commission to strengthen their coordination and collaboration, is ensured through the MIUR with the scientific and technical support of ENEA –National Agency for new Technologies, Energy and Sustainable Economic Development- and the CNR.

Italy's membership to the ESFR, to create the synchrotron in Grenoble, started in the eighties and it covers the 15% of the ESFR annual budget (for 2010 the whole budget for operating the ESRF is €98 million including funds dedicated to the Upgrade Programme, source http://www.esrf.eu/AboutUs/CompanyInfo).

Finally, thorough the Ministry of Health and the ISS (National Health Institute) Italy takes also part to several initiatives and infrastructures in the field of medical research as the European Clinical Research Infrastructures Network (ECRIN), a sustainable, not-for-profit infrastructure supporting multinational clinical research projects in Europe.

National research' programs open to foreign legal entities are not implemented.

3. Develop world-class research infrastructures (including e-infrastructures) and ensure access to them

The Italian strategy toward research infrastructures is traditionally a bottom up one. Participation is basically supported by the sectors more integrated at international level, and it is also strictly shaped by the European strategies. According to the European Strategy Forum on Research Infrastructures (ESFRI) recommendations, each country should assure about €5-6 million 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 are supposed to implement this measure accordingly.

Until nineties a special fund for infrastructures was set up at the MIUR level (about 50 billion lire per year, the equivalent of €25 thousands). Then, from 2000s, it is difficult to assess the national research investment for RI.

According to the 2010 ESFRI Interim Report, the process to formulate a new national Roadmap started, but it is not yet finished.

Italy has 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 organisations and private institutions.

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[8]) are all examples inter-governmental European infrastructure where the Italian participation play a relevant role.

The European Portal on research infrastructures' services listed 44 RI for Italy, of which 14 are classified in the scientific domain of humanities, 20 in environmental sciences, 6 in energy, 6 in life sciences, 8 in physics and astronomy, 5 in material sciences, chemistry and nanotechnology, 17 in engineering 5 in ICT and materials and no one in social sciences[9].

As to the national infrastructures, infrastructures in the engineering sciences (CIRA, ASI e Politecnico di Milano as to the aerospace, ENEA in the anti-seismic engineering, other firms and public research organisations such as OGS, CNR, CONISMA for marine sciences), and infrastructure for the high power parallel calculation (CINECA, CILEA) are the most important. The governance of national infrastructures is assured through agreements between the institutions in charge and MIUR.

As to the infrastructures for data transmission, GARR programs and the investment of many public institutions and inter-university Consortia allowed to have a very good Italian network for data transmission, which gave rise to poles of excellence in the ICT sector. Most of these infrastructures are still involved in European programmes (VI-VII EUFPs) in order to get resources aimed at implementing their opening at the international level within network of researchers.

4. Strengthen research institutions, including notably universities

There are 96 universities in Italy, of which 67 public institutions; all universities have the same mission and are involved both in education and research. Among public universities there are three polytechnics, three universities for foreign students, and 13 universities for distant learning (MIUR/CINECA, 2011). 40 public universities were

[8] ISIS is the pulsed Neutron and Muon source at the Rutherford Appleton Laboratory in Oxfordshire of the Science and Technology Facilities Council.

[9] The total number is more than 44 because each RI can be classified in more than one scientific domain.

funded prior to 1980. The number of private universities remains rather stable while the number of distant learning is growing.

General funding from the MIUR (FFO) is primarily used to pay salaries and other fixed costs. There is no a separate budget for education, but a general estimation is that 50% of financial and human resources (time) should be dedicated to teaching. FFO represents a ratio of more than 56% of the total HEIs income, while third party funding is a percentage of 25.1%, and students' fee 12.7% (CNVSU, 2011).

PROs play a very significant role in the research sphere. A government decree reforming the PROs under the MIUR supervision passed (D.lgs 213/2009), which foresee the setting of new internal Statutes, a reform of the governance, a multiyear planning of the activities for pursuing scientific excellence and integration with the private sector of research. All the PROs under the MIUR control have now modified their statutes, and internal regulations are under development in order to complete the reform process.

According to the METRIS Country Report on Italy[10] the total number of the Italian publications in the ISI-Thompson database grew from 32,547 in 2000 to 43,758 in 2006 (5.1% average annual growth rate). In 2006 Italy had the fourth largest scientific production among the EU-27 countries (10% of the total), behind UK (19.4%), Germany (18%), and France (12.4). The number of publications per thousand researchers is also quite interesting and confirms the good performance of Italy: according to 2006 data, Netherlands (527) is first, Switzerland (424) is second, Italy (319) is third among European countries and second among the EU-27, well above France (213), Germany (194) and Spain (179).

NSF statistics show the following situation for S&E articles in Italy and EU-27 from 2000 to 2007, confirming the positive trend.

Table 5: Science Budget 2010-2015

	EU-27	ITALY
2000	222,687	21,409
2007	245,851	26,554
2000-2007	+10.4%	+24%

Source: Eurostat

Although the mentioned figures cannot be attributed completely to the University and PROs performance, they can be considered a good indicator of the research performance of the public sector, which mainly contributes to the ISI publications.

Beside the good scientific performance, Universities in Italy face serious shortcoming in the technology transfer, and more generally, a low propensity toward patenting, licensing and producing spin offs (see par.5). The mentioned shortcoming, joint with the deficiencies of the PhD programmes, the scarce sectoral mobility of the researchers, and the low involvement of firms in PhD programmes, create barriers to translate scientific excellence into economic advantages. Overcoming these barriers would need dedicated policy instruments, first and foremost measures for supporting the spin off creation.

[10] http://www.metrisnet.eu/metris/index.cfm/report/findByCountry/44

In Italy universities have partial autonomy for deciding on structure and content of the degree programs, as well as for opening and closing down study programs. In both case they have to comply with “minimum requirements” or “quality requirements” settled by MIUR (by the way of ANVUR), which determine certain level of resources and study content of the curricula that the programs must assure.

Universities suffer also limitations in the power to recruit permanent academic staff (recruitment rules and authorisation for hiring new personnel), as well as to establish the salary levels. The total cost of the personnel cannot exceed the 90% of the FFO, that is the basic Government funding for Universities, and tuition fees cannot exceed the 20% of FFO. Law 1/2009 and Law 240/2010 (the University reform) modified few aspects of these rules in a more restrictive way. As to the possibility to use the resources available from the turn over, it was limited up to the 50% of the resources; as to the personnel cost, Universities that do not respect the 90% threshold in the year cannot hire new permanent personnel in the subsequent year.

The Government will is to reinforce excellence of Universities. The quoted recent laws 1/2009 and 240/2010 modified the rules for the recruitment of researchers and professors in order to overcome the actual privilege to local candidates and reinforce the quality of the selection; it also enlarged significantly the share of FFO that will be allocated on the basis of the evaluation of the research performance (up to 7%).

Modification of the University governance is another key element of the recent reform of Universities. MIUR want Universities and public research organisations become organisation driven by merit criteria in all their activities (teaching, research, services, training, etc). The reform oblige Universities to modify their internal Statute in order to comply with some general rules, namely a change in the composition of the Senate and of the Board, a limitation in the number of Departments, which become the meso-level of governance for teaching and research, the elimination of the Faculties, which become bodies for the coordination of the teaching courses, but must be limited in number and do not have any budget. Universities are now implementing the reform, changing statutes and internal governance accordingly.

Evaluation is a core element of the new reform process. Law 240/2010 foresees evaluation of University researchers and professors activities in order to obtain salaries improvements; D.lgs 213/2009 includes evaluation of the research institutions as driver of a significant part of funding allocation. Evaluation of public funding programmes is also mentioned as important item of the government programme. The ANVUR has been implemented and it is supposed to assure the support to the MIUR initiatives. A new seven year evaluation exercise (VQR) has been launched in 2011 by the MIUR in order to assess the research performance of Universities and PROs. VQR evaluates the research performance of Universities and PROs on the basis of a combination between peer review and bibliometric indicators on publications and patents submitted by the organisations. The outcome of VQR will impact on core funding allocation for a share of 10% of the FFO.

5. Facilitate partnerships and productive interactions between research institutions and the private sector

Italy doesn’t establish a financial support for the creation of technology transfer offices; Universities have received some financial aid from the State, such as the funding ex art 12, D.M. of MIUR (5/8/2004, n, 262) on the Programme for the university system 2004-2006. No recent initiatives have been approved.

The EIS indicators show a poor performance of Italy in the international comparison as to the indicators 'innovative SMEs collaborating with others' and 'public-private co-publications': values are half of the EU-27 average, exhibiting a persisting difficulty of the Italian SME system to activate efficient exchange processes for acquiring new technologies and developing new applications.

Other interesting information come from the last NETVAL Report. 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 116 in 2006, 138 in 2007 and 114 in 2008, 75 in 2009 (NETVAL, 2011). Beside the positive trend, at the end of 2009 there were in Italy only 873 spin offs, mainly localized in the North (24.3% in the North West and 26.3% in the North East) and Centre (26.9%), less in the South (22.5%). As to sectors, 32.8 % is in ICT; energy and environment (16.2%) and life sciences (15%) are the other relevant sectors, the latter in particular with relevant increase (NETVAL, 2011). Other spin-offs are involved in products and technologies such as electronics (9.3%), biomedicine (7.3%) and innovation services (7.4%) and, with a very narrow percentage, sectors as nanotechnologies (3.4%) and space (0.7%). Although the number of spin off is very low, firms created are robust: 90% of the existing firms were set up in the last ten years (NETVAL, 2011).

The 2011-2013 PNR foresees several interventions to encourage technology transfer, such as to implement the technology districts; to intensify cooperation and favour the creation of public-private partnerships to carry out large research and innovation projects (the industrial innovation projects of Industria 2015); the creation of clusters in order to reach critical mass, especially at regional level, taking advantage of the existing regional competences and 'excellences`'(high technology poles, canters of competence). No measurable outcome or results are available.

As to the knowledge interactions linked to the Human Resources mobility, the inter-sectoral mobility and the administrative framework regulating such mobility is not high, either because the absence of specific incentives for individuals, either because the administrative framework does not favour in practice such mobility (slow and complicated bureaucratic fulfilments).

The recent law of University reform obliged Universities to include the business sector in the Board as well as external members coming from the local government and other research organisations; the reform is under implementation.

6. Enhance knowledge circulation across Europe and beyond

Mobility schemes targeting researchers from third countries are often carried out by Academic Institutions on their own decisions. So far, impact studies have been develop to a very initial stage on joint studying programs which involve also mobility of students of EU and non EU countries, but are missing for researchers mobility. Nevertheless, an opening to Far East and in particular Chinese students and researchers can be observed. As an example Italy participates to the ASEM-DUO Fellowship Program, which supports visiting of professors and students in tertiary education field, aiming at contributing to setting up regular-basis exchange programs between European and Asian tertiary institutions.

The programme was proposed in 2001 and it involves at present almost all EU countries and several Asia countries (Brunei, Japan, Korea, Myanmar, etc). Italy also joins to the CEI University Network (CEI UniNet), operational since 2004. It is the specific Central European Initiative for higher education in order to enhance cooperation among universities and other institutions of higher learning in Central, Eastern and South Eastern Europe, through the mobility of students and teaching staff at post graduate level (http://www.ceinet.org/). No information on the Italian investment is available.

No policy measures aimed at enhancing open circulation of knowledge across national borders and open access to research outputs (publications and data) by researchers have be designed. CRUI has an active Working Group on Open Access, which is developing initiatives for enhancing Universities awareness and sustain to knowledge circulation, by the way of autonomous decided initiatives.

7. Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world

In Italy, trans-national collaboration in R&D activities are carried out using several bilateral and multilateral agreements, about 70 at present (November 2011), concerning different scientific sectors, have been established by the MIUR and the MAE with foreign scientific institutions, covering almost all European countries. Cooperation is carried out via the negotiation of Executive Programmes for Scientific and Technological Cooperation in the within of a intergovernmental Framework Agreement on Cultural, Educational, Scientific and Technological Cooperation (Elena Pérez S., De Dominicis L., Guy K., 2010). Recent Executive Programmes on Scientific and Technological Cooperation, which include both types of programmes, issued by the MIUR and the MAE with ERA countries are the following:

- Italy and Slovakia (for 2009-2011 and 2012) for the priority research areas of Energy, Life Sciences, New Technologies and Innovative Materials;
- Slovenia and Italy (for 2011-2013) for the priority research areas of Earth Sciences, Energy and Environment, Life Sciences and Medicine, Technology Applied to Cultural Heritage, Information Communication Technology, Basic Sciences;
- Sweden (for 2010-2013) for the priority research areas of Energy and Environment, Sustainable Cities, Space and Earth Observations, Nanotechnology and Material Science -Neutron and Synchrotron Radiation-, Technologies Applied to the Cultural Heritage-: Archaeological-Wood Conservation);
- Hungary (for 2008-2010 and 2011-2013), for the priority research areas of Basic Sciences (BS), Energy and Environment (EE), Life Sciences (LS), Nano Sciences and Advanced Materials (NSAM), Information and Communication Technology (ITC), Technologies for Cultural Heritage (TCH);

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List of Abbreviations

ACC	Alliance Against the Cancer Association
ACENET	ERA-NET for Applied Catalysis
ACR	Technical Secretary of Governance for the Coordination of Research Activity (Attività di Coordinamento della Ricerca Italiana)
AENEAS	Association for European Nanoelectronics Activities
AGNES	Successful Aging in a Networked Society
AIRTN	Air Transport Net
ANVUR	National Agency for the Evaluation of Research
ASEM-DUO	Asia-Europe Meeting Fellowship Programme
ASI	Italian Space Agency
BERD	Business Expenditures for Research and Development
BIODIVERSA	Cooperation and Shared Strategies for Biodiversity Research Programmes in Europe
BRIIC	Brazil, Russia, India, Indonesia and China
BS	Basic Sciences
CDP	Cassa Depositi e Prestiti
CEI	Central European Initiative
CERN	European Organisation for Nuclear Research
CHIST-ERA	European Coordinated Research on Long Term Challenges in Information and Communication Sciences and Technologies
CILEA	Lombard Inter-University Consortium for Automatic Computation

CINECA	Inter University Consortium for Computational Applications
CIPE	Inter-Ministerial Committee for Economic Planning
CIS3	Third community innovation survey
CIVR	Committee for Evaluation of Research
CLSF	Carbon Sequestration Leadership Forum
CNEL	National Council of the Economy And Labour
CNR	National Research Council
CNVSU	National Committee for the Evaluation of the University System
CONISMA	National Interuniversity Consortium For Marine Sciences
COSINE 2	Coordinating Strategies for Embedded Systems in the European Research Area Follow-Up Project
COST	European Cooperation In Science And Technology
CRUI	Conference Of Italian University Rectors
CTS	Techno-Scientific Commission
CUN	National University Council
DDL	Law Proposal (Disegno di Legge)
D.lgs	Legislative Decree (Decreto Legislativo)
D.M	Ministry Decree (Decreto Ministeriale)
DESY	Deutsches Elektronen-Synchrotron
DG-RTD	Directorate-General for Research And Innovation
DPEF	Document of Economic and Financial Policy
DPS	Dipartimento per lo Sviluppo e la Coesione economica
EC	European Commission
ECRIN	European Clinical Research Infrastructures Network
EDCTP	European & Developing Countries Clinical Trials Partnership
EE	Energy and Environment
EFDA	European Fusion Development Agreement
EIS	European Innovation Scoreboard
EMBC	European Molecular Biology Conference
EMBL	European Molecular Biology Laboratory
EMRP	European Metrology Research Programme
ENEA	National Agency for New Technologies, Energy and Environment
ENIAC	Electronic Numerical Integrator and Computer Joint Undertaking
EPO	European Patent Office
ERA	European Research Area
ERA-NET	European Research Area Network

ERA-PG	ERA-NET on Plant Genomics
ERC	European Research Council
ERC-IDEAS	European Research Council Programme for Investigator Driven Research
ERDF	European Regional Development Fund
ERP Fund	European Recovery Programme Fund
ESA	European Space Agency
ESF	European Social Fund
ESFRI	European Strategy Forum On Research Infrastructures
EU	European Union
EU-27	European Union Including 27 Member States
EUFP	European Union Framework Programme
EURATOM	European Atomic Energy Community
EUROPOLAR	The European Polar Consortium: Strategic Coordination and Networking of European Polar RTD Programmes
EU-SGHRM	European Steering Group on Human Resources and Mobility
FAR	Fund for Applied Research
FAS	Fund for the Underdeveloped Areas
FDI	Foreign Direct Investments
FERMILAB	Fermi National Accelerator Laboratory
FFO	Ordinary Fund for Higher Education
FIRB	Basic Research Investment Fund
FIRST	Scientific and Technological Research Investments Fund
FP	European Framework Programme for Research and Technology Development
FP7	7th Framework Programme
FTE	Full-time equivalent
GARR	Italian Research & Education Network (Gestione Ampliamento Rete Ricerca Consortium)
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
GUF	General University Funds
H@H	Health@Home
HE	Higher Education
HEI	Higher Education Institutions

HERD	Higher Education Expenditure on R&D
HES	Higher Education Sector
HHS	Human Health Services
HOPE	Heritage of The People's Europe
HRST	Human Resources In Science And Technology
HY-CO	Hydrogen And Fuel Cells ERA-NET
IAEA	International Atomic Energy Agency
ICE	Institute for Foreign Trade
ICF-OMS	International Classification of Functioning Health and Disease – Mondial Organisation of Health
ICT	Information and Communication Technologies
ICTP	International Centre for Theoretical Physics
IIAS	International Institute of Administrative Sciences
ILL	Institut Laue-Langevin
INFN	National Institute for Nuclear Physics
IP	Intellectual Property
IPI	Institute for Industrial Promotion
IPR	Intellectual Property Right
ISCED	International Standard Classification of Education
ISS	Istituto Superiore di Sanità –National Health Institute
ITC	Information and Communication Technology
IUC	Innovation Union Competitiveness
IUS	Innovation Union Scoreboard
JRC-IPTS	Joint Research Centre - Institute for Prospective Technological Studies
KT	Knowledge Transfer
LS	Life Sciences
MAE	Ministry of Foreign Affairs
MAP	Ministry of Industry, Trade and Handicrafts
MATERA	Era-Net Materials
MISE	Ministry of Economic Development
MIUR	Ministry of Education, University and Research
NRP	National Reform Programme
NET HERITAGE	European Network On Research Programme Applied to the Protection of Tangible Cultural Heritage
NETVAL	Network For The Valorisation of University Research

NResP	Number of Responses
NSAM	Nano Sciences Advanced Materials
OB1	Objective Area of The Structural Funds
OECD	Organisation for Economic Co-Operation and Development
OGS	National Institute of Oceanography and Experimental Geophysics
PNR	National Research Programme
PNRA	National Programme Of Research in Antartide
PONs	National Operational Programs
PORs	Regional Operational Programs
PRIN	National Interest Research Programs
PROs	Public Research Organisations
PUS	Public Understanding of Science
QA	Quality Assurance
QSN	National Strategic Reference Framework
R&D	Research and Development
REMOTE	Remote Health and Social Care for Independent Living of Isolated Elderly with Chronic Conditions
RI	Research Infrastructures
ROSETTA	Guidance and Awareness Services for Independent Living
RTDI	Research Technological Development and Innovation
S&T	Science And Technology
SCI	Science Citation Index
SF	Structural Funds
SME	Small And Medium Sized Enterprise
STC	Science, Technology and Competitiveness
STI	Science, Technology and Industry
SVIMEZ	Association for the development of industry in the South of Italy
TCH	Technologies for Cultural Heritage
TD	Technological Districts
TT	Technology Transfer
TTOs	Technological Transfer Offices
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USA	United States of America
UVAL	Unità di valutazione degli investimenti pubblici
VC	Venture Capital

VI EUFP	Sixth European Framework Programme
VII EUFP	Seventh European Framework Programme
VQR	Five-Year Research Evaluation Exercise
VTR	Three Years Evaluation Exercise

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Abstract

The main objective of the ERAWATCH Annual Country Reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. EW Country Reports 2011 identify the structural challenges faced by national innovation systems. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. The annex of the reports gives an overview of the latest national policy efforts towards the enhancement of European Research Area and further assess their efficiency to achieve the targets.

These reports were originally produced in November - December 2011, focusing on policy developments over the previous twelve months. The reports were produced by the ERAWATCH Network under contract to JRC-IPTS. The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from ERAWATCH Network Asbl.

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