



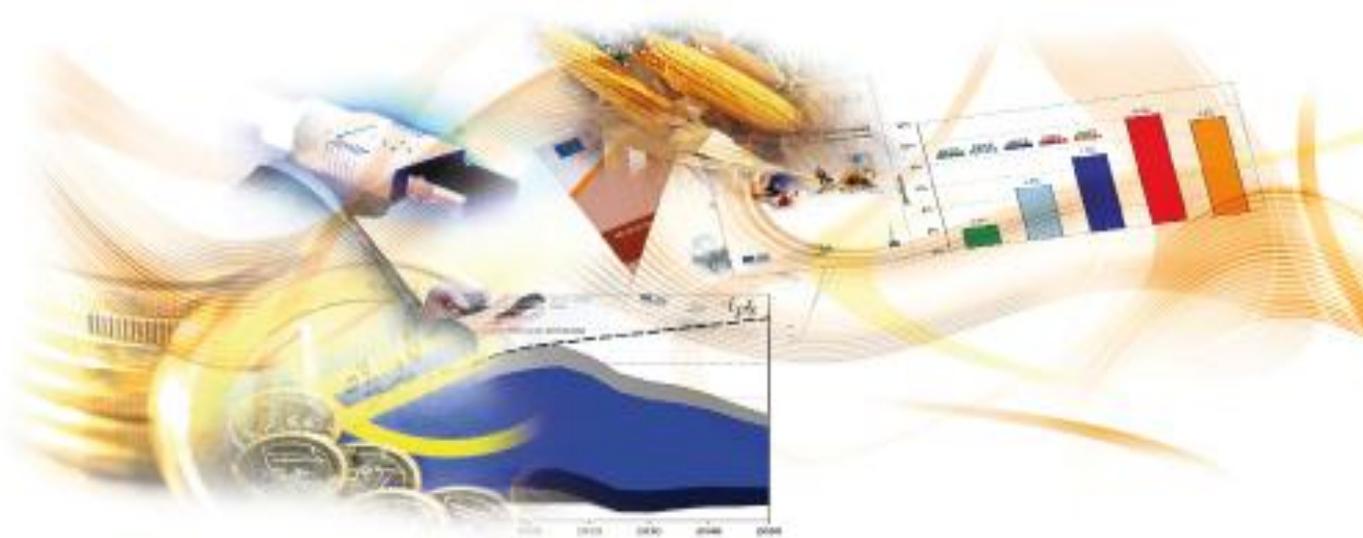
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# ERAWATCH COUNTRY REPORTS 2012: ITALY

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The Country Report 2012 builds on and updates the 2011 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges, highlighting the latest developments, their dynamics and impact in the overall national context.

The first draft of this report was produced in December 2012 and was focused on developments taking place in the previous twelve months. In particular, it has benefitted from the comments and suggestions of Andrea Conte from JRC-IPTS. The contributions and comments from DG-RTD are also gratefully acknowledged.

The report is currently only published in electronic format and is available on the [ERAWATCH website](#). Comments on this report are welcome and should be addressed to [jrc-ipts-erawatch-helpdesk@ec.europa.eu](mailto:jrc-ipts-erawatch-helpdesk@ec.europa.eu).

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## EXECUTIVE SUMMARY

The Monti government introduced innovations, relevant to the R&I system concentrated on a mixture of budget cuts and the streamlining of the main research funds.

The overall framework included a preference towards a model still focused on direct grants and loans, but with some innovation for indirect financing that is becoming increasingly important and for the introduction of demand-driven innovation in the main research areas. The decline of ordinary non-competitive funds, an higher degree of integration into the European R&D, and a simplification of the main research funds are the keywords. The establishment of the Agency for the Digital Agenda ADA, is a new element within the R&D system, since ADA will manage funds for large R&D projects based on ICT development and will manage the policy for the digitalization of the country.

As in the recent past, in Italy, during 2009-2011, the main trend in R&D funding was the shift of flows from the public to the business sector, with a small increase in total R&D expenditure.

Despite the target of achieving a ratio of R&D expenditure to GDP equal to 1.53 % by 2020, total R&D expenditure as share of GDP in Italy is roughly stable, from 1.26% in 2009 to 1.25% in 2011. In 2010 the funding of GERD in Italy came predominantly from the business sector (44.7% of the total) and government (41.6%), followed by the funding from abroad (9.8%), private non- profit institutions (3.1%) and Higher Education Institutions (0.9%).

Regions are involved in initiatives for developing the research sector with the target of promoting innovative business and to capture private-sector investment in research in their territory. Some regions, as Emilia Romagna and Puglia, experimented smart specialization methods in the previous years and now are deeply involved in the development of smart specialization processes. The Lazio Region has already adopted a smart specialization strategy for selecting the proper sectors for regional development.

The joint action of DPS policy and initiatives such as The Smart Cities, launched in 2012, are the main driver in attracting all regions towards smart innovation.

The four main structural challenges faced by the Italian system of R&I can be summarized as follows:

- Insufficient resources and performance of the Higher Education system.
- Low share of skilled human capital.
- Low R&D intensity specialization in the business sector
- Size distribution within the industrial population.

The Higher Education system in Italy is weak in terms of financial and human resources, and the pressure on the finances of the government is an ever-increasing barrier for any future improvement. Input indicators for R&D are deeply negative despite output indicators record some positive trend.

According to Eurostat, in Italy public expenditure on R&D as percentage of GDP, GBAORD, was 0.56% in 2011, below the EU level of 0.73%. In 2012 the estimated level of GBAORD continued to decline, reaching a GDP ratio of only 0.53%.

Human resources confirm the same weakness: the researcher (FTE) share per thousand labour force in 2010 was only 4.2, but in Europe the average value was 6.5; however, the number of new doctoral graduates per thousand population aged 25-34 demonstrate strong performance by

the Italian universities in the 'production' of new doctorates since the value, 1.6, is equal to the EU27 average. Eurostat figures for 2011 confirm the issue of unskilled human capital: in Italy the share of persons aged 30-34 with tertiary education attainment reached only 20.3%, significantly below the EU27 average, 34.6%.

Eurostat data also stress the lack of high-tech sectors in Italy: the number of employees in high-tech sectors (high-technology manufacturing and knowledge-intensive high-technology services) as percentage of total employment is only 3.3%, below then EU average (3.8%).

The Italian industrial structure is comprised principally of the microenterprise sector, which represents a large majority of the total number of firms.

The small size of the vast majority of Italian firms and a business specialization based on low R&D intensity in the 'Made in Italy' sectors (such as footwear, textiles and clothing) are hampering the increase in the overall R&D expenditure. The key challenge is to support a shift towards high-tech sectors through the growth of innovative industrial sectors and new high-tech firms, even if the impacts of effective policies will only be felt after the medium to long term.

The current policy mix mainly increases the support for new R&D-oriented firms, large collaborative programmes, and more recently encourages demand driven innovation. The reform of firms incentives is a sign of a move towards indirect incentives and of a focus on SMEs.

The policy mix is mainly aimed towards the business sector and in some way relegates the key issues related to Universities and Public Research Center.

The policy mix includes instruments that might mitigate the country's weaknesses, but also has some limitations that can be summarised as:

- the limited relevance of the adoption of indirect incentives
- the decline of resources for public research institutions and Universities;
- the low and uncertain funding of some measures.

ERA issues are widespread in the system, as indicated by official policy documents on the internationalisation of research, and the same policies together contribute to towards ERA objectives, such as the support for young researchers and the pursuit of excellence in institutions and programmes, as well as increasing mobility around Europe.

The major barriers to the implementation of ERA objectives in Italy are represented by the low investments in R&D and by the effects of the financial crisis.

The achievement of the target set by Europe 2020 on R&D expenditure and economic growth, will be the benchmark for evaluating the actual effectiveness of current policies.

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# 1 INTRODUCTION

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Italy is a country with a large population (60.8 million in 2012) accounting for 12.1% of the EU27 population<sup>1</sup>. The economic crisis reduced the GDP to 5.5% in 2009 and the signs of growth of the GDP during 2010 (+1.7%) declined towards stagnation in 2011 (+0.4%) and to recession in 2012 (-2.4%), a figure that was greater than the EU27 average (-0.3% in 2012) mainly due to the financial crisis related to the public debt. Official data<sup>2</sup> predicts recovery only in 2014 (+0.8%), after a 2013 marked by continue decline in GDP (-1%). The effects of the economic crisis undermined the living conditions of the population.

In 2008 the Italian GDP pro capita in Purchasing Power Standard, (PPS), was 26,100 higher than the EU27 average of 25,000 PPS, but in 2011 the Italian GDP pro capita had fallen to 25,000 PPS the same as the EU27 average<sup>3</sup>. According to the government estimates<sup>4</sup> the unemployment rate in Italy rose from 8.4% in 2010 to 10.8% in 2012 with a predicted peak during 2013 (11.4%). Italy recorded a small increase of 0.7% in the total expenditure on R&D (GERD) which rose from €19,625m in 2010 to €19,756m in 2011<sup>5</sup>. In the same period EU27 recorded a higher average increase of GERD of 4.1%.

In 2011 Italy was still recording a GERD pro capita, €325.9, which was lower than the EU27 average, €510.5, mainly due to the poor performance of the business enterprise sector, €176.5, in comparison to the EU27 average €318.3. In 2011 government (GOVERD) and higher education expenditure on R&D (HERD) as a percentage of GERD were higher than the EU27 average (13.7% in Italy and 12.7% in EU27 for GOVERD; 28.6% in Italy and 24% for HERD). The R&D intensity, GERD as a percentage of GDP fell from 1.26% in 2010 to 1.25% in 2011, and thus fell below the EU27 2011 average (2.03%). During the same period (2010-2011) in Italy the business enterprise R&D expenditure (BERD) rose from €10,579m to €10,700m, representing an increase of 1.1%, lower than the EU27 estimated increase (4.9%). In 2010 the funding of GERD in Italy came predominantly from the business sector (44.7% of the total<sup>6</sup>) and from government expenditure (41.6%), followed by the funding from abroad (9.8%), from private non profit institutions (3.1%) and from Higher Education Institutions (HEIs) (0.9%).

From 2009, the business sector and foreign investment increased their shares of R&D funding but the government R&D funding recorded a decrease. In the same period the share of R&D funding from private non profit and the HEI sector was stable. In the EU27 the composition of R&D funding is more based on the business sector (53.9%) and on the government (34.6%) each of which recorded a small decrease from 2009 (54.1% and 34.8% respectively), followed by funding from abroad (8.9%), which increased from 2009 (8.5%), and private non profit (1.6%) and HEIs (0.9%) which were stable compared to 2009.

With regards to input, in Italy the main large international research infrastructures, a strength within the Italian system, are 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-INFN, INSTM consortium and Sincrotrone Trieste: Laboratorio Elettra).

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<sup>1</sup> Eurostat (2013a) (New Cronos database);

<sup>2</sup> Eurostat (2013b) (New Cronos database);

<sup>3</sup> Eurostat (2013c) (New Cronos database);

<sup>4</sup> MEF (2012a);

<sup>5</sup> Eurostat (2013d) (New Cronos database);

<sup>6</sup> Eurostat (2013e) (New Cronos database);

The weakness is mainly within investments in human resources in science and technology (ST) that are still lower than the EU27 average. In 2011 in Italy human resources in Science and Technology as proportion of the labour force were 32.9% in Italy vs. an EU27 average of 40.1%<sup>7</sup>. Also the percentage of population aged 30-34 having completed tertiary education in 2011 was lower than the EU27 average: 20.3% in Italy vs. 34.6% in EU27<sup>8</sup>.

The Italian university system shows a better performance than the EU27 average with regards to output: publications in international journals (465.8 per million of population in Italy and 301.1 per million as EU27 average in 2010<sup>9</sup>) and number of citations and papers (Science Watch ranks Italy as 8<sup>th</sup> country both for papers and citations in the period 2001-2011<sup>10</sup>), but it suffers from a lower flow of financial and human resources. In 2011 the R&D expenditure of HEIs (HERD) decreased to €5,642m from €5,812m in 2009 and in 2009 – 2010 R&D personnel in HEIs decreased by 3.5%<sup>11</sup>.

In 2010 Italy produced 8.1% of the total European Patent Office (EPO) patent applications in EU27. Eurostat data shows that, with a ratio of 76 and 74 EPO patent applications per million inhabitants in 2009 and 2010 Italy lay below the EU27 average of 111 and 109<sup>12</sup>. In 2011<sup>13</sup>, more than the half of BERD in Italy was concentrated on the manufacture of machinery, computer, motor vehicles and transport equipment and information and communication services. Nearly 70% of BERD came from firms with 500 employees or more in 2010.

Italy is still non-specialised in high-tech sectors and suffers the low R&D intensity of some typical ‘Made in Italy’ industries, such as textiles and the low share of large firms, since the business specialisation is concentrated mainly in small and medium enterprises (SME).

### **National research and innovation system structure and governance**

The Parliament and the Council of Ministries are at the top of the research and innovation policy governance structure. The ministry for education, research and universities (MIUR) coordinates national and international scientific activities, supervises the academic system, provides funding to universities and research agencies, and establishes the means for supporting public and private research and technological development. MIUR coordinates the preparation of the three-year National Research Programme (PNR), the main government document for R&D planning, which sets the strategies for the national system by communicating with all other interested stakeholders, including other Ministries and Regions.

The coordination of Science and Technology policy falls under the remit of the Ministry Committee for the Economic Planning (CIPE) especially for medium to long term actions. The CIPE also reviews the so-called Economic and Financial Document (DEF) and releases the three-year PNR under proposal of MIUR. DEF includes also the National Programme of Reform (PNR), relevant for the monitoring of the impact on the political agenda on the R&I system. MISE (previously Ministry for Production Activities) manages industrial innovation. The Department for Competitiveness within MISE 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.

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<sup>7</sup> Eurostat (2013f) (New Cronos database);

<sup>8</sup> Eurostat (2013g) (New Cronos database);

<sup>9</sup> UNU MERIT (2012);

<sup>10</sup> The Science Watch ranking is available at <http://archive.sciencewatch.com/dr/cou/2011/11decALL/>;

<sup>11</sup> ISTAT (2012a);

<sup>12</sup> Eurostat (2013h) (New Cronos database);

<sup>13</sup> ISTAT (2012a);

The Department of development and social cohesion (DPS) within MISE is in charge of the planning, coordination and management and the structural funds and it has outlined in the multiannual programme Quadro Strategico Nazionale 2007-2013 (QSN) specific actions for research and innovation. Other Ministries (Health, Agriculture, Defence, etc) manage research funding in their specific fields. The National Agency for the Evaluation of Universities and Research Institutes (ANVUR), is in charge for assessing quality of education and research. The National Innovation Agency (NIA), is a publically funded research organization that promotes innovation. The Agency for the Digital Agenda (ADA), established in 2012, is in charge of the management and monitoring of the Italian Digital Agenda (IDA) ensuring the alignment with the European Digital Agenda. ADA will also manage large strategic R&D projects within the framework of the Italian Digital Agenda.

The research and innovation policy governance structure is based within central government though Regions, under the framework of the concurrency principle, can develop local initiatives. Nonetheless regions also contributed to the design of the more recent policy documents on R&D and are involved in many R&D initiatives.

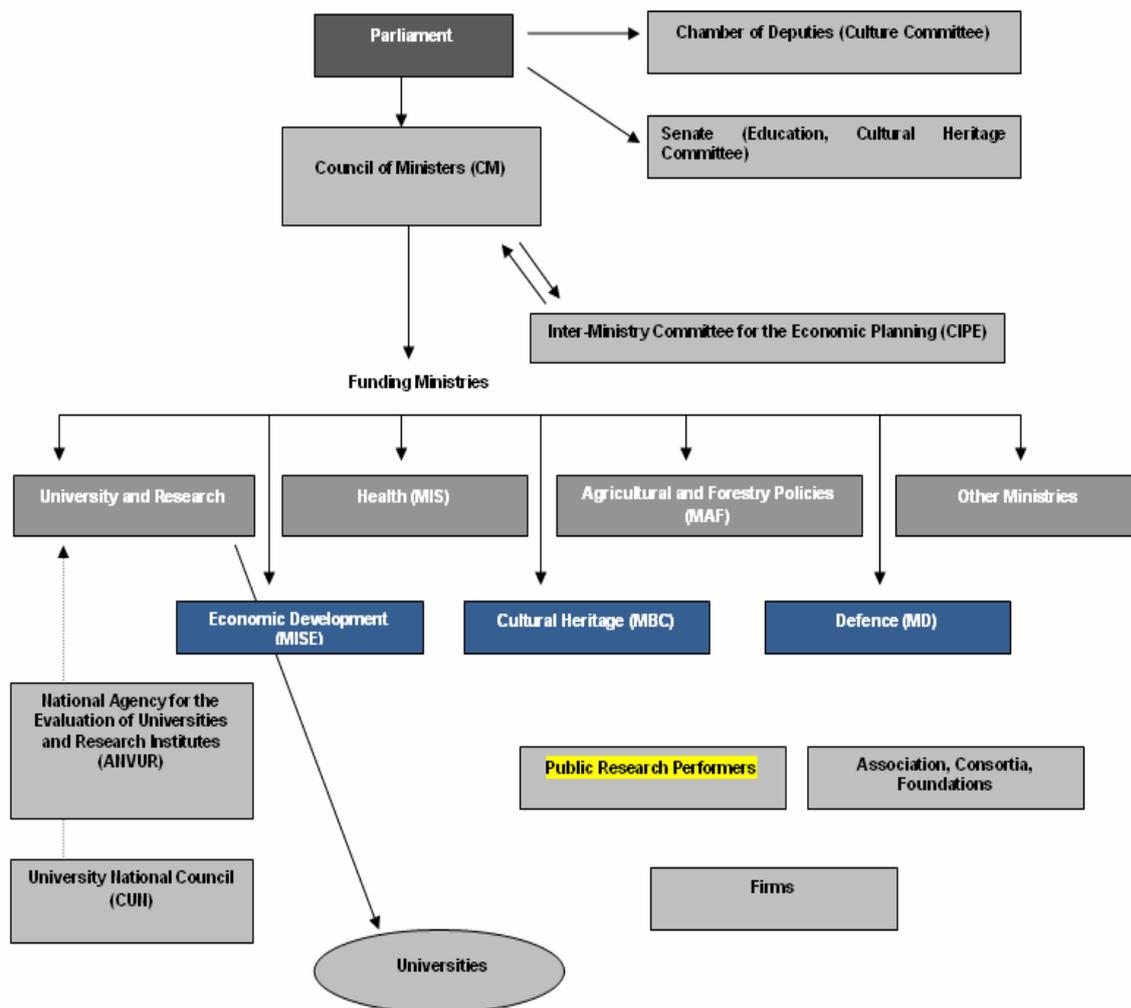
### **Research performers**

The public research sector focussed around the work undertaken by Universities and Public research organisations. Universities, which are mainly public institutions continued to expand and have become widespread across the nation. In 2013<sup>14</sup>, in the MIUR register, there are active 96 universities, of which 67 are public institutions and 11 are telematic based. The Council of National Research (CNR), involved in interdisciplinary activities, is the largest public research organisation under the supervision of the MIUR. In the private sector FIAT group (automotive) and FINMECCANICA (areospace and military) group are the most relevant player for R&D.

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<sup>14</sup> The full list can be downloaded from the MIUR portal <http://cercauniversita.cineca.it/>;

**Table 1: The structure of the Italian R&D system**



## 2 Recent developments of the research and innovation policy and system

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### 2.1 National economic and political context

During the second semester of 2011 Italy was caught in the financial storm due to the worsening of the sovereign debt crisis in Europe.

Due to the further weakening of economic conditions the new emergency ‘technical’ Monti government, in charge from November 2011 started its tenure aiming mainly to achieve financial stabilisation of the country public debt. The legislative financial acts in 2011 concentrated on a mix of budget cuts and tax increases. According to the Economic and Financial Document 2012, (DEF2012)<sup>15</sup>, the impact of the three stabilisation laws of 2011 was strongly recessive on GDP and resulted in cuts to regional and central public budgets. During 2012 the government concentrated its policy on public expenses reforms and on actions for promoting growth, including measures regarding R&D funding and the streamlining of the main research funds. The overall strategy of the government aimed for closer European integration of the Italian system promotion of growth only after financial stabilisation.

In 2012 the country suffered a deep recession (-2.4% of GDP), with rising unemployment rates. Also the outlook for 2013 is negative (-1% of GDP), and the higher fiscal pressure and the weakness of the domestic market worsens the economic outlook.

At the end of 2012, after the approval of the financial law, the Monti government resigned. At the end of February 2013 the political elections failed to produce a coalition with a clear majority with the risk of political paralysis and a return to the polls in 2013.

### 2.2 Funding trends

In Italy the total R&D volume expenditure (GERD) has recorded a marginal increase. In terms of R&D funding, the composition mix of sources demonstrated a higher contribution from the business sector compared to a smaller contribution from the public sector, converging towards the EU27 funding mix. It also demonstrated an increase of R&D intensity, though lower than the EU27 average.

In 2010-2011, in Italy GERD increased only by 0.7%<sup>16</sup>, while in the EU27 average recorded an increase in GERD of 4.1%. In 2009-2011 BERD increased by 4.5% in Italy (€10,238.1m in 2009 and €10,699.6m in 2011) but in the same period the EU27 recorded a higher BERD increase (9.3%).

The effect of the crisis on the GDP of the EU27 countries was compensated for by the growth of BERD as indicated by a roughly stable BERD as % GDP during 2009-2011 both in Italy and EU27.

Despite government target to achieve a ratio of R&D expenditure to GDP equal of 1.53 % by 2020, the indicator is roughly stable: 1.26% in 2009 to 1.25% in 2011. The Italian R&D target

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<sup>15</sup> The forecasted impact on GDP of the 2011 financial laws is estimated between -2.6% to -2.1% according to the econometric model. (MEF 2012c pp 66-67);

<sup>16</sup> Eurostat (2013d) (New Cronos database);

takes into account stringent public finance constraints caused by the financial crisis, and it is based on policies aimed to develop a greater involvement of private business in R&D.

In the period 2009-2011 the gap in R&D intensity, between Italy and the EU27, as indicated by the total GERD per inhabitant, is widened: in 2009 the GERD per inhabitant in the EU27 (€474.2) was 48,2% higher than Italy (€319.9), in 2011 the EU27 recorded a GERD per inhabitant of €510.5 which is 56.6% higher than Italy (€325.9)<sup>17</sup>. In 2010 the funding of GERD in Italy came mainly from the business sector (44.7% of the total) and government expenditure (41.6%), followed by the funding from abroad (9.8%), private non profit institutions (3.1%) and HEIs (0.9%)<sup>18</sup>.

In EU27 a larger proportion of the R&D funding came from the business sector (53.9%) and government (34.6%). The business sector as a funding source recorded a small decrease from 2009 (54.1%) while public sector funding also decreased (34.8%) and sources from abroad increased their shares (8.9% in 2010 and 8.5% in 2009 respectively) whilst private non profit (1.6%) and HEIs (0.9%) were stable.

In Italy nearly half of total expenditure in R&D is focused on applied research (48.6% in 2010), followed by basic research (25.7%) and experimental design (25.7%)<sup>19</sup>. From 2009 basic research decreased mainly due to the smaller contribution from firms and universities. The government R&D Appropriation, (GBAORD), in Italy is following a negative trend.

From €9,778.4m in 2009, GBAORD fell to €8,890m in 2011, with a further estimated decrease in 2012 (€8,469.7m). From 2009 to 2012 in Italy GBAORD fell by 13.4%. During 2009-2012 also the indicator of GBAORD as % of GDP recorded a significant decrease: from 0.64% in 2009 to 0.53% in 2012<sup>20</sup>.

In the period 2009-2011 in EU27 GBAORD recorded a small increase (1.43%) growing from €90,881.2m in 2009 to €92,308.3m in 2011, and reaching an average percentage of GDP of 0.73%.

The 'General advancement of knowledge': R&D financed from General University Funds is the first GBAORD target (36.1% in 2012) followed by 'Industrial production and technology' (12.5% in 2012) and 'Health' (10.2% in 2012). From 2009 the main changes were focused in the reduction of General advancement of knowledge not included in General University Funds and the increase in energy and environment as socioeconomic objectives.

Despite the fact that the overall system is moving towards a pattern based on integration with EU research policy and integration of research and innovation with economic policies, the main current public funding mechanisms have changed significantly from previous years.

The major changes are the streamlining of public R&D competitive funding, the reform to firms incentives, the earmarking of resources for young researchers, the introduction of demand driven innovation and the re-introduction of tax credit on R&D

- Public research and academic institutions have been financed mainly through competitive funding rather than through institutional funding. The stabilization laws of the government in 2011 and 2012 resulted in the general reduction of institutional budgets.

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<sup>17</sup> Eurostat (2013d) (New Cronos database);

<sup>18</sup> Eurostat (2013e) (New Cronos database);

<sup>19</sup> ISTAT (2012a) (New Cronos database);

<sup>20</sup> Eurostat (2013i) (New Cronos database);

In 2011 resources for the main competitive funding streams PRIN decreased from €100m in 2009 to €87.5m in 2010 and 2011 and €38.2m in 2012 (the resources for FIRB in the last call are €29.5)<sup>21</sup>.

- Subsidies are still more relevant than indirect funding, despite indirect funding is acquiring more relevance through the provision of new tax credit incentives and financial warranties. The recent reform to firms incentives changed the approach of state funding for technological innovation towards thematic areas (linked to EU programmes), indirect incentives (the mixture of direct/indirect was targeted towards indirect tools), and simplification.
- Collaborative funding is increasingly relevant especially within large R&D projects, such as the PIIs of 'Industria 2015' or the Technological Innovation Contracts of the FIT.
- The R&I system is increasingly concerned with networking actions, with a greater prevalence of public - private partnerships in R&D projects, which will continue over the next few years. An assessment of their overall effectiveness to leverage additional funding is not yet available.
- The policy of funding concentrates mainly on thematic\targeted projects. The thematic approach is the preferred solution both for large negotiated R&D programmes, such as Industrial Innovation projects (PIIs), and for large projects funded by public research institutions and universities (FIRB). Funds are thus targeted towards the same themes of EU programmes such as Horizon 2020 or European Digital Agenda.
- In recent years regional policies have acquired relevance. The national operational programme PON 'Research and Competitiveness' has been financed with €4,424.3m for 2007-2013<sup>22</sup>. The integration of research and innovation as a pillar of PON Piani Operativi Nazionali and the joint management by MIUR and MISE of the PONREC shows an increase in R&I intervention in local development and social cohesion policies.
- Transnational funding is an increasingly important source and public research institutions and universities are heavily involved in the main international research programmes. The amount of GERD funded from abroad is increasing: in 2010 it was 9.8% of total GERD (9.4% in 2009) and it came mainly from the business sector (72.2% of R&D funding in 2010). Framework Programmes (FP) are becoming a relevant channel for transnational funding of research in Italy. The participation to FP7 calls is widespread even though the success rate of Italian proposals is low (19.9% of proposals), it is the fourth highest financed country, after UK, FR and DE in the FP7. In FP7 Italian Businesses recorded high success (9 firms included in the top 50 as recipients of signed grants in 2007-2011)<sup>23</sup>. Within FP7 Italian collaborative links were mainly with Germany, France and United Kingdom.

## Table 2: Basic indicators of R&D investments in Italy

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<sup>21</sup> The Prin 2012call can be downloaded from [http://prin.miur.it/documenti/2012/BANDO\\_PRIN\\_2012.pdf](http://prin.miur.it/documenti/2012/BANDO_PRIN_2012.pdf); the FIRB 2013 call is available at [http://futuroinricerca.miur.it/documenti/2013/BANDO\\_F\\_Ric\\_2013.pdf](http://futuroinricerca.miur.it/documenti/2013/BANDO_F_Ric_2013.pdf);

<sup>22</sup> Available resources were reduced in October 2012 after the reprogramming round of MISE and MIUR. The funding from the European Regional Development Fund (ERDF) is €3,102m. The budget available can be downloaded from <http://www.ponrec.it/programma/risorse-finanziarie/>;

<sup>23</sup> EC (2012);

	2009	2010	2011	2012 (estimate, if such data are available)	EU average 2011
<b>GDP growth rate</b>	-5.5	1.7	0.4	-2.4	1.5
<b>GERD as % of GDP</b>	1.26	1.26	1.25		2.03
<b>GERD per capita</b>	319.9	325.2	325.9		510.5
<b>GBAORD (€ million)</b>	9,778.4	9,548	8,890.8	8,469.7	92,308.3
<b>GBAORD as % of GDP</b>	0.64	0.61	0.56	0.53	0.73
<b>BERD (€ million)</b>	10,238.1	10,579.2	10,699.6		159,975.9
<b>BERD as % of GDP</b>	0.67	0.68	0.68		1.26
<b>R&amp;D performed by HEIs (% of GERD)</b>	30.3	28.8	28.6		24.0
<b>R&amp;D performed by PROs (% of GERD)</b>	13.1	13.7	13.7		12.7
<b>R&amp;D performed by Business Enterprise sector</b>	53.3	53.9	54.2		62.3

## 2.3 New policy measures

The policy measures introduced aimed to implement indirect incentives, such as tax credits to the business sector, to promote new modalities of financing innovation especially for SME, such as venture capital, to reform public funding for research and introduce some budget cuts in the framework of stabilisation of the overall government budget.

In 2011-2012 two laws reintroduced tax credit for R&D and skilled workers. The previous law on tax credit regarding R&D ( L 296/2006 ) financed firms for years 2007-2009.

The tax credit was available for businesses financing university research projects or projects in partnership with public research entities (DL70 L106/2011). The available resources were €55m in 2011, €180.8m in 2012, €157.2m in 2013 and €91m per year by 2014.

The tax credit for firms employing highly skilled workers in innovation and research (DL83 L134/2012 ) was financed with €25m in 2012 and will be financed with €50m from 2013.

The stabilization law of July 2011, (DL98 L111/2011) introduced some measures for stimulating venture capital towards start-ups. This law is significant in being able to decrease barriers to credit sources to SMEs, especially for the new firms (start-up) focused on high knowledge activities. Some resources for venture capital investment in innovative firms have also been made possible by DL83 L134/2012.

Aiming to promote the development of new innovative SMEs, in 2012 DL 179 L221/2012 introduced a new programme for innovative start ups amounting to €200m in 2012 and €110m

from 2013 onwards and on March 2013 more than 450 firms are included in the special section of the Chamber of Commerce register<sup>24</sup>.

DL 83 L134/2012 reformed the funding of research managed by MIUR and MISE. The law simplified the procedures, redefined the notion of research in accordance with EU requirements, defined the beneficiaries of resources and the mix of instruments (direct and indirect financing).

The spending review law (DL95 L135/2012) reduced the financing of the ordinary budget of PROs and of MIUR. The budget cuts were €33.1m in 2012 and €88.4m for the following years. The financial resources of MIUR will be reduced by €182.9m in 2013; €172.7m in 2014 and €236.7m in 2015. The spending review also provided some cuts in the number of the workforce in PROs, with the exclusion of researchers. The same act reduced the ordinary funding of PROs by €51.2m for 2013.

The financial laws of December 2012 (L 228/2012 and L 229/2012) financed the policy measures (i.e. R&D tax credits and FIRST fund and the budget cuts of the spending review) and made available the ministry budgets for 2013-2015. The total budget for MIUR decreased from 2013 to 2015<sup>25</sup> (€51.1b in 2013 and €50b in 2015), including some budget cuts for university expenditures (€7.8b in 2013 and €7.5b in 2015), research (€1.91b in 2013 and €1.9b in 2015) and international cooperation for research (€127.2m in 2013 and €127.1m in 2015). The budget for MISE for scientific research showed a decrease in research expenditures (€165.4b in 2013 and €164.1b in 2015)<sup>26</sup>.

## 2.4 Recent policy documents

The major policy documents for R&I are:

National Research Programme 2011-2013, PNR

National Reform Program 2012, NRP included into the economic and financial document DEF 'Atto indirizzo concernente l'individuazione delle priorità politiche del MIUR per l'anno 2013' AIP 2013.

Italy defines the strategy for R&I on multi year basis.

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 and substitutes the former PNR 2005-2007. The structure of current PNR used as the driver of the other policy documents such as the NRP and MIUR acts.

NRP 2012, is a government document which sets up the framework of domestic economic policies consistent with guidelines established within the European Union and with the Europe2020 targets and it is released as part of the the Economic and Financial Document (DEF).

NPR 2012 replaces the 2011 version introduced by the former government. It introduces an increase in the number of measures for R&D and attributes a different financial impact on the public budget from the measures for 'innovation and human capital'<sup>27</sup>. The documents are in agreement continuing the implementation of the reform of universities, of indirect incentives such as tax credits, of measures for attracting the return of Italian researchers from abroad, incentives for R&D in SMEs international and public-private cooperation. With regards to state

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<sup>24</sup> The list can be downloaded from <http://startup.registroimprese.it/>;

<sup>25</sup> Data available in Senato (2012b);

<sup>26</sup> Senato (2012c)

<sup>27</sup> Human capital and innovation is the chapter including policy measures such as R&D, innovation and university;

budget, for ‘innovation and human capital’ the former PNR accounted €4.6b of yearly savings in 2012-2014 only partially counterbalanced by €900m of additional expenses, PNR 2012 estimated a net impact of €706m additional expenses in 2012, €275m in 2013 and €119m in 2014. NPR 2012 is focused on the Agenda Digitale implementation, that replaces the ‘Banda larga’ approach, as an additional source for increasing R&D and innovation and for modernizing public administration. Some differences can be found in the decreased usage of the PON ‘Research and competitiveness’ as a financial resource up until 2015: €5b in NRP 2012 and €20.8b in NRP 2011 and in an approach that, in NRP 2012, is concentrated on increasing private R&D, but with a larger role of public R&D. It is not easy to assess the results achieved by NRPs due to the change in governments in 2011 and 2012 but the GERD GDP ratio is still, nonetheless, far from the Europe 2020 target.

The ‘Atto indirizzo concernente l’individuazione delle priorità politiche del MIUR per l’anno 2013’<sup>28</sup> (AIP2013), anticipated in the relation attached to the stability law<sup>29</sup>, defines the priorities for 2013-2015 of MIUR and confirms the approach of PNR and of NRP 2012.

## 2.5 Research and innovation system changes

The establishment of the Agency for the Digital Agenda, ADA, financed by DL 179 L221/2012 is relevant for the R&D system, since ADA will manage funds for large R&D projects based on ICT development.

The Agency for Innovation Technologies Diffusion established in 2006 has been replaced in 2012 by the ADA.

In 2012 the DL 5 L5/2012 established the International Experimental PhD School ‘Gran Sasso Science Institute’, for attracting doctoral students from abroad, for promoting post doc courses and strengthening the public-private partnerships. The new school will start its courses from the academic year 2013-2014.

## 2.6 Regional and/or National Research and Innovation Strategies on Smart Specialization (RIS3)

The research and innovation policy governance structure is based on the central government though, Regions, under the framework of the concurrency principle, can develop local initiatives. Usually regions developed structures at local level with a heterogeneous approach resulting in high differentiated strategies, methods and outcomes.

In Italy the R&I system still demonstrates many differences at regional level reflecting the level of economic development. The southern regions, falling under the Ob.1 of EU structural funds show many inequalities with the rest of the country including for R&I, though not for the university system. In Ob.1 regions, in 2010<sup>30</sup> the expenditure per employee for innovation was €1,900 (in non Ob.1 region it was €4,300) and the percentage of firms with product or process innovation was 22.3% (in non Ob.1 region it was 33.6%). In 2010, R&D expenditures of business as a percentage of GDP in Ob.1 region was 0.2% (in non Ob.1 region it was 0.8%) employees in R&D per thousand in Ob.1 region were 1.9 (in non Ob.1 region they were 4.7). Only on the university side and regarding the public research expenditure the gap with the rest of the country was not significant.

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<sup>28</sup> MIUR (2013);

<sup>29</sup> Senato (2012a);

<sup>30</sup> Istat (2013a);

In the recent years the action of DPS allowed a progress towards a more systematic approach under the requirements of the National Strategic Framework QSN 2007- 2013, with the regional policy of cohesion and competitiveness and the release of PON ‘Research and Competitiveness’ 2007-2013 - the instrument for implementing regional policy on R&D and innovation.

The participation of regions in the more recent policy documents on R&D is a signal of an increasing interest from regional policy-makers.

Many regions are involved in initiatives for developing the research sector with the target of promoting innovative business and capturing private-sector investment in research in their territory.

The effect of the adoption of the smart specialization for accessing some relevant funds, such as structural funds and Horizon 2020, increased regional interest in the adoption of RIS3 methods . Some regions, such as Emilia Romagna and Puglia, experimented with smart specialization methods in previous years and now are heavily involved in the development of smart specialization processes.

The Lazio Region has already adopted a smart specialization strategy for the definition of the relevant sectors for regional development<sup>31</sup>.

The action of DPS and the success of initiatives such as ‘The smart cities call’ launched in 2012, are the main driver in attracting regions towards smart innovation.

However, the deep cuts to regional budgets introduced in 2011 and 2012 may have created problematic issues slowing down the whole process.

## 2.7 Evaluations, consultations

In 2011 a new MIUR regulation (DM 15 July 2011<sup>32</sup>) was adopted for the assessment of research quality in 2004-2010. ANVUR, the agency in charge of evaluating the Italian system of R&I is still working on a report that will be available during the first semester of 2013.

Within the framework of structural funding and PON, a 2012 assessment report was only available for Ob.1 regions (southern regions).<sup>33</sup>

The report is relevant as it demonstrated some strengths and weaknesses of Ob.1 regions.

Strengths of Ob.1 regions highlighted by the report include universities and public research organisation dissemination on the territory, a growing number of new graduates, availability of skilled labour force, and evidence of moves towards new sectors of specialisation.

The main weaknesses stressed were a low level of BERD, an uncompetitive business system due to the lack of modern cultural and managerial skills, and the negative impact of too many fragmented tools for providing incentives.

From the resulting strategy of the report it is important to point out the preference for an integrated approach to technology and competitiveness and the promotion of inter regional agreements.

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<sup>31</sup> The relevant sectors are: aerospace, bio-sciences, technologies for cultural heritage and the creative-digital industry (MEF 2012b);

<sup>32</sup> Decree of Ministry;

<sup>33</sup> MISE-MIUR (2012);

## 2.8 Policy developments related to Council Country Specific Recommendations

Italian R&D intensity is still far from the target of 1.53% for GERD to GDP ratio. The increase of GERD is slow and is mainly due to the business sector. Both PNR and NRP share the objective of increasing R&D expenditure as the major policy measures, with the NRP being based on the Lisbon strategy. Even if they meet the requirements of the Country Specific Recommendations<sup>34</sup> (CSR) for Italy they find a barrier in the negative economic outlook.

In 2011-2012 the government implemented measures for providing incentives to the business sector in terms of tax credits, streamlining of funding and better access to the financial market, especially for innovative SMEs. These measures meet the requirements of the CSR 'Improve access to financial instruments, in particular equity, to finance growing businesses and innovation' as well as resulting in a simplification of the regulatory framework for businesses.

On the public sector side the general target was to manage budget savings, within research and universities and to implement measures aimed to maximise efficiency.

On the business sector the measures encounter a limitation in the negative economic climate since many firms have to postpone or to stop long term risky investments like R&D, and often have instead to tackle with a liquidity scarcity.

The stronger emphasis on the inclusion of the R&I system within the boundaries of competitiveness of a business is a positive feature, but it need more resources in order to trigger growth and a higher R&D level than the current one in Europe 2020, even if the CSR assessed it as not ambitious.

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<sup>34</sup> Council of the European Union COUNCIL RECOMMENDATION on the National Reform Programme 2012 of Italy and delivering a Council opinion on the Stability Programme of Italy, 2012-2015. 11259/12 Brussels, 6 July 2012;

### 3 Structural challenges facing the national system

The Innovation Union Competitiveness Report 2011 (IUC2011) highlights the main structural challenges faced by Italy, ranked as a moderate innovator in the EU27. For the report a lower BERD explains the low R&D intensity score. The low level of skilled human capital, a public research system in need of modernization, specialization of the industrial system and the small size of the majority of firms are highlighted as hampering factors for R&D performance. However, the same report also stresses the good results on the output side of the scientific production due to the positive contribution of high tech sectors to the trade balance.

The Innovation Union Scoreboard 2011 (IUS2011) provides a ranking of the overall performance of EU members according to the joint analysis of 24 indicators. Italy falls into the group of moderate innovators<sup>35</sup> with a performance below the EU27 average, even if Italy is considered the best in class within the group. As an emerging trend, Italy demonstrates a positive performance for the growth of new doctorate graduates, a growing attraction for non-EU doctoral students and high license and patent revenues from abroad.

The ISTAT report on welfare BES<sup>36</sup> outlines Italy's low ranking in EU27 regarding research and patents but also the high ranking from the point of view of technological and non technological innovation performance of firms. The report highlights the issue of the industrial specialization, the low skilled human capital and also includes the polarization of R&D and technological innovation into the northern regions and Lazio. The negative trend for patenting intensity and for employment in the high tech sectors underlines the issues related to industry specialization. The rising territorial polarization of R&D and innovation is an issue that may acquire more relevance in the next few years with policies aiming to increase the share of BERD and the corresponding decline of the public components.

The business component of the R&I system, as seen in par. 2.6, is concentrated in some regions, whilst the public component (HEI and PRO) is the factor counterbalancing polarization.

From the information coming from these reports four main structural challenges faced by the Italian system of R&I can be defined:

- Insufficient resources and performance of the Higher Education system.
- Low share of skilled human capital.
- Low R&D intensity and specialization of the business sector.
- Size distribution within the industrial population.

#### **Insufficient resources and 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 the pressure on the budget of the government is a barrier for improvements. Input indicators based on R&D are very negative, whilst output indicators are demonstrating some positive trend. The university system still suffers from a low degree of differentiation in education and only a few universities specializing in research and the budget cuts in the public sector are a barrier for increasing the performance of the university system. The 'Ordinary fund', the channel for wages in public universities in 2013 will, in real terms, reach a lower level in 2013 than 1996<sup>37</sup>. As shown in par 2.3 budget cuts to universities are also predicted in the future, and as outlined by OECD, Italy expenditure on university education is 1% of GDP, one third less than the EU27 average (1.5%)<sup>38</sup>.

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<sup>35</sup> The other moderate innovators are: Czech Republic, Greece, Hungary, Italy, Malta, Poland, Portugal, Slovakia and Spain;

<sup>36</sup> ISTAT (2013b);

<sup>37</sup> CUN (2013);

<sup>38</sup> OECD (2012);

According to Eurostat data<sup>39</sup> GBAORD as percentage of GDP in Italy was 0.56% in 2011, below the EU27 average 0.73%. In 2012 in Italy the estimated level of GBAORD intensity fell to a percentage of GDP of 0.53%. The largest component of the GBAORD 'R&D financed from General University Funds' demonstrated a decrease from 2009 (€3,097m) to the estimate for 2012 (€3,058m). Also the intensity of Higher Education R&D, HERD, as percentage of GDP was 0.36% in 2011 below the EU27 average of 0.49%.

Even though the ability of financing the R&D from Universities, measured by the indicator GERD by HERD as source of funding, in Italy was 0.9 equal to the EU27 average, HERD pro capita in 2011 was 93.1 below the EU27 average of 122.5. Moreover in Italy the HERD procapita is continuing to fall from 2009.

With regard to human resources, Italy's weakness is evident: the proportion of researchers (FTE) per thousand labour force in 2010 was 4.2 and the EU27 average was 6.5<sup>40</sup>.

Another indication on the issues of the insufficient performance of universities arises from the low worldwide ranking of Italian institutions.

The Academic Ranking of World Universities 2012<sup>41</sup> does not list any Italian university among the top 100; only 2 universities ranked between 100-150 (University of Pisa and University La Sapienza of Rome), 4 in the first 200 positions and 20 universities are included in the top 500.

According to IUS, the number of new doctoral graduates per thousand population aged 25-34 does however demonstrate a positive performance of the Italian universities in the 'production' of new doctorates since the value of 1.6 is equal to EU27 average. The positive performance on doctorates is reinforced by a growth in the percentage of non-EU doctoral students 6.2% in 2009, that even though this is still below the EU27 average, 19.2%, the gap has reduced from 2004 (2.4% in Italy and 17.4% in the EU27 average).

The scientific output of the HE system demonstrates a positive performance too.

International scientific co-publications per million population are higher than in Europe: 465 in Italy versus a European median value of 301.

Scientific publications within the top 10% most cited publications worldwide as percentage of total scientific publications in the country was 9.8 in Italy and 10.7 in EU27 and, even though below the average, the gap to EU27 is reducing<sup>42</sup>.

### **Low share of skilled human capital**

Eurostat data shows that in Italy, in 2011, the proportion of people aged 30-34 with tertiary education attainment, 20.3%, was below the EU27 average, 34.6%. However, the proportion of people aged 20-24 having completed upper secondary education in Italy in 2011, 76.3%, was not far from the EU27 average 79%<sup>43</sup>.

According to Eurostat, in 2008 the number of graduates in mathematics, science and technology per 1000 of population aged 20-29 was 14.4% in the EU27, while only 11.3% in Italy.

Furthermore the proportion of doctorate students in science and technology fields, in 2007, was 36.5% of total PhD students, while the EU27 average was higher (42.5%). Moreover, in 2007 the proportion of doctorate students working in science and technology fields as a % of the population aged 20-29 was 0.25% in Italy and 0.3% in EU27.

In 2011 the human resources in science and technology as proportion of labour force in Italy was lower, 34.4%, than the EU27 average 42.3%. In the same year also the proportion of scientists and engineers as percentage of active population was lower, 3.8%, than the EU27 average 6.5%<sup>44</sup>.

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<sup>39</sup> Eurostat (2013i) (New Cronos database);

<sup>40</sup> EC (2011a);

<sup>41</sup> Data available at <http://www.shanghairanking.com/Country2012Main.jsp?param=Italy>;

<sup>42</sup> IUC2011;

<sup>43</sup> Eurostat (2013g) (New Cronos database);

<sup>44</sup> Eurostat (2013f) (New Cronos database);

The human capital is below the EU27 average and the low preference for scientific disciplines in Italy suggests the necessity for ‘structural adjustment’ including with regards to demand in the education market.

In Italy the low proportion of highly skilled population<sup>45</sup>, particularly within S&E disciplines, may result in a skill shortage in the knowledge intensive business sector, as outlined and it may also reduce the effectiveness of R&D funding. Italy is still far, from the target of Europe2020 in terms of tertiary education (26%-27%). In 2012, only 21.3% of the population aged 30-34 attained tertiary education (35.5% in the EU27). Moreover the number of new students admitted to universities is falling and in 2011-2012 universities reported 280,144 new students with a decrease of more than 58,000 units from 2003-2004<sup>46</sup>.

### **Specialization of the business sector**

Italy traditionally suffers from low business R&D investment. The BERD as % of GDP indicator, was already under the EU27 average in 2002: 0.54% in Italy and 1.2% in EU27. In 2011 the traditional low level of private business expenditure measured by the indicator BERD as % of GDP, confirmed the same trend: 0.68% in Italy and 1.26% in the EU27.

Also the private funding of GERD in 2011 reached 44.7% of the total gross R&D expenditure in Italy, lower than the EU27 average, 53.9%.

The low level of BERD in Italy is mainly due to the specialization of the business sector with a focus on low technological activities.

Italy remains non-specialized in the high-tech sectors (except chemical industry), though in some cases it shows a significant scientific specialization (e.g. in ‘pharmaceuticals’) or a high concentration of patents (e.g. in ‘other machinery and electrical equipment’).

As noted by IUC2011 a key challenge is the shift towards high-tech sectors through the growth of the more innovative industrial sectors and new high-tech firms but effective policies will only show returns after the medium to long term.

As outlined in relevant OECD publications<sup>47</sup> in twenty years (from 1990 to 2009) the Italian percentage of total world manufacturing value added has decreased substantially.

Some key factors can explain the long term decline of the Italian manufacturing: small size of the high-tech sectors, limited number of foreign controlled firms and a low availability of venture capital.

Also Eurostat data confirms the small size of the high-tech sectors in Italy: the number of employees in the high-tech sectors (high-technology manufacturing and knowledge-intensive high-technology services) as percentage of total employment is only 3.3%, below then EU27 average (3.8%)<sup>48</sup>.

The intensity of risk capital to GDP is another weakness of the Italian business system: venture capital as a % of GDP is much lower in Italy, 0.035%, than in EU, 0.095%<sup>49</sup>.

The joint effect of these key factors undermines the country’s approach towards innovation. The main challenges concern the reorientation of the old manufacturing sector towards new activities and the establishment and growth of new firms that can help the process of adjustment.

### **Size distribution within the industrial population**

The distribution of firms size within the industrial population is another key issue: the Italian industrial sector falls for the quasi totality within the microenterprise category.

According to Istat data<sup>50</sup>, even though the number of enterprises in Italy is greater than 4.5 million, only 3,495 firms employ 250 employees or more.

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<sup>45</sup> The strategy for incentivating Italian scientists working abroad to return home, is helpful for contrasting skill shortage but it is not an instrument which can achieve an high amount of returns.

<sup>46</sup> Cun (2013) Elaboration on MIUR data;

<sup>47</sup> OECD (2011);

<sup>48</sup> Eurostat (2013j) (New Cronos database);

<sup>49</sup> IUC2011;

The small average size of the Italian firms (3.8 employees per firm) indicated by ISTAT data suggests a business structure based on microenterprise. Firms with 1-9 employees number more than 4.1 million and account for the half of the total employment of the business sector.

In 2010, 69% of business R&D expenditures was concentrated within firms with 500 employees or more and only 9% occurred in firms with less than 50 employees.

The poorer attitude towards technological innovation is indicated also by CIS data<sup>51</sup>: in the period 2008-2010 64.1% of firms with 250 employees or more were innovating firms, whilst this figure was 47.1% within the 50-249 employees class and 29.1% within the 10-49 employees class.

Thus, policies addressed to increase the average size of firms may not only trigger R&D but also competitiveness, export and a better access to finance. In a recent survey one quarter of exporting SMEs in Italy indicated their size was a barrier to their performance<sup>52</sup>. Access to finance for SMEs, after the crisis, has also become more difficult with lower success rates. More than 50% of SMEs will access the financial market and 20.1% will ask for resources in order to finance R&D<sup>53</sup>.

The GDP recession and the interactions between the above mentioned structural challenges are additional features of this problem.

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<sup>50</sup> ISTAT (2012c);

<sup>51</sup> ISTAT (2012b);

<sup>52</sup> ISTAT (2013d);

<sup>53</sup> ISTAT (2011);

<b>HUMAN RESOURCES</b>	
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	1.6 (2009)*
Percentage population aged 30-34 having completed tertiary education	19.8 (2010)*
<b>Open, excellent and attractive research systems</b>	
International scientific co-publications per million population	465.3 (2010)*
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	9.8 (2007)*
<b>Finance and support</b>	
R&D expenditure in the public sector as % of GDP	0.56 (2011)**
<b>FIRM ACTIVITIES</b>	
R&D expenditure in the business sector as % of GDP	0.68 (2011)**
<b>Linkages &amp; entrepreneurship</b>	
Public-private co-publications per million population	20.7 (2008)*
<b>Intellectual assets</b>	
PCT patents applications per billion GDP (in PPS€)	2.05 (2008)*
PCT patents applications in societal challenges per billion GDP (in PPS€) (climate change mitigation; health)	0.36 (2008)*
<b>OUTPUTS</b>	
<b>Economic effects</b>	
Medium and high-tech product exports as % total product exports	50.4 (2010)*
Knowledge-intensive services exports as % total service exports	31.5 (2009)*
License and patent revenues from abroad as % of GDP	0.16 (2010)*

Source: \*IUS2011 \*\*Eurostat New Cronos

## 4 Assessment of the national innovation strategy

### 4.1 National research and innovation priorities

The NRP and the PNR are important documents for the defining the priorities in research and innovation.

PNR details the R&D policy priorities, the governance framework, the instruments, and the funding appropriations to be allocated to the various policy instruments for over three years.

The 2011-2013 PNR defines three R&I priorities: 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 a greater attention to be paid to SMEs and start-up companies. On the innovation side PNR is in line with the MISE multiannual strategy outlined in 'Industria 2015', released on 22<sup>nd</sup> September 2006. 'Industria 2015' and PNR share the objectives of increasing the active role of the government, public-private partnerships and innovative finance: private funding for innovation investments.

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.

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

- growth of the country's competitiveness in 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.

NPR 2012 is an important document for the monitoring of progress of the national measures on R&D for innovation and research policies and is a relevant part of the overall agenda since also NRP looks at R&I as a key feature for increasing the competitiveness of the country. The inclusion of regions, as a relevant stakeholder, offers the opportunity to monitor in a single document their progress in heading towards the national and European target in a broader framework than the R&I policy.

The more relevant actions for R&I outlined from the analysis with the NPR are the following:

Measures for supporting the activity of young researchers through the earmarking of a share of research funds

Measures to give financing priority to projects coherent with EU objectives

Simplification action for research projects

Supply- and demand-side measures for the growth of R&D expenditure in business

Measures for a better access to finance for innovative SMEs

Promotion of projects jointly carried out by businesses, universities and research organisations.

In the report attached to the 2013 financial law (L 229/2012) MIUR, for years 2013-2015, MIUR defined the policy priorities for innovation, public research and universities.

The 3 policy priorities relevant to the R&I system in these acts are:

Strengthening of technological innovation

Support for the growth and valorisation of public research

Increase of quality and efficiency of the university system

On the basis of the report MIUR will continue to implement the reform (L 240/2010) for universities in terms of increasing performances of public universities, and with regards to research confirms the PNR as main driver. Public research will be strengthened in a framework of close cooperation with the business sector in order to promote technological innovation and to increase competitiveness.

The report was released in anticipation of the ‘Atto indirizzato concernente l’individuazione delle priorità politiche del MIUR per l’anno 2013’ that outlines each priority. On the innovation side the focus is on the digital economy as in the NRP 2012; on research side the main points are Digital Agenda, adoption of EU funds, thematic research, streamlining of funding and support to public research. Concerning universities the priority is based on achieving better performances, cooperation between PROs and HEIs and internationalisation of the Italian university system.

All the documents are written to follow the strategic guidelines of the PNR integrated into the broader framework of overall economic policy and European integration. NRP 2012 regards the Digital Agenda assessed as a driver for growth and innovation. The digital economy, and the recovery from the delay in the digitalization of the country, is considered strategic also for social cohesion and for increasing the productivity of the whole system.

However, NRP 2012 does not put a great emphasis in actions specifically directed to the public R&D system. Relevant initiatives such as the doctoral school of Gran Sasso, the earmarking for young people for a share of the research fund and also the initiatives for supporting the mobility of researchers are balanced by a lower actual amount of funding, such as for the most recent call of FIRB and PRIN.

Specialization of the business sector and the size distribution issues are addressed with measures, that may also impact R&D in the short time since they have been produced within a framework aimed to increase growth and competitiveness. However, the measures for higher education and the skill orientation of the human capital are likely to have a smaller impact since they are limited in scope by the lack of funding.

The joint analysis of the NRP 2012 and of PNR delineates a policy mix based on the following key features:

- improving entrepreneurship, with policies focusing on innovative SMEs, start up and an increasing 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;
- introduction and development of demand driven innovation;
- support for the digital economy;
- support for to allow to take more effective advantage of structural Funds
- full integration of R&I policies into the broader framework of economic policy and European Union policies

## 4.2 Evolution and analysis of the policy mixes

According to the six routes classification of the policy mix aiming to raise R&D investment levels<sup>54</sup>, the R&D policy in Italy is mainly comprised of efforts to stimulate greater R&D investments by R&D-performing firms and to stimulate public-private collaborations. The Agenda Digitale and the strengthening of public research are part of efforts to increase R&D levels in public sector organisations.

The Monti government introduced innovative and indirect incentives for the development of new start up companies. The instrument aimed to establish fiscal holidays and some incentives in terms of simplification, incubators and liabilities in case of bankruptcy for startups deeply involved in R&D. With regards to innovation, DL 179 L221/2012 also included crowdfunding as a channel of financing. The measure is recent (December 2012) and it is not easy to assess the actual impact on R&D indicators but the boom of new start ups (more than 450) registered in the chambers of commerce is encouraging.

The Monti government reformed the governance of the instruments for financing R&D, innovation and technological transfer.

During 2012 the government introduced a reform of R&D funding<sup>55</sup>, adopting EU based classification (Fundamental research, Industrial research and internationalization of research), introducing innovative modalities of financing research such as social innovation, adopting streamlined access to resources and earmarking a share of funding for young researchers. Unification of the resources of main research funds managed by MIUR (FAR, FIRB and PRIN) within the fund for investing in scientific and technological research (FIRST) has been undertaken in order to streamline access to funds.

The new fund is targeted towards strategic research programmes and internationalization of the firms. In the report of the same act the government outlined the principal importance of a research system fully integrated into general economic policy. The report outlined also the poor achieved results of the past were due to the lack of a strategy, the outdated approach of the linear model, the lack of evaluation tools and the low financing. The reform of R&D funding need a new ministerial regulation act not yet available. The report attached to the act estimates resources of around €300m will be available for the new fund. The act also reforms the tools for financing R&D in firms, in PROs and in HEIs making both direct and indirect incentives available.

Regarding technological innovation the same act also reformed the financial incentives available to enterprises (which are managed by MISE) by creating the Fondo per la Crescita Sostenibile (FCS) that will include all the resources for technological innovation. FCS is linked to Horizon 2020 guidelines and definitions. FCS substitutes the former Fondo rotativo per sostegni alle imprese e gli investimenti in ricerca (FRI), simplifying regulations and redefining the scope and the beneficiaries and the mix of the incentives that will be available for indirect financing. On March 2013 MISE took over the management of FCS with the allocation of €600m.

The various instruments employed in 2012-2013 changed the composition of the instruments and the main funds available for research, innovation and universities are the following<sup>56</sup>:

Fondo per la Ricerca Applicata (FAR) the traditional fund for industrial research, managed by MIUR, based mainly on grants and loans. In 2007-2011 FAR distributed €1376.3m and during 2012 financed the last 'smart cities call' (€655m)<sup>57</sup>. In 2013 it froze its activities due to a lack of resources<sup>58</sup>.

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<sup>54</sup> Guy K., Boekholt P., Cunningham P., Hofer R., Nauwelaers C., and Rammer C., (2009)

<sup>55</sup> (DL83 L134/2012);

<sup>56</sup> The previous country report (2011) focused on some funds, such as Jeremie and Fund for Greenfield Infrastructures for addressing resources towards SMEs;

<sup>57</sup> MISE (2011);

<sup>58</sup> <http://hubmiur.pubblica.istruzione.it/web/ricerca/dettaglio-news/-/dettaglioNews/viewDettaglio/24402/11213;>

Fondo Ordinario per il finanziamento degli Enti e istituzioni di ricerca (FOE) is the fund for basic research, managed by MIUR, aimed at PROs working on strategic projects which address national priorities through enabling key technologies. This instrument also shifted its target towards international research EU guidelines.

Fondo per gli Investimenti della Ricerca di Base (FIRB) It is managed by MIUR, and aimed at basic research implemented by researchers in HEIs and PROs with a proportion of funding earmarked for young researchers.

Progetti di Rilevante Interesse Nazionale (PRIN): it is competitive funding, managed by MIUR, for cofinancing projects coordinated by HEIs and PROs

Programma Operativo Nazionale (PON) Ricerca e Competitività 2007-2013 is funding for social cohesion with a basis in R&D. It is open to public and private entities. From 2010 to 2012, the national operational programme PON “Research and Competitiveness” allocated €282m to support existing High-Tech Districts, €107m to existing Public-Private laboratories, and €526m to new Public-Private laboratories and High-Tech districts in the Convergence regions.

For universities there is the Fondo Ordinario per le università (FFO) which is managed by MIUR and it is the core fund for the management of public universities.

Fondo per la Crescita Sostenibile (FCS) is the new fund for technological innovation managed by MISE.

Fondo per l’innovazione tecnologica (FIT) is a fund for financing technological innovation, is managed by MISE, and based on grants and bank credits for firms, especially SMEs. FIT also allows Technological Innovation Contracts for large projects (of around 10 million euros) within a negotiated procedure between the Ministry and (private and public) national and international stakeholders, within an agreed procedure.

The Fondo Nazionale per l’Innovazione (FNI), 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.

Thus, the picture is of a system still based on grants and loans but that makes some moves, especially for technological innovation in firms and technological transfer, toward a policy mix based on indirect financing. Up until now tax incentives, such as tax credits, re-introduced in 2011 and 2012, are not yet relevant as they are aimed only at specific typologies. The efforts of the government also introduced innovative instruments such as crowdfunding and demonstrated an increased interest in social innovations.

The introduction of some innovative instruments for innovation of SMEs and startup is encouraging but it is still too recent for any meaningful assessment. The adoption in many cases of EU definitions and guidelines is a step towards integration, as are the stronger links between economic and social policy. Some results have already been achieved such as the success of Smart cities, which points towards the development of projects aiming for demand driven innovation and social innovation. University funding does not follow the same stream, and it seems that the progress of reforms is slower. The amount of available resources seems to be significantly limited by budget constraints and the reform of 2010 introduced many administrative requirements and procedures that produced a high bureaucratization burden.

**An analysis of the strengths and weaknesses** of the current policy mix, developed on the basis of the Innovation Union self-assessment tool, reveals some features relevant for understanding the effectiveness of the current policy mix, and highlights points essential to allow resolution of the key challenges within the whole R&I system:

The **role of research and innovation** within the overall national/regional policy mix is becoming more relevant, as highlighted by official documents outlining multi-annual strategies (for both R&D and innovation policy) and reinforced by the strategy of NRP, but weaknesses in the national system still persist, since private investments are still low. In 2012 societal challenges

included in the PNRs which could drive socially oriented innovation (predominately health and environment), which have and could result in investments in innovation energy and public procurement, started to be implemented and some policy measures are thus opening funding towards social innovation. Digital Agenda and innovation in the public sector are additional ways to develop R&D and innovation aimed at addressing the ‘digital divide’ and issues arising from territorial inequalities.

- The **governance** of research and innovation policies enjoys a government centered structure, through the development of multi-annual strategies and the definition of priorities. However, monitoring and review systems (concentrated on regional policy) underwent a revision in 2012 removing some duplications, such as ex ante evaluation for projects already approved at EU level.
- The **scope of the innovation policy** has been broadened, and now includes organizational and services innovation. This is shown by the relevance given to innovation in the public sector (particularly in the Public Administration), though demand-driven innovation, despite being of greater relevance, is still in the early stages of development.
- **Public funding in terms of leverage on private investment** involves innovative financing solutions, based on the attraction of private savings towards targeted investments by using public guarantees and public participation in special funds. The new system of funding was only recently introduced. Indirect incentives, like tax credits, are supported by less funding than in the past and can contribute only in some cases. Other indirect incentives coming from DL83 L134/2012 are not yet fully implemented.
- **The pursuit of excellence** in research and education policies is attained through the use of competitive and project-based financing, but there is no clear evidence for the relative balance between institutional and project-based funding. The introduction of ex - post evaluation may increase the quality of the output. New incentives for attracting leading international talent have been implemented. The evaluation of research institutions has followed internationally criteria (past CIVR evaluations). The new ANVUR, established in 2008 but implemented in 2011, covers quality assurance, accreditation, and research and education evaluation for universities. A major weakness is the lack of opportunities for research careers. In the last two years budget cuts have also affected University research activities and in the next few years the financial laws suggest other cuts will be made that will significantly affect universities.
- The ability of the education system to produce the **proper mix of skills** is still weak, due to poor policy incentives ensuring 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. Moreover the outlook for new researchers, such as PhD students, is gloomy given the budget constraints placed upon universities and PROs.
- The promotion of **partnerships at all levels and links between research and innovation** is one of the strengths of the national system. 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 issue is the low mobility of researchers and innovators between public and private institutions, but some recent measures eliminated some of the regulatory barriers to mobility between HEIs and PROs and mobility of researchers involved in international projects.

- Framework conditions **promoting private investment** in research and innovation are improving, thanks to the protection of IPRs and the new measures for starting up innovative businesses; however, the venture capital market is still not developed enough and some measures in the policy mix still tend to support risk-oriented financing mostly for existing firms. The new approach, developed from the reform of firms incentives, is focused on the need to finance particular activities such as R&D maximizing additional effects that have previously been scarce.
- **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 such as start ups and for streamlining some funding lines for innovation. A weakness is the limited use of evaluation tools to adapt policy measures to their targets.
- **Public Procurement** driving innovation has been implemented only recently by the Smart cities programme and will only be able to be assessed in the future. Demand driven, social innovations and regional dimensions are increasing their relevance over time. The integration with EU policies is increasing but at regional level, especially for private business, greater inequalities are demonstrated.

### 4.3 ASSESSMENT OF THE POLICY MIX

R&I priorities and strategies highlight some solutions which need to be implemented and funded to produce a consistent, comprehensive, and efficient policy mix.

The negative outlook of the economy and an increasing territorial inequality in the distribution of innovative firms are key factors that limit the effectiveness of the current policies.

The policy mix mainly increases support for new R&D-oriented firms, large collaborative programmes and more recently encourages demand driven innovation.

The policy mix is mainly targeted at the business sector and to a certain extent relegates the key issues related to Universities and Public Research Organisations to the background.

Thus, the current policy mix includes instruments that though they 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) also have some difficulties summarised as:

- the limited relevance of the adoption of indirect incentives
- the decline of resources for public research institutions and Universities;
- the low and uncertain funding of some measures.

A survey (2009-2010) on the state of Italian research conducted by the Seventh Commission of the Chamber of Deputies (Parliament)<sup>59</sup> emphasized the critical situation of the public research system (PROs and Universities): limited resources availability, infrequent collaboration among public research institutions, lack of a general strategy and an inefficient/locked-up system of access and careers for researchers. The implementation of the policies aiming to increase merit, mobility and create more open access, as the Merit Fund creation, can solve only some of the critical issues affecting the public research system. Moreover, for human capital, though the implemented measures are positive, they are marginal.

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<sup>59</sup> VII Commissione della Camera (2009);

Three years later the Consiglio Universitario Nazionale CUN, the representative body of universities within MIUR, released a document outlining the emergencies within the university system<sup>60</sup>.

The document points out the issues of increased bureaucratization, due to law reform, leading to negative effects on the 'core' activities, and a decreasing stream of resources. The document outlines how the university system funding has been decreasing constantly from 2008 (in both absolute and real terms) with a lower level of technical and research work concentrated in some areas, mainly southern regions, where there are more prevalent socioeconomic problems. In the recent years fewer professors, fewer students, fewer courses have resulted from the budget cuts and economic difficulties within the system. Universities are no longer attractive due to the level of wages, frozen by law from 2011, and for the low probability of researchers of achieving a permanent position. This negative assessment of the situation is further reinforced by the progressive reduction in budget to the two funds which provide money for basic and not targeted research (PRIN and FIRB), a reduction that will also occur in 2013. In Italian universities the number of new students in 2011/2012 decreased dramatically from 2003-2004 (-17.2%) and in 2012 the university system reported nearly 15,000 young researchers with non permanent position, with little opportunity to challenge for a permanent position since the budget for university is continuing and will continue to decrease as shown in the budget estimates for 2013-2015 in par 2.3<sup>61</sup>. In 2010-2011 the number of new PhD students fell slightly (-500 individuals) compared with 2007-2008 but there was also a greater proportion of foreigners (6.8% in 2007-2008 and 10.9% in 2010-2011).

The effects of the recessions with rising unemployment rates undermine also the effectiveness of human capital. Istat data indicate that 197,000 people holding a degree under 35 were unemployed in 2012 (+43% compared to 2008) with a total number of graduated unemployed of 307,000<sup>62</sup>.

Thus, the university policy mix, which is mainly due to the recent reforms and budget cuts, has resulted in lower figures on the input side, lower attractiveness of the research institutions and a progressive downgrading of the human capital base. The university system traditionally counterbalanced the territorial inequalities in R&I, but current policies will concentrate resources within northern regions deepening the territorial gap, and will also affect the input of human capital.

On the innovation side the policy devoted to SMEs is fully integrated into the current industrial policy and during 2012 recorded some changes. It is aimed at supporting their capitalisation and innovation through specific Funds (Investment Fund, Innovation Fund) supporting the IPRs expenditure of SMEs and the commercialisation of patented innovations.

The recent measures for innovative startups follow the approach of enabling innovative tools which allow a better access to the financial market for new startups and also allows the monitoring and support of their activities over time.

The reform to firms incentives<sup>63</sup> has partly changed the approach towards innovation funding.

The reform, based on the Giavazzi report<sup>64</sup>, aimed to review the approach used for funding loans and providing subsidies to firms. Following the new approach, firms can receive incentives only if two requirements are fulfilled: market failure and additionality.

In the case of R&D, incentives are described as being effective by many authors, particularly if aimed towards SMEs through automatic methods, and indirect incentives are preferred to subsidies. In Italy there is not a long tradition of provision of tax credits for R&D. Tax credit for

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<sup>60</sup> CUN (2013);

<sup>61</sup> The ordinary resources for employing new research units in 2012 accounted for less than 600 as indicated in DM 297/2012 of MIUR;

<sup>62</sup> Istat (2013c);

<sup>63</sup> DL83 L134/2012

<sup>64</sup> Giavazzi F., D'Alberti M., Moliterni A., Polo A., Schivardi F., (2012);

R&D was introduced in the 2007-2009 period. For 2008-2009 more than €1.8b of tax credits were distributed through a random method, based on the so-called click day, and the additional effects on R&D were ‘weak’<sup>65</sup>.

The incentives reform is aimed towards a pattern based on indirect R&D financing in SMEs. Either way the amount of resources for tax credits and the eligibility typology (firms collaborating with universities and research centres) traditionally only represents a small proportion of total number of innovative firms. The negative economic outlook is affecting the effectiveness of the policies aimed at innovation for SMEs since the access to credit is more difficult for ordinary activity and investments in R&D probably are being resized or postponed.

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<sup>66</sup>.

Nonetheless the policy efforts made in the last few years for SMEs contributed to the slight increase in R&D in medium firms<sup>67</sup> (the firms with 50-249 employees spent €1,236m in 2007 and €1,426m in 2011 on R&D) which was also seen in small firms (the firms with less than 50 employees spent €820m in 2007 and €949m in 2011 on R&D).

The other structural challenge that might be addressed by the current policy mix is Italy’s medium-low tech industrial sector, which can be dealt with by means of large projects/programmes involving different stakeholders and R&D activities.

The economic policies, as indicated in NRP, are aiming to shift the activities of firms towards high knowledge sectors, such as the digital economy, but structural adjustment is a very slow process. The Agenda Digitale and the success of start ups may stimulate this process in the next few years. Internationalisation of firms may represent an additional factor which may shift the Italian specialization towards high tech sectors.

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 Public Administration, contributing with their specific funds towards 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 negotiations between the government and the involved actors. The PIIs have financed – within three bids (Sustainable Mobility; Energy Efficiency; Made in Italy) – 232 projects proposed by 1,745 firms (1,268 of which are SMEs) and 500 PROs and Universities, reaching a total investment of 2.2 billion Euros.
- the Technological Innovation Contract, implemented in 2010, is a FIT negotiated 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 implementation of the Smart Cities and Communities programme, funded by 900 million of euro in 2012, and the Digital Agenda which aim to stimulate the growth of the digital economy.

The overall policies are counterbalanced by the recession and last available figures demonstrate that the increase of R&D expenditure is still far from the target of Europe2020, and that BERD is slowly rising but the public component of R&D expenditure is suffering from a mix of budget cuts and the bureaucratization effects of the recent reform. Rising territorial inequalities may become a new structural challenge in the next few years, and the policy should address this by

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<sup>65</sup> Cantabene C., Nascia L., Perani G., (2011);

<sup>66</sup> Eurostat (2013k) (New Cronos database);

<sup>67</sup> ISTAT (2012 a);

focusing business R&D towards less developed regions (in which PON 'Research and Competitiveness' is a fundamental instrument).

The current policy mix can be assessed as polarised mix of business friendly and innovative initiatives, contrasting with a 'residual' approach towards the HEIs and PROs.

Up until this point the imbalance of the policy mix towards the business sector with flows of resources coming from the public system, rather than increasing R&D, has changed the composition and the contribution of each of the stakeholders.

Table 3: Assessment of the policy mix

Challenges	Policy measures/actions <sup>68</sup>	Assessment in terms of appropriateness, efficiency and effectiveness
<p>Insufficient performance of the Higher Education system.</p>	<p>Distribution of additional funding according with performance to universities;</p> <p>Mobility between HEIs and PROs;</p> <p>New rules for competitive funds;</p>	<p>This is a suited measure but budget cuts conflict with any incentivisation. The appropriation of funding is, in fact, a substitution of other funds since they are implemented through savings coming from MIUR. Over the next few years the overall financial budget for universities will be lower. The lack of a general assessment report is a significant limitation.</p> <p>It is a positive measure that can increase the quality both in input and output</p> <p>The reform on competitive funding, is appropriate but it is too recent for fully understand its effectiveness. The volume of funding is lower than in the past.</p>
<p>Low share of skilled human capital.</p>	<p>Tax incentives to attract researchers back to Italy;</p> <p>Creation of the Merit Fund to promote merit and quality learning in the school and university system;</p> <p>New doctoral school of Gran Sasso;</p>	<p>The tax incentive measure is limited in scope and it is not particularly important in overcoming challenge, whilst the attractiveness of research institutions is decreasing due to wage levels and the lack of new permanent positions</p> <p>The Merit fund activity is appropriate but the recent increase in university fees and rising unemployment rates may hamper the effectiveness of this policy. The number of students is decreasing and the share of new unemployed graduates is arising.</p> <p>The opening of the new doctoral school is appropriate and effective but the number of additional doctorates will be small. Foreign doctoral students are increasing over the years</p>

<sup>68</sup> Changes in the legislation and other initiatives not necessarily related with funding are also included.

Challenges	Policy measures/actions <sup>68</sup>	Assessment in terms of appropriateness, efficiency and effectiveness
Size distribution within the industrial population.	<p>Firms incentives reform for R&amp;D in SMEs and measures for innovative startups</p> <p>Tax credit for industrial firms collaborating with universities and PROs for R&amp;D.</p>	<p>Appropriate for the growth of SMEs; synergic with the economic policy but the effectiveness cannot currently be assessed, especially for the measures regarding innovative start ups. The incentive reforms may increase the R&amp;D potential</p> <p>Tax credits are appropriate but limited in scope.</p>
Specialization of the business sector	<p>Large Programs including collaboration among private and public organisations and between large and medium-small companies, such as the Industrial Innovation Projects of “Industria 2015”. Other new instruments have been implemented recently (Contract of technology innovation and Agreement contract of strategic research)</p> <p>Implementation of the Digital Agenda</p>	<p>PIIs have mobilised (financial and human) resources, but they suffered from a delay in funding which is still present. The credit system didn't support the Government policy.. Their design seems appropriate and innovative.</p> <p>A coordinated policy devoted to sustaining the growth of high tech sectors and of new large sized companies is a key issue.</p> <p>It is an appropriate policy. Up to this point the initial success of Smart cities programmes and the inclusion of demand driven innovation are the preliminary steps towards an effective policy. Only after the full establishment of the ADA and an evaluation of the activities will it be possible to assess its effectiveness and efficiency. The Digital Agenda is synergic with the economic policy and coherent with EU integration</p>

## 5 National policy and the European perspective

The national policy mix has, over the last two years, improved the degree of coherence with the European perspective.

In 2011-2012 the government designed a policy aimed at a closer integration at European level. The EU 2020 targets in NRP 2012 and the increasing relevance of the compatibility of each measure with regards to European benchmarks highlight the approach of the Monti government. Today awareness of ERA issues is significant, as indicated by official policy documents on the internationalisation of research, on the promotion of young researchers and the pursuit of excellence within institutions and programmes, as well the mobility of people around Europe.

The major R&I policy documents share the themes and targets outlined by the EU and the policies of MIUR and MISE are aimed at integration with EU standards for funding access and regulations. Currently the trajectory planned by the government is still in the progress of being developed and it is likely that over the next years the strategy of R&I policies will follow subsequent approaches.

The target of competitive funding within Universities is based on the promotion of international cooperation. With regards to business R&D funding measures are aimed to promote international partnerships and to award public.-private collaboration. The PON 'Research and competitiveness' is the instrument to be used to attract local stakeholders to R&D activities from an EU perspective.

Internationalisation is widely regarded as essential for modernisation of the business sector, and research is regarded to be essential.

Innovation in the public sector, especially in the digital field, is highlighted as necessary for the successful integration of the R&I system.

Major weaknesses concern the public system of research and education. The labour market for researchers is still more unattractive than in past years due to the stabilisation policies that stopped wage increases, the lack of permanent contracts, and, despite the recent reforms, the limited relevance of merit in career advancements.

The education supply for science and engineering is still inadequate and, in some fields, the available training does not match market demand.

Also the public research system falls under the budget savings. The recent reforms of universities and public research organisations aimed to improve excellence and merit whilst reducing the overall cost of the system. However, up until now there is scarce evidence of progress towards quality within the whole system, which is also due to the lack of an evaluation of the whole system, (other than additional bureaucratic procedures). Nonetheless the government has made some effort in trying to remove barriers to mobility for researchers and to increase the degree of openness of Italian research to EU flows. In some competitive funding foreign experts are mandatory, the number of foreign students in university courses is increasing year by year and research infrastructures are acting as poles of attraction for international research.

The not ambitious target for R&D (1.53% of GDP) is currently proving difficult to reach, with the stagnation of GERD mainly due to the decrease in government expenditure and to the small growth of BERD. The main risk is a policy mix resulting in a change of composition of R&D without triggering any real growth.

**Table 4: Assessment of the national policies/measures supporting the strategic ERA objectives**

	<b>ERA dimension</b>	<b>Main challenges at national level</b>	<b>Recent policy changes</b>
1	<b>More effective national research systems</b>	<p>Methods for awarding competitive fundings</p> <p>Rewarding institutions which undertake research</p> <p>Securing resources for project funding is discontinuous and the process for selecting beneficiaries too long</p>	<p>Following 2012 procedure changes, PRIN and FIRB fund allocation includes an evaluation process with foreign experts (1/3 of the board) and apply peer review principles</p> <p>Merit Fund to promote merit and quality learning in the school and university system;</p> <p>In 2012 the government implemented some improvements to policies aiming at simplify selection procedures and the earmarking of funds for young researchers.</p>
2	<b>Optimal transnational co-operation and competition</b>	<p>Guidelines and targets for main funding streams for universities, research and innovation</p> <p>Low mobility of researchers and incentives to participate in international projects</p> <p>National compatibility with EU standards 2010-2013 PNR and NRP 2102 recognising the need to strengthen international cooperation in science and technology across Europe</p> <p>Legal barriers to transnational cooperation</p> <p>Development and implementation of the national Roadmap for RI is not yet completed; Italy is coordinating the development of other relevant RI for EU research</p>	<p>All the 2012 measures introduced the themes, guidelines and definitions of EU regulations and programmes such as Horizon2020 or European Digital Agenda.</p> <p>Elimination of some of the barriers to mobility in the case of international projects and the introduction of incentives for research institutions promoting international projects. Mobility during doctorates decreasing for financial reasons</p> <p>Elimination of national evaluation of projects already awarded at EU level</p> <p>No policy changes</p> <p>No policy changes</p>

	<b>ERA dimension</b>	<b>Main challenges at national level</b>	<b>Recent policy changes</b>
3	<b>Open labour market for researchers</b>	<p>Recruitment of researchers in HEIs and PROs</p> <p>Low mobility and openness of the researchers labour market, and lack of open programs. Overall low attractive working conditions for researchers, low salaries, difficulties to gain permanent positions, scarce relevance of merit for advancements and no effective implementation of policies for supporting carrier development .</p> <p>Policies for attracting Italian researchers from abroad</p> <p>Mobility of researchers</p>	<p>Major recruitment channels are regulated by law. Within universities, the reforms significantly changed the evaluation methods.</p> <p>The number of open positions is low due to the lack of financial resources for permanent positions. The number of fixed term contracts increased. Wages are low if compared to EU average. From 2011 financial laws stopped wage increases, slowed carrier opportunities and resulted in budget cuts. No service for supporting carrier development is provided</p> <p>Calls for attracting Italian researchers back from abroad are active but not significant given the number</p> <p>Barriers to mobility between academia and industry are high in case of public HEIs and PROs</p>
4	<b>Gender Equality</b>	<ul style="list-style-type: none"> <li>• The gender gap is significant in the business sector</li> <li>• Participation data from FP7 revealed a wide gap in project coordination</li> </ul>	No relevant policy changes
5	<b>Optimal circulation, access and transfer of scientific knowledge</b>	<ul style="list-style-type: none"> <li>• Open data policies are still in their initial phases</li> </ul> <p>Despite the proliferation of initiatives the dialogue between HEIs\PROs and industry is not effective</p>	Digital Agenda initiatives and increasing effort from public institutions to make open data available

## 6 Annex: Alignment of national policies with ERA pillars / objectives

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### *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 to government R&D policy is to enhance the ability of universities to produce researchers and post-graduates, particularly in science and engineering sectors, which are supposed to be able to sustain the competitiveness of the national economy. Eurostat figures show that in 2011, in the EU, the human resources employed in science and technology occupations (HRST) represented 40.1% of the labour force; Italy was one of the countries that, in that same period, recorded a decrease in HRST (in relation to labour force), from 34.6% in 2006 to 32.9% in 2011. The indicator HRST ‘core’ – made up of people with a university level degree who also work in a science and technology occupation – further highlights the gap with EU: in 2011 in Italy this was 12.3% vs. 18.5% in the EU.

In Italy the mobility of PhD students is encouraged, but not compulsory and the lack of funding is the main barrier to supporting mobility.

Regarding prestigious Italian scientists working abroad to return home a strategy is being pursued through specific measures (FIRB, FIRB Futuro in ricerca, Levi-Montalcini Programme), favouring the recruitment of researchers living abroad to the public scientific sector.

Furthermore, mobility of permanent staff is constrained by the lack of specific investment at national level. However, the National Research Council – CNR, has short-term mobility instruments, including an open call for senior and junior researchers, aimed at funding short periods of research in non-Italian European countries.

The introduction of the MIUR decree in November 2012 (DM 27 November 2012) resulted in guidelines for promoting the mobility of research units between PROs and HEIs.

According to the EC study on mobility and career paths (EC, 2010), the estimated proportion of internationally mobile HE researchers in Italy was 60% (56% EU), mainly concentrated in medical sciences and agriculture. The proportion of researchers who had moved to a new employer in another country as part of their research career was 32% (58% EU), whilst the proportion of researchers that completed one research visit to another country during their research career was 88% (78% EU). The estimated proportion of researchers that have worked in industry on a formal placement, internship, apprenticeship or similar was 18% (EU 28%), and the proportion of those who have been employed as researchers in both the public and the private sector was 17% (EU 16%).

Intra-EU inflow of doctoral candidates is very low in Italy (1% of the total number of doctoral candidates); The areas of origin of the candidates underline the low attractiveness of Italy: 95.7% are from Italy, 1.5% from EU-27, and 0.6% from other European countries.

The Berlusconi Government introduced a new scheme for the reform to doctorates in September 2011, based on reforms to universities in December 2010; a consultation, involving the CUN (National Committee for Universities), the CNSU (The Committee for student representation) and the ADI (Association of Italian Doctorates) criticised the reforms and requested of amendments 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 low investment in R&D compared with the EU27 in terms of both the gross expenditure and the government expenditure. This weak investment is associated with a limited number of people entering research within our job market. Italy has the lowest number of researchers per unit GDP among industrialised countries and the lowest percentage of researchers in the active population. The low availability of research positions in Italy is more greatly affected by the private sector than the public sector, given the low propensity of business enterprises to hire graduates. Some data from national sources help to describe the issues present.

According to a survey undertaken in 2012 by Almalaurea<sup>69</sup>, a consortium which includes the Conference of the Dean of Italian Universities, one year after graduation about 66% of graduates have entered the labour market, while 21%-23% are unemployed.

The University reform of 2010 limits the maximum period of post-doc positions 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 reforms to the PROs: people hired with a temporary research contract (either post-doc positions, contracts or others) 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<sup>70</sup> in Italy the average adjusted total yearly salary for researchers was €36,201, significantly lower than France (€50,879), Germany (€56,132) or United Kingdom (€56,048), and similar to Spain (€34,098). Looking at figures for net average yearly salary for researchers in terms of PPS (Purchasing Power Standard), we find Italy at €22,372, significantly below France, Germany and UK. Thus, Italy appears to be 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 prizes for brilliant high performing researchers are lacking. Opportunities are given to Italian researchers who participated in ERC selection, and had produced high quality and novel proposals, and who were selected but did not receive a grant. The FIRB opened its evaluative procedure to these kinds of projects.

From the end of 2011 budget law prevented any wage increase in the whole public sector, including universities and public research organisations. As such, the stagnation of FFO represents a barrier to young researchers who can obtain only fixed term contracts with a low probability of progression to a permanent position.

Permanent research positions in the public sector, in the case of university professors and researchers, are completely regulated by law. 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 hiring of non-Italian citizens, but there are no positive measures for encouraging it.

Universities and PROs can hire scientists working abroad for at least three years, providing them with specific fix-tem contracts, funded by their own resources though some calls for applications have been managed centrally by MIUR.

A clear system to establish the equivalence/validation of foreign academic degrees is in place, with MIUR supplying all the relevant information and assistance for international applications or

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<sup>69</sup> Almalaurea (2012);

<sup>70</sup> EC report (2007)

for research career purposes. A specific regulation was approved in 2009 (DPR 189/2009) and has been operative from January 2010.

Transfer of research grants to other national institutions is still limited, while transfer to foreign institutions is not allowed. The reform of 2010 to the University system changed the rules of academic recruitment resulting in selection based on merit and objective criteria. DL5 L5/2012 introduced financial resources to allow a call for researchers and professors within universities, and is still ongoing. The selection process aims to produce a register with candidates that have passed the selection, a provides a group from which single universities will select their staff.

The weakness of the whole process is the lack of resources within the whole university system, such that increase in workforce can only be achieved with difficulty.

### ***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 significant.

In order to tackle the problem of students having insufficient knowledge of mathematics and science, from 2010 several actions were undertaken aiming to renew the teaching of scientific disciplines in 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 at enhancing the competency of graduates in S&T fields.

Particularly support by MIUR was given to the diffusion of the scientific culture and to the development of scientific museums using the specific funding instrument of the L 6/2000

In general, a period in a foreign country is considered an essential step in the training of young researchers in Italy; universities encourage mobility during the graduate courses, and the Ph./post-doc period, but often do not have sufficient dedicated funds to support a longer stay abroad. Nevertheless a period in a foreign country is not considered a prerequisite for obtaining a permanent research position in universities or public research agencies. As for the labour market for researchers, fixed term contracts are becoming increasingly common and the budgets of HEIs and PROs act as a barrier to new permanent positions. Private investment in R&D in Italy is very low and reduces the hiring possibilities of universities and PROs. This results in on the one hand, the improvement of the number of researchers with non-tenured positions, but 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.

At the end of 2012 the FIRB and PRIN call earmarked a proportion of resources for young researchers.

### ***1.4 Promote equal treatment for women and men in research***

Italy has a gender gap which is not greatly different from the other European countries. The last She survey 2009 showed that in 2006 the proportion of female PhD graduates in Italy was 52% of the total (45% in EU27); compound annual growth rates of PhD graduates in the period 2002-2006 was 29.2% for both females and males. With regards to R&D in 2010 there was a significant gap in the business sector in the number of female personnel (20.4%), followed by HEIs 41.8% and PROs 44%.

As for human resources in S&T, even though with regards to education women represent 54.7% of the total population – greater than the EU27 average (51.6%) – considering employment they account for only 46.1%, which is under the EU27 average (50%). Among scientists and engineers, the proportion of women is below the EU27 average (respectively 31.6% and 39.7%).

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 opposing any measures which could create discrimination. The effectiveness of these Committees is more focussed on the promotion of cultural awareness, rather than impeding particular issues within careers.

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

Cross-border cooperation at the European level is important for those undertaking research, although Italy has not yet produced a dedicated policy which support joint programs and jointly funded activities.

At present Italy is involved in 144 ongoing initiatives within large EU programs in sectors such as Agriculture and Biotechnology (22 initiatives); Telecommunication and Information Science (22); Chemicals (14); Forestry (16) and Medical research (11)<sup>71</sup>.

MIUR, the Ministry for Universities and Research, plays a leading role in the management and coordination of a number of instruments and regulation of the amount of funds, ensuring there is financial support for Italian participation in initiatives such as COST, EUREKA and European Framework Programmes. The other Ministries involved, with more limited roles as research funders, are MISE and the Ministry of Health, which operates mainly through the ISS ("Istituto Superiore di Sanità").

Participation in the EUREKA initiative has also been important for Italy since its launch, and has emerged as a meaningful instrument for funding international industrial research. Italy participates in 346 of almost 1,700 EUREKA projects launched from the beginning of the initiative. Italy's financial commitment in these projects amounts to €2,200m. 42.5% of projects involving Italian participation concentrate on information technologies, 16% on robotics and 11.6% on the environmental disciplines. The breakdown of financial commitment by technological area shows that 50% was spent on information technologies, 16.3% on robotics and 14.7% on transportation<sup>72</sup>.

Finally, Italy has fully participated in EUFPs since their launch, through MIUR, which also serves to influence the priority-setting of the PNR. Italy has also joined important collaborative arrangements which concerns infrastructural facilities, supporting their establishment and improvement through financial contribution, towards several research facilities of European and national interest.

For example, Italy participates in ESA –European Space Agency- activities with direct contributions from Italian government through the National Space Agency (ASI-Agenzia Spaziale Italiana).

Italy also contributes to several inter-governmental research infrastructures such as 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), ICTP (the International Centre for theoretical Physics) and IIAS (International Institute of Administrative Sciences).

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

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<sup>71</sup>, EC (2010c);

<sup>72</sup> EC (2010c);

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

Finally, through the Ministry of Health and the ISS (National Health Institute) Italy also takes part in several initiatives and infrastructures in the field of medical research, such 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 have not been introduced.

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

The Italian strategy toward research infrastructures is traditionally bottom-up. Participation is essentially supported by the sectors which are most integrated international level, and it is strictly shaped by European strategies. According to the European Strategy Forum on Research Infrastructures (ESFRI) recommendations, each country should provide about €5-6 million as contribution aimed at sustaining the dedicated European budget.

Up until the 1990s, a special fund for infrastructures existed at the MIUR level (about €25m). Then, from 2000, it is more difficult to assess the national research investment for RI.

According to the 2010 ESFRI Report<sup>73</sup>, the process to formulate a new national Roadmap has started, but has not yet been finished.

Italy has its own research infrastructures, beyond participation in and access to international research infrastructures in some disciplinary fields, which operate mainly through the activity of some public research organisations and private institutions.

These include, for example, the infrastructures concerning nuclear and sub-nuclear physics at the INFN (Gran Sasso, Virgo,) in Italy and CERN, DESY, FERMI LAB at international level and the multi disciplinary infrastructures for the Science and Technology of Materials, Bio-materials and Nano-structures (CNR-INFN, consortium INSTM and Sincrotrone Trieste: Laboratorio Elettra in Italy and large scale international facilities in the form of ESRF, ILL, ISIS<sup>74</sup>). These are all examples of inter-governmental European infrastructure where Italian participation plays an important role.

The European Portal on research infrastructure services listed 44 RIs for Italy<sup>75</sup>, of which 14 are classified in the disciplinary 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, though none in social sciences<sup>76</sup>.

Considering the national level, infrastructures focussed on engineering sciences (CIRA, ASI e Politecnico di Milano which concern aerospace research, ENEA which focuses on anti-seismic engineering and other firms and public research organisations such as OGS, CNR, CONISMA which works in marine sciences), and infrastructures which work on high-power parallel calculations (CINECA, CILEA) are the most important. The governance of national infrastructures is regulated through agreements between the institutions in charge and MIUR.

As for the infrastructures concerning data transmission, GARR programs and the investment of a number of public institutions and inter-university Consortia have allowed the creation of an excellent Italian network for data transmission, giving rise to poles of excellence in the ICT sector. Most of these infrastructures are already involved in European programmes allowing the

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<sup>73</sup> ESFRI (2011);

<sup>74</sup> ISIS is the pulsed Neutron and Muon source at the Rutherford Appleton Laboratory in Oxfordshire of the Science and Technology Facilities Council;

<sup>75</sup> Data available at <http://www.riportal.eu/public/index.cfm?fuseaction=ri.search>;

<sup>76</sup> The total number is more than 44 because each RI can be classified in more than one scientific domain;

attainment of resources, aimed at implementing their opening at the international level and creating a network of researchers. In accordance with the ESFRI strategy report on infrastructures, Italy will coordinate the European Multidisciplinary Seafloor Observatory EMSO, for which construction will begin from 2013, the European Plate Observing System EPOS, under construction from 2015, the European Marine Biological Resource Centre EMBR, for which construction started in 2010, and Kilometre Cube Neutrino Telescope K3NET, under construction from 2013.

#### ***4. Strengthen research institutions, including notably universities***

There are 96 universities in Italy, of which 67 are public institutions (40 funded prior to 1980) and 11 are universities for distance learning. All the universities share the same mission and are involved both in education and research. In the last ten years the number of private universities increased, especially distance learning institutes. Currently, the university reform of 2010 is still under implementation by the university sector.

Generally, ordinary funding from MIUR (FFO) is primarily used to pay salaries and other fixed costs. There is not 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 more than 56% of the total HEIs income, while third party funding represents 25.1%, and students' fees 12.7% (CNVSU, 2011).

In Italy, universities have partial autonomy in determining the structure and content of their degree programs, as well as for opening and closing down study programs. In both cases they have to comply with "minimum requirements" or "quality requirements" settled by MIUR (by the way of ANVUR), which determine certain levels of resources and the study content of the curricula, which programs must assure.

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

The Government's aim 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 advantage given to local candidates and reinforce the quality of the selection; it also significantly enlarged the share of FFO that will be allocated on the basis of the evaluation (up to 10%).

Modification of University governance is another key element of the recent reform of Universities. MIUR wants Universities and public research organisations to become organisations driven by merit criteria in all their activities (teaching, research, services, training, etc). The reform obliges 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 to the number of Departments, which become the meso-level of governance for teaching and research, and 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. L 240/2010 foresees the evaluation of University researchers' and professors' activities in order to obtain salary improvements; D.lgs

213/2009 includes the evaluation of public research institutions as drivers of a significant part of funding allocation. Evaluation of public funding programmes is also included as an important element of the government programme. The ANVUR has been implemented and is supposed to ensure the support of MIUR initiatives. A new seven year evaluation exercise (VQR) was launched in 2011 by MIUR in order to assess the research performance of Universities and PROs. VQR evaluates the research performance of Universities and PROs based on a combination of peer review and bibliometric indicators from publications and patents submitted by the organisations. The outcome of VQR impacted on core funding allocation for a share of the FFO. In 2012 MIUR assigned €600.6m to Universities for research performance.

PROs are important players in the research system. Since 2009, PROs under MIUR supervision are implementing the reform (DL 213/2009), which demands the setting of new internal Statutes, a reform of governance, multi-year planning of activities which pursue scientific excellence, and integration with the private sector of research.

According to the Essential Science Indicators database<sup>77</sup>, the total number of Italian publications was 429,301 between 2001 and 2011 (8<sup>th</sup> in the global ranking) with 5,151,675 citations (8<sup>th</sup> in the global ranking).

However, since 2007 a slight decrease of Italian scientific output can be observed, as shown by the percentage of worldwide articles which were produced by Italian institutions on the world's scientific production: 3.5% in 2007, 3.4% in 2008, 3.3% in 2009<sup>78</sup>.

Besides the good scientific performance, Universities in Italy participate in academic patenting and recently the number of academic patents directly owned by Universities increased. In recent years a growing number of spin offs are attempting to transfer scientific excellence into economic advantages.

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

Italy has not established a system of financial support for the creation of technology transfer offices; Universities received some financial aid from the State, during a limited period- 2004-2005, through the funding ex art 12, DM of MIUR (5/8/2004, n, 262) as part of the programme for the university system for 2004-2006.

The European Innovation Scoreboard EIS indicators show a poor performance by Italy when compared to other countries in the indicators of 'innovative SMEs collaborating with others' and 'public-private co-publications': values are half of the EU-27 average, exhibiting a persisting difficulty for the Italian SME system in activating efficient exchange processes for acquiring new technologies and developing new applications.

Other interesting information comes from the NETVAL Report<sup>79</sup>. In Italy, since 1993, there have been a regular annual spin-off creation, which has increased since 2000 (the number of new spin offs doubled, from 22 new spin offs in 1999 to 43 in 2000), linked to the new incentive system, which introduced Government support for spin-off creation. Looking at the recent past the number of new spin offs were 116 in 2006, 138 in 2007, 114 in 2008, 75 in 2009. Despite the positive trend, at the end of 2009 there were only 873 spin offs in Italy, mainly located in the North (24.3% in the North West and 26.3% in the North East) and Centre (26.9%), with fewer in the South (22.5%). With regards to the sectors, 32.8 % are in ICT; 16.2% in energy and environment 16.2% and 15% in life sciences, the latter in particular showing a significant increase. Other spin-offs are involved in products and technologies such as electronics (9.3%), biomedicine (7.3%) and innovation services (7.4%) and, to a much lesser extent, sectors such as

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<sup>77</sup> The citation index can be downloaded at <http://archive.sciencewatch.com/dr/cou/2011/11decALL/>;

<sup>78</sup> Daraio C. and Moed H.F., (2010);

<sup>79</sup> NETVAL (2011);

nanotechnologies (3.4%) and space (0.7%). Although the number of spin off is low, firms created are robust: 90% of the existing firms were set up in the last ten years.

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

With regards to the knowledge interactions linked to human resources mobility, inter-sectoral mobility and the administrative framework regulating such mobility is not great, either because of the absence of specific incentives for individuals, or because of the fact the administrative framework does not, in practice, favour such mobility (slow and complicated bureaucratic requirements).

The recent University reform law obliged Universities to include business sector representatives on their Board as well as external members from local government and other research organisations.

## ***6. Enhance knowledge circulation across Europe and beyond***

Mobility schemes targeting researchers from developing countries are often undertaken independently by academic institutions. So far, the initial stages of looking at joint studying programs, which involve mobility of students of EU and non EU countries, have been completed, but there is no such research for researchers mobility. Nevertheless, an openness to Far East and, in particular Chinese, students and researchers has been observed. As an example Italy participates to the ASEM-DUO Fellowship Program, which supports visiting professors and students in the tertiary education field, aiming to contribute towards the establishment of regular-basis exchange programs between European and Asian tertiary institutions.

The programme was proposed in 2001 and it currently involves almost all EU countries and several Asian countries (Brunei, Japan, Korea, Myanmar, etc). Italy also joined to the CEI University Network (CEI UniNet), which has been in operation since 2004. This is the specific Central European Initiative for higher education and aims 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<sup>80</sup>.

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 been designed. CRUI has an active Working Group on Open Access, which is developing initiatives for enhancing Universities awareness and to sustain 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 concerning different scientific sectors, and were established by the MIUR and the MAE in conjunction with foreign scientific institutions, covering almost all European countries. In 2012 Italy was participating in 56 bilateral agreements, 9 multilateral entities and 1 multilateral cooperative programme (COST). Cooperation is carried out via the negotiation of

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<sup>80</sup> The information on CEI is available at <http://www.ceinet.org/>;

Executive Programmes for Scientific and Technological Cooperation within an intergovernmental Framework Agreement on Cultural, Educational, Scientific and Technological Cooperation<sup>81</sup>. 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) focussing on the priority research areas of Energy, Life Sciences, New Technologies and Innovative Materials;
- Slovenia and Italy (for 2011-2013) with the priority being 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) aimed at 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), focussing on 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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<sup>81</sup> Elena Pérez S., De Dominicis L., Guy K., (2010): Developing the European Research Area: Opening-up of National R&D Programmes and Joint R&D Policy Initiatives, JRC.

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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)
ADA	Agency for the Digital Agenda
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	<a href="#">European Recovery Programme Fund</a>
ESA	European Space Agency
ESF	European Social Fund
ESFRI	European Strategy Forum On Research Infrastructures
EU	European Union
EU27	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	<a href="#">European Framework Programme for Research and Technology Development</a>
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
NPR	National Reform Programme
NET	European Network On Research Programme Applied to the Protection of
HERITAGE	Tangible Cultural Heritage
NETVAL	Network For The Valorisation of University Research
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
VQR	Five-Year Research Evaluation Exercise
VTR	Three Years Evaluation Exercise

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#### Abstract

This analytical country report is one of a series of annual ERAWATCH reports produced for EU Member States and Countries Associated to the Seventh Framework Programme for Research of the European Union (FP7). 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.

The Country Report 2012 builds on and updates the 2011 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges, highlighting the latest developments, their dynamics and impact in the overall national context. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. These reports were originally produced in December 2012, focusing on policy developments over the previous twelve months.

The reports were produced by independent experts under direct contract with 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 external experts.

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new standards, methods and tools, and sharing and transferring its know-how to the Member States and international community.

Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.

