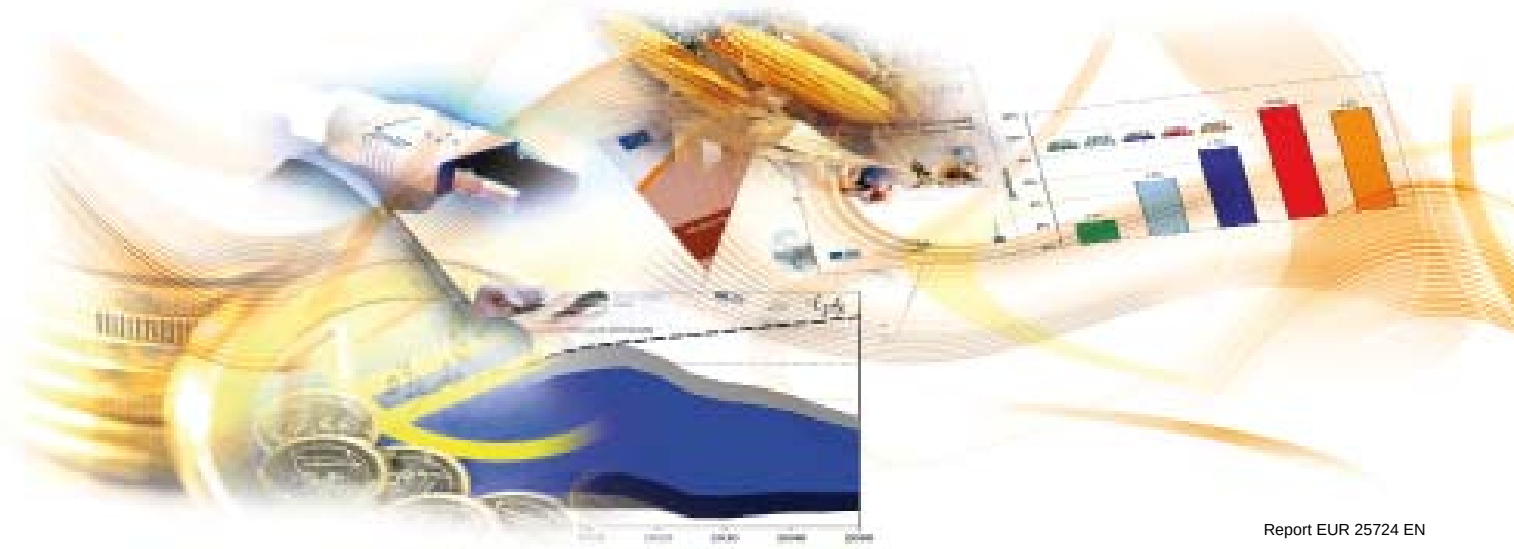
European Commission

JRC SCIENTIFIC AND POLICY REPORTS

ERAWATCH COUNTRY REPORTS 2011: SPAIN

Joost Heijs

2013



Report EUR 25724 EN

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JRC77842

EUR 25724 EN

ISBN 978-92-79-28127-3 (pdf)

ISSN 1831-9424 (online)

doi:10.2791/5619

Luxembourg: Publications Office of the European Union, 2013

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Printed in Spain

Acknowledgements and further information:

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). ERAWATCH is a joint initiative of the European Commission's Directorate General for Research and Innovation and Joint Research Centre.

The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from ERAWATCH Network Asbl. The report has been produced by the ERAWATCH Network under contract to JRC-IPTS. The first draft of this report was produced in November 2011 and is focused on developments taking place in the previous twelve months.

In particular, it has benefited from comments and suggestions of Marco Vivarelli, who reviewed the draft report. The contributions and comments of Fernando Hervás from JRC-IPTS and DG-RTD are also gratefully acknowledged. The author would like to thank the FECYT as National Contact Point of Spain for their thorough revision and comments on the draft versions and their direct involvement in the elaboration of the final version, although all inaccuracies that could persist are the responsibility of the author.

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

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Executive Summary

Spain can no longer be considered as a low wage country and the introduction of the Euro implies the loss of the exchange rate as an instrument to gain competitiveness. Instead of a barrier it can be interpreted as an opportunity to obligate the creation of positive mutually reinforcing virtuous circles based on an increase in the innovative culture of firms, R&D investments and new policies in order to overcome low labour productivity and lack of economic growth. In fact, in the years before the crisis Spain did carry out a clear restructuring and improvement of its policy mix and more than doubled the public budgets for public R&D and support for R&D and innovation (R&D&I). Moreover the New Spanish Innovation Strategy and the Law of Sustainable Economy (approved respectively in 2009 and 2011) reinforced the R&D&I policy (For details see the Mini Country report for Spain, 2011). Also in this moment of economic crisis the Spanish government and political parties consider R&D and innovation as a main driver for the future competitiveness of Spain and as a solution to beat the current crisis The concrete measures to overcome the crisis included specific support for R&D&I, and the total Spanish Government Budget Outlays on R&D (GBAORD - including the regional budgets) for 2009 still showed an increase (+3.4%). Moreover the decrease in 2010 (-6.5%) was clearly below the overall reduction in the state expenditures. For 2011 and 2012 only some provisional data are available on the predicted budget for public expenditures of the central government. In 2011 this budget decreased (-7.4%) and for 2012, due to general budgetary reasons, another reduction of €600m was announced by the Spanish government[1]. Anyhow, the Spanish innovation and science system doubled its Gross Expenditure on R&D (GERD) in the period 2002-2008. Regardless of this important growth in the years before the crisis, Spain is still lagging behind the most advanced economies in R&D activities. Their GERD reached a level of 1.35% of its GDP in 2008, which is still below the EU-27 average of 1.9%. Spain performs especially badly in the case of patenting and the creation of new technology - based firms. Since the beginning of the crisis (in the period 2009-2010) the GERD fell -0.76%, while the business expenditures decreased almost -7%. The GERD as % of GDP in 2010 was 1.39%, slightly higher than in 2009, 1.38%, while the BERD as % of GDP decreased from 0.74% in 2008 to 0.71% in 2010. Two remarkable trends can be mentioned: first the loss of almost 10,000 innovative firms in 2009 and 2010 (almost 24% of all innovative firms). Secondly, the selective way in which the BERD decreased. The firms spent substantially less on capital investment while the current costs decreased only slightly. In 2010 the basic R&D expenditures of firms also showed a clear decrease (13%). If this tendency were consolidated in the future it could affect the long term efficiency of R&D and the “technological level” of the future efforts and outcomes. It could represent a decrease in the advanced R&D activities at the edge of the technical frontier and a bias in the orientation towards more incrementally applied R&D.

[1] The new Spanish government did not have time to approve a new state budget for 2012 and extended the 2011 budget for 2012. However the government announced on December 30, 2011 that they will apply a €600 million cut on this extension for 2012. The final version of the State Budget of 2012 will be approved in April and some adjustments on the R&D related budget may still be introduced.

The main barrier to promoting R&D as a way out of the crisis is the structure of the Spanish production sector with a significant weight of small and medium sized firms in low-tech traditional sectors and a low innovative culture in all type of firms or sectors. Moreover Spain has a small high tech sector, a marginal growth of the promising emerging sectors and a lack of sufficient Spanish multinational enterprises that could have a leading role in creating R&D related networks or clusters based on scale and scope economies with their corresponding systemic advantages. There exist some specific measures to handle such problems as support for large scale, long term cooperative projects and the cluster policies (on regional and state levels) but it is not easy to solve these systemic failures. The annual survey of the COTEC Foundation (2011a) mentions as the main problems or obstacles: the lack of culture in the financial system for financing innovation; the lack of collaboration in innovation between firms and the insufficient potential of internal demand as an engine of innovation. Also the deficient level of excellence of the public research sector is an important weakness that partially makes the creation of a system based on synergies between private and public research more difficult (Heijs, 2010). The long term impact of the huge increase of the budgetary efforts of the Spanish government and private firms reflected in the growth of the GERD and BERD and the clear improvement of the policy mix –before the crisis- will be almost marginal if they are not accompanied by measures that ensure structural changes and modernisation of the public research system (Heijs, 2010). This endogamic system shows a lack of meritocracy and excellence; an inefficient use of resources, a lack of critical mass and fragmentation; a small number of academic spin-offs from technology based firms. Moreover there exists a mismatch between academic research and commercial or societal needs with a negative effect on the efficiency of the R&D efforts, the usefulness of the research results and on the quality of the human capital generated. These problems make technology and knowledge circulation more difficult and impede multiplier effects for the Spanish innovation system as a whole.

Typical for the Spanish case are the pluriannual National Plans for R&D and innovation (the National Plan or NP) which have a four-year time span. The duration of the last “National Plan” (2008-2011) is extended to 2012. Moreover, there exist overlapping institutions and policy measures between the central and regional policies in this field. However, at the same time some specific policies are more frequently made at regional level (such as the cluster policies). Also the real amount of support and the exact balance between thematic versus generic R&D funding of the public administration is difficult to assess.

Although the official priority setting by thematic areas of the R&D and innovation policies should be established in the National Plan the way of establishing the exact distribution of the budgets is not clear and far from transparent. Despite the inclusion of formal priorities in the NP the thematic focus was not a real policy intention but the factual consequence of aggregation of the funding of the different administrative units and ministries involved and this is decided in a decentralised way and ad hoc basis.

According to a statement of the Spanish Foundation of Science and Technology (FECYT) a thematic approach is not appropriate to analyse the National Plan. It was designed to create the appropriate environment for science and innovation and to overcome the limitations identified in earlier plans (OECD, 2006). Therefore its structure and the distribution of the funds are not based on topics but, rather, on instrumental priorities aimed at involving stakeholders in achieving collective goals through strategic and operational objectives, and developing their contribution to them. The available information of the programs does not enable a distribution

according to subjects to be easily drawn up. This new structure reduced, simplified and standardized tools, programs and actions, as well as increasing its visibility to the executors of the activities and decreasing the number of calls. Moreover, the new structure has involved a more selective process with a strong strategic component to create enough critical mass to achieve an innovative environment. This was the highest priority. In the near future a policy based on thematic priorities should be established (FECYT, SISE Report 2010).

In any case some specific aspects or thematic fields are receiving growing attention in Spanish R&D and innovation policies. Examples of this are public- private cooperation, the commercial usefulness of public R&D, the solution to the major societal challenges and the contribution to sustainable development (See ERAWATCH Mini Country report for Spain, 2011, section 2.2). Moreover an increasing use of loans (to the detriment of subsidies) was identified. The subsidies are mainly used for scientific research in the public sector while the credits are used to promote R&D and innovation in enterprises. Maybe the most important tendency in the policy mix in the last decade was a clear shift towards innovation policies and knowledge transfer from science to industry and competitive funding. Almost all new initiatives increased the promotion of cooperation between the scientific system and enterprises. This is a continuous change often difficult to track with exact data or to pinpoint at a specific moment. Also several instruments were created to generate large long term strategic projects based on public private cooperation (PPC) in order to create a critical mass. In 2010-2011 some new measures were initiated to solve some specific problems. A first important novelty is the **Spanish Innovation Strategy 2010-2015** (E2i-Strategy), which reinforced some existing measures such as the financial support for R&D&I in firms and especially the funds for risk capital and the support for cooperation between enterprises and the scientific sector. Moreover, this strategy introduced for the first time in Spain a demand-oriented R&D&I policy in the form of innovation- based public procurement (IBPP). Moreover the strategy includes some specific measures to foster the interregional integration of the Spanish innovation system. A second “novelty” is the implementation strategy report of the AVANZA2 Plan (2011-2015) that promotes the diffusion of the Information and Communication Technologies (ICT) by firms and users (consumers) in order to ensure the use of advanced ICT products and services.

Spain still lacks some instruments for some specific aspects. It has no special or specific support schemes to stimulate firms that do not perform R&D yet[2] or to attract R&D-performing firms from abroad. Moreover the demand- side polices are of growing importance, however, still underdeveloped. Another policy challenge could be based on the above mentioned selective cut of the BERD, which might require new measures. Despite these facts Spain has at the present time a broad policy mix with a huge set of differentiated instruments that try to tackle almost all the barriers and weaknesses of the Spanish innovation system. However, the existence of instruments is not enough because they do not handle the systemic failures related to the functioning of the R&D agents. As argued above, the long term impact of this policy mix could be low if the Spanish government does not initiate the institutional modernisation of the public research system. Therefore, the real changes have to come from the scientific world and this requires a new open and competitive approach or culture on doing useful, high quality research. In fact, the research and educational activities of the vast majority of the universities and public research

[2] Create a footnote in the corresponding section

organisations are not being evaluated. On the one hand the research institutions need more freedom (especially in the case of salaries and budget cycles) to allow long term strategic planning and to compete with R&D institutes abroad. The basic principles of the present configuration of the Spanish innovation system (based on the Science Law of 1986) will change drastically. On the one hand, this is due to the new Law on Science, Technology and Innovation (STI law: approved in May 2011 – see the box below and for details annex 2). However this new law does not solve the above-mentioned problems of an inefficient public research system. Moreover the new President in charge since the 21st of December did close down the Ministry of Innovation and its responsibilities are assigned mainly to the new Ministry of Economics and Competiveness that includes a State Secretary of Research, Development and Innovation[3].

Box 1: The new Law on Science, Technology and Innovation

The new Law on Science, Technology and Innovation (approved in June 2011 and operative since the beginning of December 2011) will generate several changes in the Spanish innovation system and its institutional setting. An important novelty of the new Law is its inclusion of the terms "technology and innovation" aimed at the integration of those types of activities with scientific research. The STI Law allows for some changes in the organisational structure. The current General Council of Science & Technology and the Advisory Council of Science & Technology will be replaced by a Scientific & Technology Policy Council (STPC) and an Advisory Council of Science & Innovation (ACSI). Moreover, two funding agencies of the public system are envisaged, the present Technological and Industrial Development Centre (CDTI – already in existence) and a new State Research Agency (NRA). The new STI Law also improves several aspects in the career of the researchers, especially in the case of the young researchers and those of the public research organisations. However it does not solve the main systemic obstacles mentioned above

[3] At the moment when this report was written the exact and final distribution of responsibilities was still not clear. Updated information will be available in Spanish Country profile of the ERAWATCH website.

TABLE OF CONTENTS

Introduction

Spain has 45.9 million inhabitants (9.2% of the whole of Europe) and produces around 8.7% of the GDP of the EU-27. The GDP per capita (22,800€) in 2010 was 7% below the EU-27 average of 24,400€[4]. The crisis in Spain especially affected the unemployment rate, which rose to the highest in Europe (22.7% in November 2011)[5]. Spanish GDP decreased -3.7% and -0.1% respectively in 2009 and 2010 while in the Euro Zone these percentages were respectively -4.2 and +1.8%. With regard to the input side of the innovation and science system Spain made strong efforts in the period 2002-2008 when their Gross Expenditures on R&D (GERD) in absolute term duplicated while in relative terms the GERD by GDP increased from 0.99% in 2002 to 1.35% in 2008. Moreover there was a restructuring of their policy mix on R&D and innovation including new instruments that should tackle the main challenges and overcome bottlenecks mentioned in the OECD report of 2006 (for details see ERAWATCH country report 2009). However, the financial crisis cut short the positive trend. In 2009 the GERD decreased by -0.8% and in 2010 it increased slightly (0.1%) reaching a GERD of €14,588m (Despite this tendency the GERD by GDP increased to 1.39%). Business R&D expenditures (BERD) decreased respectively by -6.3% and -0.8%, and there was a remarkable decrease in the number of innovative firms -9.6% in 2009 and -17.9% in 2010 The INE data on the statistics of R&D showed a 9.5% increase in the public R&D expenditures in 2009 and a 0.1% one in 2010. The Eurostat data of the foreseen Government Budget Appropriations or Outlays on R&D (GBAORD) in Spain and its regions increased in 2009 to 3.4 (0.83% of the GDP) .However, in 2010 the foreseen budget decreased (-6.5), reaching a budget of €8,134m. For 2011 and 2012 only some provisional data are available on the foreseen budget for public expenditures of the central government. This state level budget (All data comes from the annual reports of COTEC and COSCE) increased from €4,000m in 2003 to €9,673m in 2009. After a slight decrease in 2010 the foreseen budget for 2011 decreased to €8,590m (-7.4%) and for 2012 another 7% reduction was announced[6]. It must be pointed out that the foreseen state budgets for 2011 and 2012 do not include only direct expenditures and subsidies on R&D but also loans. In fact, in 2011 the role of loans increased while the budget for subsidies decreased, which implies, de facto, an even higher decrease. Anyhow, the Spanish government consider R&D&I as a central activity to overcome the crisis and the decrease in the public budget for R&D&I is below the average cut.

The number of persons employed in R&D activities in 2010 was 222,022 (Full Time Equivalent - FTE). This implies an increase of more than 64% since 2002. In 2009 and 2010 the number increased respectively by 2.4% and 0.6%. Based on the FTE

[4] Data on Europe are from Eurostat and data on Spain from the INE except when indicated differently.

[5] In this report the most recent data are used. However most of them, such as the data of the Unemployment, Community Innovation Survey and the Official Statistics on R&D, are provisional data that can change slightly and even on some occasions the differences to can be remarkable. This is particularly so in the case of regionalised or sector data or those R&D data related to the GDP. Here the differences can be important.

[6] The new Spanish government did not have time to approve a new state budget for 2012 and extended the 2011 budget. So the foreseen budgets for both years are formally. However the government announced on December 30, 2011 that they will apply a cut of €600 million on this extension for 2012.

data, 42% are working in the private sector, 37% in universities and 21% in public research organisations (INE data for 2010). The number of scientists and engineers (from 25 -64 years) as a percentage of the total labour force in Spain (4.6%) is somewhat below the EU-27 average (5.3%) although it is still far behind the leading European countries. Human resources in science and technology (HRST) as a share of the active population in the 25-64 age group are in Spain 39%, which is 1.5% percentage points below the EU-27 average of 40.5% (Eurostat data for 2010). With regard to the output side of the Spanish innovation system it can be stated that Spain shows an increasing level of production –especially in the case of publication, while patenting is still its main weakness[7]. Spain in 2009 produced 61,493 publications, which implies 1,282 publications per million inhabitants (685 in 1999). This level is just below the level of the US (1,352), France (1,388) or Germany (1,409). However it is far below countries like Switzerland, (3,583), the Netherlands (2,360) or Sweden (2,650). The quality of the publications (measured by the number of citations in the period 2003-2009) seems to be low. Each Spanish publication is cited 13.6 times while the publications from countries such as the UK, the USA or the Scandinavian countries are cited on average 18-22 times[8]. In the case of patents, the Spanish production increased in each year in the period 2001-2008. However it was and is still at a very low level. In 2009 for the first time the number of patent applications by the national and European Patent Offices declined. Spain produced in 2009 over 31.6 European patents per million inhabitants, far below the EU-27 average of 115.8 (Eurostat Data). To analyse the "quality" of the Spanish patents in relation to other countries the TRIADE patents can be used (Patents that are protected simultaneously by the European, Japanese and American Patent office). Spain had, in 2008, 4.9 TRIADE patents by million of inhabitants while the EU-27 average is 29.1. In other words, in the case of the European patents Spain is at 27.2% of the EU-27 level while in the case of the most important patents this relative technological level is even worse (only 16.8%).

Regardless of the important growth in the GERD before the crisis, Spain is still lagging behind the most advanced economies in R&D activities and their R&D by GDP (1.39% in 2010) is still a long way short of the Spanish Lisbon Objective of 2%, established in the National Reform Programme of 2005 and the related "INGENIO 2010 programme". Also the complementary objective -a private participation of 55% in the financing of the GERD- was not achieved, in 2010 the enterprise financed only 45% and executed 52%. Despite these facts the Spanish government and all political parties strongly support the R&D and innovation policy initiatives in order to foster economic recovery and productivity growth and to assist the structural change of the production system towards emerging high tech sectors. They consider it as the only way to overcome the weakness of the existing Spanish low-tech industrial structure, because Spain has to compete nowadays with industrialised low wage countries (like the global players such as China or India or the Eastern European EU countries). Spain has opted for R&D as a solution to overcome the crisis. However, the efforts made in the past do not ensure the necessary modernisation of the public institutional framework. This impedes a real long-term impact and perpetuates the fragmentation, the unsatisfactory level of excellence, and weak science industry

[7]Publication data are based on the SCOPUS data base and taken from COTEC (2011) and FECYT (2011). The patent data are taken from the Eurostat.

[8] The average number of citations in those countries is: UK: 18.29; USA: 20.26, Sweden: 20.67 and Denmark: 22.14: However other advanced countries show a lower level of citations like Japan: 12.33 (Taken from COTEC 2011).

linkages (See § 2). As will be explained in detail in § 3.3 almost 50% of the Spanish support for R&D is distributed as non-oriented generic funds while the most important –also broad- fields are industrial production and technology, transport, telecommunication and other infrastructures, agriculture and health.. Complementary, and taking into account only the support focussed to the production sectors the highest absolute R&D expenditures in 2010 are: R&D based services (that include the technology centres; NACE 72, 21%); pharmaceuticals (NACE 21, 8.4%); programming, consultancy and other activities of informatics (NACE 62, 8.1%); other transport material (NACE 30, 7.6%) and motor vehicles (NACE 29, 5.1%). They are responsible for over 50% of the BERD in 2010.

The main responsibilities for research and innovation policy design and operational management were concentrated –till the end of December 2011- in the Ministry of Science and Innovation, which distributed (in 2010) 65% of the Spanish State Budget[9] on R&D&I (FECYT, 2011a, P. 21). The new President in office since December 21st closed down the Ministry of Innovation and its responsibilities have been assigned mainly to the new Ministry of Economics and Competitiveness, which includes a State Secretary of Research, Development and Innovation[10]. The Ministry of Industry, Tourism and Commerce accounted for 30% of the budget, which is basically devoted to innovation and largely delivered in the form of credits to firms or other agents, especially in the field of information and telecommunication technologies. Other players are the Ministry of Defence (2.5%) and the Ministry of Education with 1.6% of the total R&D-related funds of the Spanish State Budget. Formally the design, planning and coordination of the main Spanish instrument for R&D policy – the pluriannual National Plan for R&D and Innovation (4 years) – was assigned (till the end of December 2011) to the Ministry of Science and Innovation (by its General Directorate for Research and the management of the National R&D&i Plan) taking into account the formal role of the Inter-ministerial Commission on Science and Technology (CICYT). The new government - in office since December 21st 2011 - assigned these responsibilities to the Ministry of Economics and Competitiveness.

The CICYT is advised by its Monitoring and Support Commission (CAS-CICYT). Spain has a quasi-federal decentralised political system which is also reflected in its R&D and innovation-related policies. There is no clear division of responsibility between national and regional administrative levels since nowadays most regions have similar R&D plans and on both administrative levels (national and regional) there coexist a large number of – often overlapping – instruments, programmes and agencies[11] (EW policy mix report 2010). However some specific policies are more often carried out on a regional level, such as cluster policies and SME oriented measures, Moreover the regional governments are also in charge of the universities.

Three regions accounted in 2010 for 57% of all R&D expenditures. Madrid (26%), Catalonia (22%) and the Basque Country (9%) are the leading regions with a GERD

[9] Contrary to the case of the GBAORD data this budget includes not only subsidies and direct or indirect R&D&I expenditures but also the loans and credits.

[10] At the moment when this report was written it the final distribution of responsibilities was still not clear. Updated information will be available in the website of the ERAWATCH country page for Spain.

[11] Such as the case of scholarships for PhD students; R&D project support for firms, PRO or HEI; National and regional agencies that has to vouch for the researchers and give them a declaration that their experience is suitable to fulfil certain levels of jobs as a researcher. Moreover several regional R&D policy plans are similar to the National Plan of R&D&I.

by GDP of 2.02%; 1.63% and 1.95% respectively[12]. This strong imbalance between regions –existing in most of the developed countries- is a weakness which is difficult to overcome due to the advantages of scale, indivisibilities and the need for a critical mass. Due to the need for efficiency policymakers should ensure that support is concentrated and avoid a dispersion of the support based on convergence arguments. Such a dispersion - based strategy often applied in the national and even regional policy is an important shortcoming of the Spanish R&D&I policies (Heijs, 2010).

The basic principles of the present configuration of the Spanish innovation system and R&D policy framework were based on the so-called Science Law of 1986 and the organograms below reflect the situation which was operative until December 2011. However, 2012 will bring some drastic changes[13]. Firstly this is because of the new Law on Science, Technology and Innovation approved in May 2011 and officially operative since December 2011. However the main changes of the institutional system have to be implemented in 2012 and are, therefore detailed in annex 2. Secondly the new Spanish President in office since December 23rd did close down the Ministry of Innovation and its responsibilities are assigned mainly to the new Ministry of Economics and Competitiveness[14]. This changes the organisational chart and again the new structure (not totally revealed when this report was written) can be seen in annex 2.

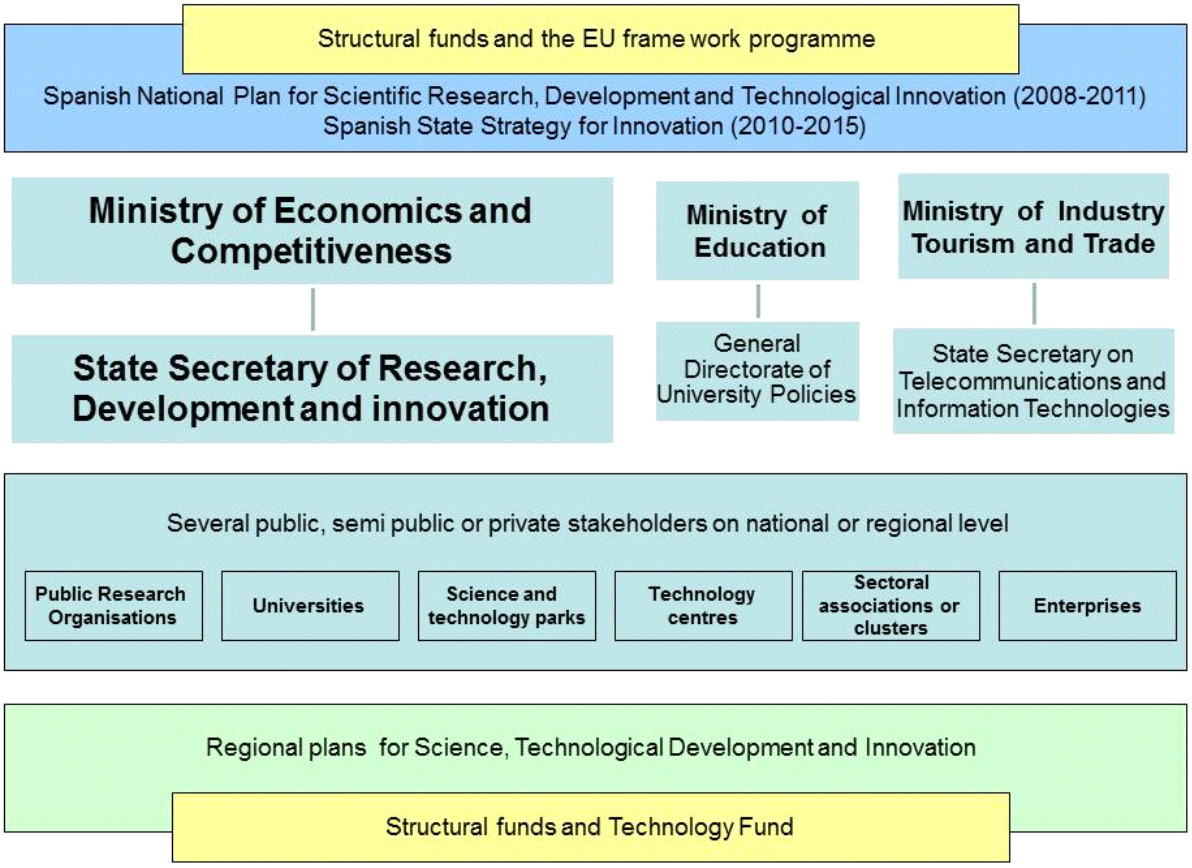
An important novelty of the new STI Law is its inclusion of the terms “technology and innovation” aimed at the integration of those types of activities with scientific research. The STI Law foresees some changes in the organisational structure. The current General Council of Science & Technology and the Advisory Council of Science & Technology will be substituted by a Scientific & Technology Policy Council (STPC) and an Advisory Council of Science & Innovation (ACSI). Moreover, two funding agencies of the public system are foreseen: the present Technological Industrial Development Centre (CDTI – already in existence) and a new State Research Agency (NRA). The new STI Law also improves several aspects in the career of the researchers, especially in the case of the young researchers and those of the public research organisations. (For details of the changes envisaged see annex 2). However the new STI law does not resolve the main systemic failures and obstacles of an inefficient public research system mentioned in section two.

[12] The data are provisional especially in the case of the GERD by GDP. Two other remarkable regions are Andalusia with 12% of the GERD. However this is a very large region of Spain and in fact its GERD by GDP is only 1.2%. The other region is Navarra, a small region ,though its GERD by GDP is very high 2.0 in 2010

[13] In this section the real situation in 2011 is reflected. However the last changes in December 2011 and the changes envisaged for 2012 are reflected –as far as they are already revealed and assured- in annex 2.

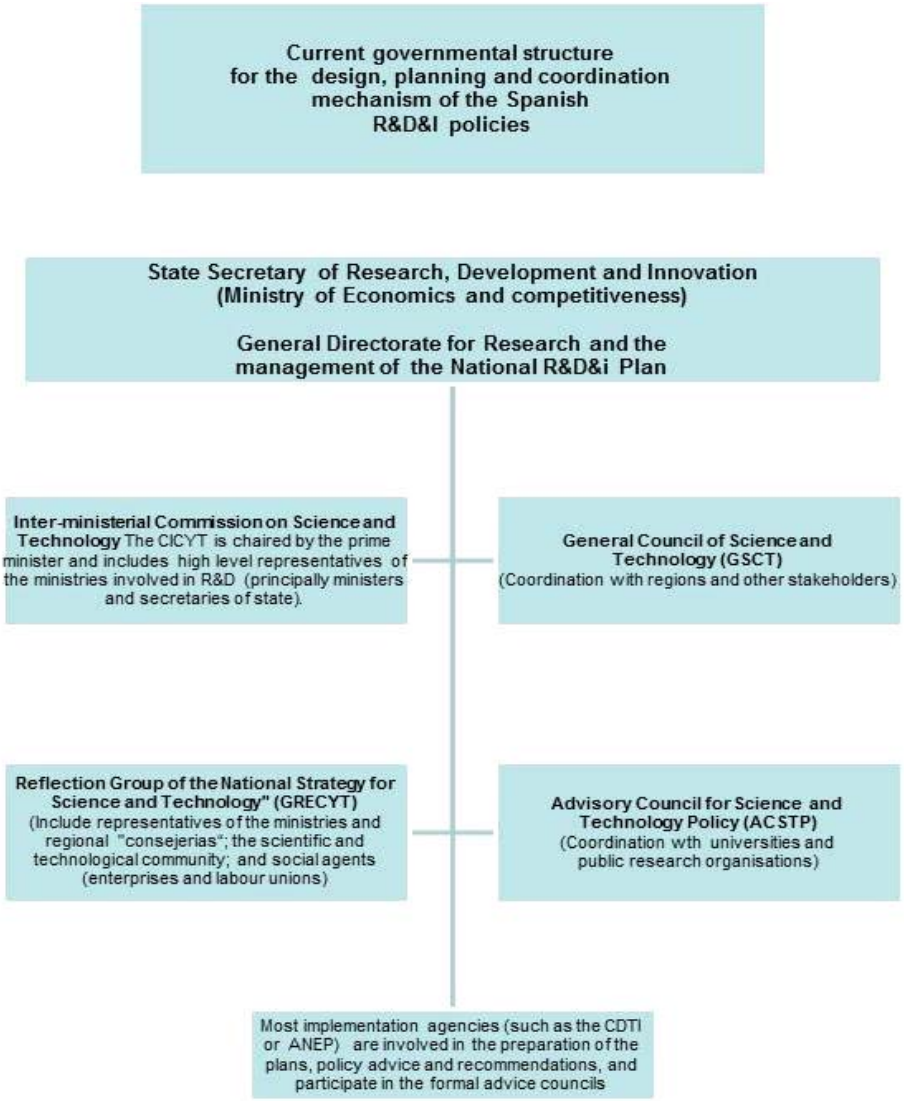
[14] At this moment it is not clear what the exact distribution will be. I hope to add some new information before the final publication especially in figures 1 and 2. Both figures are based on the data available on December 29th and will be adjusted for the latest changes just before the moment when the report is published and after the Revision of IPTS

Figure 1: The Spanish structure of science and innovation policies since December 21st 2011



Source: Own elaboration. Yellow reflects the European policies, green refers to the regional initiatives and blue to the national policies. The "green-blue" block in the middle indicates generically the existence of several agents or stakeholders of different levels.

Figure 1: Governance of the Spanish R&D and innovation policies before the implementation of the new Law on Science, Technology and Innovation) (For the new structure in 2012 see annex 2)



Structural challenges faced by the national system

Spain can no longer be considered as a low wage country and the introduction of the Euro implies the loss of the exchange rate as an instrument to gain competitiveness. These structural changes –especially notable in the case of the design for a strategy to overcome the economic crisis- force the Spanish firms to compete in innovation and quality. Instead of a barrier they can be interpreted as an opportunity to obligate the creation of positive mutually reinforcing virtuous circles based on an increase of: the innovative culture of firms, the R&D investments and new policies in order to overcome the low labour productivity and growth (Heijs, 2010). This brings us to one of the main barriers for the increase of the R&D efforts in Spain:the structure of the Spanish production sector with a significant weight of small and medium sized firms in low-tech traditional sectors (ERAWATCH, 2010, 2009; EC, 2011a). Furthermore, the Spanish productive structure as a whole lacks technological capabilities and has a low innovative culture (COTEC, 2011), where innovation is considered more as a

short term problem solving activity than as a strategic option for future long-term development. Anyhow, innovation and technological change is considered as the only way to overcome the existing Spanish low-tech industrial structure. Spain has to compete nowadays with industrialised low wage countries including global players such as China or India or the Eastern European EU countries (such as Poland, Romania, etc…). The increasing wages generated a relocation of production units of traditional sectors to the above mentioned low wage countries, a tendency which has increased in this period of financial crisis. This in itself would not be the problem if at the same time new firms in medium high tech sectors had been created but this is not really the case. The relocation of firms from traditional sectors could be partially delayed with specific policies to foster in-house R&D in non-innovative firms15. Such instruments, non- existent in Spain16, together with the existing cluster policies or instruments focused on technology transfer, could be important to reactivate those low tech sectors and to ensure the survival of at least some firms by creating innovative products with a higher added value. However, it is just the small and medium sized firms (with 10 to 49 employees) that (in 2009) reduced their R&D expenditures more intensively (see § 3.2 or COTEC 2011a). On the other hand, Spain has a small high tech sector and a marginal growth of the promising emerging sectors. The firms of these sectors seem to have increased (at least in 2009) their R&D efforts. This is because the Spanish innovative firms with fewer than 10 employees did increase their R&D expenditures by almost 16% while their number increased by 9.6%. Another important problem of the Spanish production sector is the lack of sufficient Spanish multinational enterprises that could have a leading role in creating R&D related networks or clusters based on scale and scope economies with the corresponding systemic advantages. Another structural and historical weakness and barrier in relation to the enterprises is the low level of patenting (COTEC, 2011a) which is on a level constituting 32% of the European average (Innovation Union Scoreboard (IUSB), EC, 2010b). The annual survey of the COTEC Foundation (2011a) - carried out at the end of 2010- showed that the main problems or obstacles are: the lack of culture in the financial system for financing innovation (mentioned as very important by 80% of the correspondents); the lack of collaboration in innovation between firms (78%) and the insufficient potential of internal demand as an engine of innovation (83%). This latter problem is also highlighted indirectly by the Spanish version of the Community Innovation Survey in companies (CIS) of 2009 where 28% of the firms consider the lack of demand a reason for not innovating and 29% of the firms consider demand as the main difficulty for innovation. Also the lack of allocation of resources (human and financial) is considered by the COTEC survey as a very important problem (74%) together with the lack of public support for emerging sectors (69%). Also in this case the SIS supports these findings, because 45% of the innovative firms mentioned the cost factor as a very important difficulty. The COTEC survey also asks about some tendencies and showed a growing preoccupation with the decline of: the availability

[15] Beside the instruments to promote R&D in "non-innovative firms" an important policy is the development of processes to spread innovation to all firms which could be based on “non-R&D" based innovation. In low-tech sectors, investing in capital equipment (purchase of incorporated innovation) is often more productive than investing in R&D, in terms of productivity improvements. For the specific existing measures on technology transfer and public private cooperation see the ERAWATCH country page for Spain section 4.3.

[16] Although several instruments (like the National Programme for Applied Research or for Experimental Development) and agencies (like the CDTI) foster in-house R&D in small and medium firms, no specific programme for non-R&D performing firms do exist.

of public support (83% considered this as a negative trend); technological competitiveness (57%); the innovative culture (48%); and entrepreneurial dynamism in relation to innovative threats (53%). A number of those weaknesses are confirmed by the Innovation Union Scoreboard (IUSB). This report considers the performance of Spain as a moderate innovator[17] and identifies as relative weaknesses firms' investments in R&D, the existing linkages and entrepreneurship and the level of intellectual assets and -with a strong decline- the availability of venture capital.

Several of the above mentioned challenges require a targeted industrial policy. However it is not easy to force the creation of strong clusters or high tech sectors. Some instruments for cluster policies exist on a regional level and also on a national level (For details see section 3.4). Moreover, Spain does not have specific instruments to attract R&D-performing firms from abroad, which is another important problem mentioned by COTEC (2011a). The implementation of such policies (cluster policies and attracting R&D performers from abroad) could be difficult due to the insufficient low level of excellence of a large number of (public) R&D institutes[18] (see below). The attraction of foreign R&D performers requires excellence. Concluding this problem of excellence impedes the creation of virtuous circles that increase the R&D investments in foreign or domestic firms. In fact, the public research sector is still one of the main weaknesses to ensure a system based on synergies between private and public research (Ramos, 2008; Heijs, 2010; ERAWATCH, 2010). The public R&D system is characterised by its fragmentation and lack of institutional strategies in most research centres and universities. These public institutions do not exert their autonomy to develop strategies for specialisation and excellence to promote the transfer of their knowledge to the production sector in order to support the Spanish economic development. Although Spain was one of the leading countries in relation to the growth of the gross expenditures in public R&D (EC, 2011a) the long term impact of these growing financial efforts will be almost zero if they are not accompanied by measures that ensure structural changes and modernisation of the public research system (Heijs, 2010). The lack of meritocracy and excellence; the inefficient use of resources, the lack of critical mass and the fragmentation of its public research system (in public research organisations and especially in universities); the small number of academic spin-offs of technology based firms and the mismatch between academic research and commercial or societal needs has a negative effect on the usefulness of the research results and the quality of the generated human capital.[19] These problems make technology and

[17] Together with the Czech Republic, Greece, Hungary, Italy, Malta, Poland, Portugal and Slovakia

[18] This report points out in several places the lack of excellence (and its reasons) of the public research sector with specific data and the lack of integration of the science versus production structure. Summarising this fragmented information on **the lack of excellence** it can be stated that (1) the Spanish public research sector has a low efficiency with a high cost per student or publication; (2) almost 25% of the researchers do not meet a (low) minimum level of production to obtain an official recognition of a minimum level of productivity (for point 1 and 2 see this section); (3) the number of publications is somewhat below the world average, although the quality of these publications (average number of citations is low (section 1), (4) have a high level of endogamy (see annex 1.1.2.1), (5) productivity affects the salaries only marginally (idem); (6) the evaluation of public research institutes and individual researchers is not systematic nor compulsory. With regard to the **lack of integration of the science versus production structure** it can be stated that (1) the main criteria for the evaluation of the researchers is based on scientific publications while the application or technology transfer is rewarded only marginally (annex 1.1.2.1); (2) the universities have a high level of Autonomy and firms or other stakeholders have only a marginal role (in their decision making process (see annex 1.4); (3) low level of patenting).

[19] For details on these aspects see also annex 1 section 1.2.2. and section 4.

knowledge circulation more difficult and impede multiplier effects for the Spanish innovation system as a whole. The low average level of excellence and quality of the research results –which do not reach a sufficient level- means that Spanish firms maybe will contract R&D abroad and foreign subsidiaries, will not locate R&D in Spain. In conclusion, the above mentioned aspects can be considered as systemic failures and should be tackled in the planned reforms to ensure a modernisation of public research and consequently a continuous growth of its R&D expenditures and knowledge circulation. Below (and also in annex 1) some of the above mentioned aspects will be analysed in more detail[20].

The fact that Spain has an above average figure of scientific publications apparently reflects the strength of the science sector. However, this high level is accompanied by a low impact factor of those publications. Moreover, it reflects the scientific orientation of the public research sector and, indirectly, the distance between science and he production sector. In other words, the Spanish scientists are more prone to scientific activities than to responding to the demands of the production sector. This is partially the result of the evaluation system of scientific researchers based on the number of publications in scientific referenced journals while applied research or technology transfer are almost neglected in those criteria (see also annex 1.2.1).

Another important barrier is the inefficient use of the resources of scientific research especially in the case of the universities. The empirical analysis of Hernandez and Perez (2011) indicates three main reasons this inefficiency. First of all, the growing number of new universities or local campuses was created by the regional governments despite the lack of demand from potential students. A second cause is the fact that the future stable employment of young researchers or university professors in the public sector depends almost exclusively on the possibilities in their own organisation, which generated a strategy of internal growth. To justify this growth new studies and degrees (including expert or master courses) were created again without the necessary demand from students. Both tendencies increased the costs per student exponentially. A third form of inefficiency is based on the low productivity and insufficient excellence level of the research activities. Almost 25% of the Spanish public scientific researchers –despite the existing very low minimum requirements- do not have a formal recognition of their research activities (ERAWATCH, 2010; Hernandez/Perez, 2011). One of the causes is the very low –or almost non-existent- payments for productivity or excellence for their research and educational activities. And the few existing mechanisms have a very low discriminating level due to the low minimum requirements.

The mutual coordination between the scientific and productive sector is almost non-existent. There exists only a marginal role for the users and stakeholders in the teaching, research and innovation activities of the universities. This has a negative effect on the matching of study plans with the future requirements on the labour market and of the usefulness of the research outcome. The principle of “University Autonomy” is protected by the Spanish constitution and offered the universities a broad level of self-government. This implies that they are highly likely to defend the personal interest of the researchers (corporative behaviour) rather than the general interest of society as a whole. This created a situation in which most universities or research centres can be characterised as a closed community with a low level of

[20]In this paragraph the main problems will be mentioned and some recent data will be presented. The annex of this report and the ERAWATCH Country Report for 2009 includes a specific and more detailed analysis of most of the subjects.

transparency rather than an open dynamic organisation based on meritocracy. For example, the vast majority of the curricula of universities are designed taking into account the interests and power of their lecturers without any influence from other stakeholders or a serious study about future societal needs. This generated a mismatch of the skills and knowledge of the students in relation to the (future) demand for human capital. This mismatch is considered by the COTEC survey experts as a very important (59%) or important (31%) problem. This mismatch is also clear in the case of PhD holders. In general the managers of human resources in Spain recognise a low added value in the fact that somebody has a PhD and on several occasions it has a negative effect[21]. Only 15% of the PhD holders work in the private sector while in Germany, Austria or the USA this percentage is around 35%. Also the present day model of research is regulated by the researchers themselves and does not promote cooperation or connection with the social and economic environment. It generated a fragmentation of the research groups (lack of critical mass) and a lack of coordination. This absolute freedom of each researcher concerning his/her own research activities impedes or makes it very difficult –even for the universities themselves- to implement a strategic plan that integrates the different partial interests of every kind of internal and external stakeholders. This autonomy of research and education coexists with a reduced level of "economic" autonomy, because almost all financial resources come from the General State Budget (GSB). However, this economic dependency has never been used to orient the research or educational activities of universities or to force universities to open up and professionalize their institutions. The recent legal changes and the new Law on science, technology and innovation of April 2011 do not resolve the problems of excellence and endogamy. It still leaves a high level of discretional space in the selection mechanisms and does not impede the abuse of the "scientific" autonomy of universities. Such abuse could be corrected by the distribution of the public funds for block funding. Taking into account the economic or financial dependency of the universities, the regional governments develop a creative application of the distribution criteria requiring better ways of organisation and selection of researchers.

Assessment of the national innovation strategy

National research and innovation priorities

In relation to the policy goals two or three important policy documents can be mentioned. The first is the National Reform Programme (INGENIO 2010) that indicated the specific goals to meet the challenges of the Lisbon Strategy. Spain pursues an increase in the ratio of R&D investment by GDP to 2% with private participation in the funding of 55%.Typical for the Spanish case are the pluriannual National Plans for R&D and innovation (the National Plan or NP) which have a four-year time span. The last "National Plan" (2008-2011 and extended to 2012) was designed after a thorough review of the needs and problems of the Spanish innovation system (see OECD 2006).This comprehensive policy programme has six main objectives which are presented in the box together with a short description of their 24 specific principles or sub- objectives (24 in total - for each of the following

[21] Opinion of senior experts in Human Resources of Randstad and Adecco (taken from the Newspaper Expansion, 28-10-2006)

items they indicate their number). However, the national plan also includes quantitative objectives based on the pursued improvement of 16 statistical R&D indicators.

Box 1: Main and particular objectives of the Spanish R&D and innovation policy (between brackets the number of the particular objectives for each main one)

I. **Putting Spain in the vanguard of knowledge (3):** Raising the profile of knowledge generation; finance based on criteria of excellence and demand; increasing the number of researchers and their qualification.

II. **Promoting a highly competitive structure of firms (5):** (1) Increasing the capacity of the Science and Technology (S&T) infrastructure organisations and (2) its interdisciplinary use by all agents, especially small- and medium-sized enterprises (SMEs), fostering (3) cooperation and (4) technology transfer; (5) matching R&D to demand in the markets.

III. **Integrating the regional level into the national S&T system: (3)** (1) Encouraging coordination between national and regional policies (2) including joint tenders and (3) the evaluation of the policies.

IV. **Strengthening the international dimension of the S&T system (5):** Promoting the international (1) cooperation of Spanish R&D agents; (2) participation in and use of large European research facilities and (3) in the VII Framework Programme (FP), (4) providing access for foreign R&D agents to national public tenders; (5) coordination of R&D executing agents of different countries by ERA-NET.

V. **Making available a favourable atmosphere for R&D investments (4):** Improving (1) cooperation, (2) transparency, (3) policy-management and (4) organisation (evaluation criteria, access, etc.) to ensure the goal achievement related to R&D and innovation investment.

VI. VI. **Making available favourable conditions to promote scientific culture and the diffusion of S&T advances in society (3)** (1) Using new means of communication to show the scientific and technological innovations to the society; (2) designing stable structures to promote scientific culture; (3) creating networks for social communication in science and technology.

This scheme of goals is almost the same as that presented in the **National Strategy for Science and Technology (ENCYT)** – a common declaration of intentions approved by the 3rd Conference of the Regional Presidents (chaired by the President of the Spanish government). Analysing these goals it can be observed that they consist of general ideas or intentions which could be applied to most of the countries. Moreover, they do not include any thematic priority-setting. On the other hand, the National Plans also establish general and broad priorities, specifying the main policy programmes at national level. The structure of the plan sought to overcome the limitations identified in earlier plans (OECD, 2006). Therefore its structure and the distribution of the funds are not based on thematic areas however on instrumental priorities aimed to involve stakeholders in achieving collective goals through strategic and operational objectives, and to develop their contribution to them. In addition, following OECD recommendation (OECD, 2006), this structure reduced, simplified and standardized tools, programs and actions, as well as increasing its visibility to the executors of the activities and decreasing the number of calls. Moreover, the new structure has meant a more selective process with a strong strategic component.

This new structure sought to create enough critical mass to achieve an innovative environment which was the highest priority.

Officially the priority setting should be ordered in the National Plan for R&D&I although the way the budget is distributed thematically is not clear. Despite the inclusion of formal priorities in the National Plan the thematic focus was not a real policy intention but the factual consequence of distribution of generic funding in the hands of each of the administrative units and ministries involved (OECD, 2006; ERAWATCH 2010).

In fact the data on thematic priorities can only be derived from different complementary –although fragmented- information. The National Plan for R&D and innovation (2008-2011) includes several thematic fields as a priority (special actions) like: Telecommunications and Information Society; Nanoscience and Nanotechnology; New Materials and New Industrial Processes; and Biotechnology. Moreover analysing the Plan's annual report data some priorities (revealed below) can be identified on the basis of the actual allocation of funds -which is in fact a sum of decentralised decisions-. The annual reports of the National R&D&I Plan includes nine broad areas completed with a "non-oriented policy area (NOP) that received the largest followed directly by the Information Society Technologies Area (IST - 20%) (especially electronics and communications and service-related IST) and the broad area of chemistry, materials and industrial design and production (17%) (especially industrial design and production 10%). Two other important areas are the Life Science Area (13%) - particularly biomedicine (7%) and biotechnology (3%)- and the Transport and Construction Area (13%). This real distribution of the support by technological field – revealing real priorities of the overall research policy– is not specified for a certain number of public tenders. The available data refer to several subprograms for R&D projects and special actions. As mentioned before the National Plan is based on instrumental priorities. The National R&D&I Plan involves 3,461.5 M€ distributed by six instrumental areas. The tender for R&D&I Projects received 41.6% of the budget (of which 42% are subventions and 58% loans). Over 15% of the funds are assigned to Internationalisation and Coordination of the System (52%-48%) and 10% to the Scientific Infrastructures (24%-76%). The promotion of Human Resources obtained 9% of the budget (100%-0%), while Institutional Strengthening received 4.3% (7%-93%) and the policies for Technological Transfer 1% (22%-78%). Moreover the plan also includes a Program for Scientific and Innovation Culture with 0.1% of the funds (100%-0%). The Plan includes three Strategic Actions. These are support for Information Society and Technologies with 11.6% of the budget (27%-73%), the Health area with 4.7% (100%-0%) and the support for Energy and Climate Change with 2.2% of the funds (20%-80%) (FECYT 2011a, p38 with data for 2010)[22].

In the case of the priorities or the structural impact of public support for research in the private sector the data of the INE can be used. In 2010 the Spanish state (and/or regions) financed 16.6% of the total private R&D (support intensity). In the service sector this percentage (19.9%) is clearly higher than in the industrial sector (13.0%). In the agriculture sector it was 21.5% and in the construction sector 14.6%. Within the service sector "other business services" (40%), the "R&D services" (28% .NACE 72 - including the technology centres) and the "public, social and collective services" (27%). Also some industrial sectors are supported more intensively: such as Aerospace (40%) and "other transport material" (32%).

[22] Section 3.3 offers a more detailed panorama based on the ERAWATCH classification of the instruments.

The solution to the major societal challenges and the contribution to sustainable development are receiving growing attention in Spanish R&D and innovation policies. The new E2i-Strategy (2009) and the new Law on Sustainable Economy (March, 2011) are partially focused on sustainable development and societal challenges (see also § 3.3) such as clean energy and biotechnology. Both objectives –sustainable growth and structural change- are considered as complementary because technological progress towards solving societal problems could generate new high tech enterprises and will promote the required structural change considered as one of the mayor challenges of the Spanish economic recovery and long term growth.

R&D policy evaluations are still not a systematic activity (CIA4OPM, 2011; Heijs/Martinez, 2011; Eparvier, 2009). However several R&D and innovation policy programmes were evaluated. Likewise, several instruments were evaluated spontaneously on an individual level by PhD students and other researchers without –or with only some marginal- help from the public policy agencies. They make use of the publicly available databases on the firm level. Most studies offer a positive view on the impact and indicate the existence of financial additionalities. The Centre of Industrial technological Development (CDTI) in charge of most of the business oriented instruments seems to function well and carried out several internal and external evaluations of their activities that showed positive results (See § 3.4).

Table 1: Basic indicators for R&D investments in Spain

	2007	2008	2009	2010	EU-27 Total or average for 2009	Spain as % of the EU = 100 (2009)
GDP growth rate	3.5%	0.8%	-3.7%	0.33%	-4,30%	78.8%
GERD as % of GDP	1.27%	1.35%	1.38%	1.39%	2.01%	68.7%
GERD per capita	300	324.7	318.2	317.2	473.9	67.1%
GBAORD (€ million)	7,987,053	8,414,438	8,699,846	8,134,013	90,974,621	9.6%
GBAORD as % of GDP	0.76%	0.77%	0.83%	0.77%	0.77%	107.8%
BERD (€ million)	7,453,902	8,073,521	7,567,596	7,506,443	146,012,292	5.1%
BERD as % of GDP	0.71%	0.74%	0.72%	0.71%	1.23%	57.7%
% of GERD financed from abroad	7.0%	5.7%	5.5%	5.7%	8.4	64.9%
R&D performed by HEIs (% of GERD)	26.4%	26.7%	27.8%	28.3%	24.1%	115.7%
R&D performed by PROs (% of GERD)	17.6%	18.2%	20.1%	20.1	13.2%	151.6%
R&D performed by Business Enterprise sector (as % of GERD)	55.9%	54.9%	51.9%	51.5	61.7%	84.1%
HERD (€ million)	3,518,595	3,932,413	4,058,359	4,123,150	56,933,566	7.1%
PRO-ERD (€ million)	2,348,843	2,672,288	2,926,733	2,930,562	31,331,456	9.3%
GERD (€ million)	13,342,371	14,701,39	14,581,676	145,884,55	236,637,908	6.2%
GERD growth rate	12.93	10.19	-0.81	0.05	-1.19	

	2007	2008	2009	2010	EU-27 Total or average for 2009	Spain as % of the EU = 100 (2009)
Population (millions)	44.8	45.5	46.0		501.1	9.2%
GDP (Provisional)	1,053,161	1,087,749	1,047,831		12,257,461	8.6%
GDP per capita	23,5	23,9	22,8		24,4	93.4%

Trends in R&D funding

After important Spanish growth of the absolute Gross Expenditures in R&D (GERD) in 2002 – 2008 the GERD decreased by 2009 -0.8% while it grew 0.5% in 2010. The relative indicator - the GERD as % of GDP- increased from 0.99% in 2002 to 1.35% in 2008. In 2009 and 2010 a slight growth of this indicator can be observed -reaching 1.39% in 2010-, basically caused by the statistical effect of the decrease of the GDP in 2009. On the other hand, an important remarkable trend is the loss of almost 10,000 innovative firms in 2009 and 2010 (almost 24% of all innovative firms)[23]. Analysing the private sector trends in 2009 and 2010 a decrease of respectively -6.3% and -0.8% of the BERD can be observed and the number of firms with R&D expenses decreased respectively by -9.6% and –15.6. While the BERD as % of GDP decreased from 0.74% in 2008 to 0.71% in 2010.

Meanwhile the public administration increased its expenditures by +9.5% and +0.1% in both years. This meant that the amount of R&D carried out by the private sector fell from almost 55% in 2008 to almost 52 in 2009 and 2010, which is far below the EU-27 average of 62% in 2009. The Spanish R&D efforts (GERD/GDP) were, in 2009 and 2010, around 1.39%, which is far below the EU-27 average of 2.0% in 2010 and still a long way short of the Spanish Lisbon Objective of 2%, established in the National Reform Programme of 2005 and the related “INGENIO 2010 programme”. Also the complementary objective -a private participation of 55% in the financing of the GERD- was not achieved, in 2009 firms carried out 52% of the GERD and financed 43.4% of it. From a regional perspective only two “Autonomous Communities” have an above EU-27 level of R&D efforts (The Basque Country and Madrid with a GERD/GDP of 2.06% each in 2009 (see also footnote 12). In 2010 Madrid (2.02%) is the only region with an above EU-27 level. A detailed analysis shows that the cut in the BERD in 2009 and 2010 was very selective. It affected basically the capital investments in R&D (-37% in 2009 and -10% in 2010) while the current R&D expenditures increased slightly. In the case of the basic R&D in 2010 a growth of +24 was observed and for 2009 a decrease of -13% while the applied R&D decreased -7% and grew 6% 2010 respectively[24]. The total number of persons devoted to R&D (FTE) in the firms decreased -1.6% in 2009 and decreased another -1.6% in 2010, while the number of researchers (FTE) in Spanish firms decreased respectively by -0.5% and -1.7%. Looking to trends by size of the firms it can be observed (for 2009), that the largest firms (over 250 employees) and the smallest ones (fewer than 10 employees) did more or less maintain their expenditures. On the other hand, especially the small and medium sized firms (with 10 to 49 employees) reduced their R&D efforts more drastically (taken from the COTEC 2011a and based on the INE data for 2009). Also in 2010 it can be observed that the firms with fewer than 250 employees suffer more than the larger firms. To conclude, the firms with a stable and consolidated innovative behaviour do maintain their efforts and opt for R&D (especially applied R&D) to overcome the crisis while, probably, the firms with a less developed innovative culture halted or downsized these kinds of activities. On the other side, the cut in capital investment and basic R&D –if this tendency were to become established over a long period of time- could hinder future long term output and competitiveness.

[23] In fact the number of innovative firms has fallen since 2006. In that year the “Community Innovation Survey” elaborated by the National Institute of Statistics reflected 49,414 innovative firms while in 2010 this number went down to 32,041

[24] Data based on our own calculations of the Spanish R&D statistics of the INE.

The Spanish GBAORD by GDP (0.83% in 2009) and by the total Public State Budget (1.7% in 2010) are clearly higher than for the EU-27 averages (0.77% and 1.5% respectively). In fact, the Spanish government and political parties consider R&D and innovation as a main driver to overcome the current crisis[25]. Therefore the reduction of the GBAORD in the 2009 and 2010 was almost non-existent or below the average cut in government expenditures. For 2011 and 2012 only provisional data are available on the projected budget for public expenditures on R&D of the central government. The central government budgets on R&D (CGB-R&D) increased from €4,000m in 2003 to €9,673m in 2009. After a slight decrease in 2010 the foreseen budget of 2011 decreased to €8,590m (-7.4%) and for 2012 another reduction of 7% was announced[26]. It must be pointed out that the foreseen CGB-R&D for 2011 and 2012 do not include only direct expenditures and subsidies on R&D but also loans. In fact, in 2011 the role of loans increased while the budget for subsidies decreased, which implies, de facto, an even higher decrease. In the period 2008-2009 the subventions represented 53-54% of the total CGB while this percentage fell to 36% and 24% respectively in 2010-2011. Therefore the real long term costs (or budget) of the policies is probably much lower than in the period 2001-2009. Moreover the incentive power of loans is not the same as support in the form of subsidies. Despite the reduction of the CGB in 2011 the funds related to the R&D and innovation policy instruments increased in 2010 and 2011 respectively by 21% and 29% (For detailed information see ERAWATCH Fiche). This means that the cut in the CGB especially affects direct public R&D expenditures such as the block funding for Public Research Organisations and Universities or other direct R&D expenditures of the Ministries. Moreover, as in the case of the BERD, the public administration and universities showed an increase in salaries and current cost, while the capital investment decreased. The above presented data on CGB are planned budgets, the real expenditures could be overestimated and the crisis could have altered the exact amount. For example, the level of execution of the budget for 2009 was 85.7% and for 2010 93.2%. (Central Government Comptroller).Moreover, the extra reductions for public expenditures applied during 2011 or foreseen for 2012 could have reduced the real budget. In any case, the cut in the GBAORD was clearly below the overall cut in the public expenditures and the R&D and innovation was one of the priorities of the anti-crisis measures which could have increased the real budget (For details see ERAWATCH Country Report 2010).

As stated, the mentioned sources for 2011 and 2012 include only the central state expenditures excluding the budgets of the regional R&D plans. Most policies focused on SMEs (often with co-finance from the EU), technology centres or cluster initiatives are implemented on a regional level. In 2010 the regions financed €1,382m in support of R&D projects and the promotion of human capital (FECYT, 2011b, P. 729). On the other hand, the budgets of these regional policies were downsized in the last two years drastically.

For example several regions (such as Madrid) did not renew their regional R&D&I plan due to the lack of finance and Valencia cut the support for research drastically. No clear data are available about the share of funds provided by different funding sources (like the public national or foreign funds or private involvement) nor are there any data on the role of the co-finance by the ERDF/ESF funds nor the exact amount of thematic or sectoral distribution of the funds. On the other hand, transnational or inter-regional funding as a complement to national funding is a marginal aspect of the Spanish innovation policies.

The ERAWATCH Policy TrendChart report for Spain of 2011 (ERAWATCH, 2011b) offers some complementary data concerning the role of tax incentives compared to the subventions received by the firms. The data show that both types of support finance 20% of all the Business Expenditures in R&D (BERD). The majority of the support comes from several support schemes that offer subventions. This kind of support financed 12-14% of the BERD in 2004-2006 while in the last few years this percentage increased to 17-18%. The tax incentives financed around 5-6%of the BERD in the period 2002-2006. The expected tax deductions for 2008-2009 are 4-5%. This is not the result of a less positive support scheme (which has remained the same) but could be an effect of the economic crisis.

As mentioned by labour unions, politicians and entrepreneurs and reflected frequently in press releases of the Ministry of Science and Innovation, articles in the newspapers "El País" or "ABC" and by Spanish society (see the FECYT survey on social perception of science and technology).:

[26] The new Spanish government did not have time to approve a new state budget for 2012 and extended the 2011 budget. So the foreseen budgets for both years are formally the same. However the government announced on December 30, 2011 that they will apply a €600 million cut on this extension for 2012 and due to the new forecasts on the economic situation further reductions can be expected.

Evolution and analysis of the policy mixes

In 2010-2011 some new measures were initiated to solve some specific problems. A first important novelty is the **Spanish Innovation Strategy 2010-2015** (E2i-Strategy) as part of the ERA 2020 Vision and Europe 2020 as European growth strategy for the coming decade. This strategy is an extension of the Spanish National R&D&I Plan and reinforced some existing measures such as the financial support for R&D&I in firms and especially the funds for risk capital and the support for cooperation between enterprises and the scientific sector. Moreover, this strategy introduced for the first time in Spain a demand-oriented R&D&I policy in the form of innovation-based public procurement (IBPP). However the implementation of this instrument is still in an initial phase. The CDTI is in charge of the presentation of the annual proposal of the Innovative Public Procurement that indicated the percentage of the budgets[27] of the departments and ministries that should be devoted to such acquisitions (For details see the ERAWATCH Policy TrendChart Report for Spain 2011 (ERAWATCH, 2011b). The strategy includes some specific measures to foster the interregional integration of the Spanish innovation system. The most important change in terms of specific instruments of the policy mix is maybe–together with the IBPP- the strategic implementation report of the AVANZA2 Plan (2011-2015). It promotes the diffusion of the Information and Communication Technologies (ICT) by firms and users (consumers) in order to ensure the use of advanced ICT products and services. Moreover in 2010 a new Plan to Promote Industrial Properties (2010-2012) was launched. The support is based on a faster process of approval, bringing down the costs of patenting by 50%, and promotion of the importance of IPR. It has a budget of €41m.

The most important tendency in the policy mix in the last decade was the clear shift towards innovation policies and knowledge transfer from science to industry and competitive funding. Almost all new initiatives increased the promotion of the cooperation between the scientific system and enterprises. This is a continuous change often difficult to track with exact data or to pinpoint at a specific moment. The growing attention for public private cooperation is not only based on new instruments implemented in 2008-2009 or the above mentioned extra budgets for the existing instruments. It also stems from the inclusion of the "level of cooperation" in the "evaluation criteria" for the support of non-cooperative R&D and innovation projects. Also several instruments were created to generate large long-term strategic projects based on public private cooperation (PPC) in order to create a critical mass and in recent years a large number of Science and Technology Parks have been created in cooperation with universities and/or public research organisations[28].

The highest weight in the policy mix in 2011[29] is the support for competitive projects for public research organisations and universities (around 23-28% of the budgets in the period 2009-2011). Moreover, these institutions receive block funding. The total direct support for business R&D was around 38% of the total budget of the policy mix in 2011 (Subventions 18%; support for PPC 17%; and tax advantages 3%). The tax incentives have been losing ground in the last three years from 15% to 3% of the budget. This is not a deliberate decision (the tax advantages are the same) but is probably the result of a reduction in the private R&D expenditures and the fact that several firms had decreasing profits, which makes tax reduction in the short term more difficult. The support for R&D&I infrastructures absorbs over 11% of the funds, a level much lower than in 2009 when it still absorbed 18% of the funds. In fact the total support for the science sector and the creation of facilities for technology transfer absorbed around 50% of the total support budget in 2009-2010 while in 2011 their participation dropped to 37% (excluding the block funding). In the meantime the support for R&D in firms for individual and cooperative (science-enterprises) projects (including tax incentives) rose from 26 to 38% of the total budget. As a conclusion, it can be highlighted that the support for business R&D increased because it is seen as a way for a sustainable long term way to overcome the present economic crisis.

[27] For 2010 an IBPP budget of €1,262m is foreseen and the objective is that by 2013 around 3% of the total budget of public procurement should be devoted to IBPP

[28] For example, the INNPRONTA programme requires PPC, a minimum budget of €15m and minimum duration of 4 years and financing of up to 47% of the budget).

[29] This data is a summary of section 2.2 of the ERAWATCH mini country report for Spain (ERAWATCH 2011b). This report uses the ERAWATCH classification and summarise the data of the Working Plans of 2009 to 2011 that offer detailed information on the foreseen budgets for all the instruments of the Spanish R&D&I policies of the central government.

Spain has a large number of instruments (with increasing funds) to foster Human Resources in science and innovation (see annex 1.1.3) and the mobility of the Human resources (see annex 1.1.1 and 1.1.2.3). Over 14% of funds of the main national R&D-related policies for 2010 are devoted to this subject. Moreover, the regional governments also offer a large number of schemes geared to HH.RR. The education policy to create human capital is in the hands of the universities and, as mentioned, their management is isolated and not always oriented to the needs of the future labour market. Although in the case of Catalonia a first step has been towards a new model of governance that integrates the production sector into the decision making process of universities. They created a Commission to study and propose a new Governance system of the university with a specific role of the stakeholders[30].The OECD recently published two studies on Higher Education Strategies in Catalonia and Andalusia pointing out the already mentioned problems (OECD, 2011b and 2011c).

Only limited qualitative information is available about the changes in the target groups. The trend has to be derived from the general changes in the policy mix such as the growing attention to the support for innovation and public private cooperation. This means a larger budget for the private sector. Moreover, in the period 2005-2010 vast investments were made for the creation of new science and technology parks. However in the coming years this type of support will be limited. Looking to the balance between the funds for universities and Public Research Organisations (PRO) it can be stated that in the period 2005-2008 the PROs showed a higher increase in the public funds than the universities. However in the last two years the downsizing of the public funds affects the PROs more than the universities.

Although the official priority setting should be established in the National Plan of R&D&I the way in which the Spanish government establishes the exact distribution of the budgets between the policy priorities is not clear and far from transparent[31] The distribution between scientific areas or sectors of the funds is in the hands of each of the administrative units and ministries involved and this is decided on an ad hoc basis. Therefore the overall thematic focus is not a real policy intention but the factual consequence of the distribution of generic funding. Also the real amount of support and the exact balance between thematic versus generic R&D funding of the public administration is difficult to assess for several reasons. First of all, a part of the public support comes from the “autonomous communities” and most of the data of this administrative level is only available on an aggregate level[32].The New Law of Science, Technology and Innovation deals with this lack of information through article 11 where with the creation of an Information System of Science, Technology and Innovation (SISE)[33] In this system agents on regional and national levels have to provide and share homogeneous information in order to overcome information shortcomings. The data are secondly, a substantial part of the budget. Data on a national level does not offer information by thematic fields or technological areas, and if they do so, they do not distinguish between the use of subsidies and credits[34]. The former are mainly used for scientific research in the public sector while the credits are used to promote R&D and innovation in enterprises. The most comprehensive approach to analysing the changes in the thematic priority setting of the Spanish policies for R&D and innovation is the distribution of the Spanish GBAORD. The distribution of the GBAORD by socio-economic objectives shows that most of the funds (46%) are used in generic support measures without clear priorities and only 53.5% of the funds are directly assigned to specific

[30] See newsletter of www.corresponsables.com (24th of December)

[31] In fact three complementary sources of information can be analysed in order to determine the thematic or sectoral distribution of Spain's national public research funding. A first source is the data of the annual Government Budget Appropriation for R&D (GBAORD). The second source is the official statistics on R&D expenditures (GERD) published by the National Institute of Statistics (INE). And a third source of information is the annual reports on the real execution of the Spanish National Plan for Scientific Research, Development and Technological Innovation (2008-2011). For a critical view and the (dis)advantages of each source see the ERAWATCH inventory country fiche for Spain.

[32] The data for 2010 seems to be reliable and homogeneous. Also in the earlier years such data was collected but the quality was low and the data of regional governments was very heterogeneous using different concepts and definition for the same variables (Statement of the regional government of Madrid during an informal meeting in September 2010).

[33] The SISE has already been implemented since 2006 and this system clearly improved the gathering of data. The information on the execution of the R&D&I policies was published earlier and was more accurate and the data (as in the case of the above-mentioned regional data) is more homogeneous and more complete. The main shortcoming of the annual reports is that the data is not published, with some exceptions, by subjects or scientific fields.

[34] This data is only available (although in highly detailed) by type of instruments. For a review see the ERAWATCH mini country report for Spain (ERAWATCH 2011b).

technological or scientific areas. The two most important ones are health (11.2%) and industrial production and technology (IPT–11.2%), followed by agriculture (7.6%), transport, telecommunications and other infrastructures (TTI – 9%). The fields of agriculture, health and TTI increased their participation while the IPT lost weight in the overall GBOARD. Looking at the EU-average (for 2007) it can be observed that the participation of health and IPT in the EU is also important, albeit smaller, while agriculture and TTI have a small role in the EU-27 average. Moreover on a European level the defence-related GBAORD (8.5% - EU-27 average) is more important than in the case of Spain (2.3%).

As mentioned in section 3.1 the solution to the major societal challenges and the contribution to sustainable development are receiving growing attention in Spanish R&D and innovation policies. The National Plan for R&D and innovation (2008-2011) includes several **societal challenges** (such as biotechnology, nanotechnology etc). In the last two years two new initiatives reinforced the support for these topics. The E2i-Strategy is partially focused on sustainable development and societal challenges. A second initiative that reinforces the support for the major societal challenges is the new Law on Sustainable Economy (Approved in March 2011) which includes the promotion of the new technologies such as clean energy and biotechnology. Both objectives –sustainable growth and structural change- are considered as complementary because technological progress to solve societal problems could generate new high tech enterprises. Therefore this new Law indirectly promotes the required structural change, which is – as mentioned before- one of the major challenges of the Spanish economic recovery and long term growth.

Another important change is the new regulation of the Spanish innovation system. The new Law on Science, Technology and Innovation (approved in June 2011 and operational since December 2011) replaces the Law of Science of 1986. An important novelty of the new Law is the inclusion of the terms "technology and innovation" which is aimed at the integration of those types of activities with scientific research. The real impact of this new law depends on its implementation in the following years (See also annex 2).

Assessment of the policy mix

The Spanish policy mix in the last decade has experienced important changes. Most of them were based on several analyses of the obstacles and problems of the Spanish innovation system (OECD, 2006[35]; COSCE, 2005; COTEC, 2005). Although these studies are not really recent their impact was very important and, in a certain way, still notable. The INGENIO 2010 initiative –approved at the end of 2005- had an important qualitative influence on the balance between the different policy instruments. In particular it reinforced the creation of NTBFs and university spin-offs, the promotion of R&D projects in general and more specifically public-private cooperation in long term strategic projects[36] and the policy directed to Human Capital, such as the incorporation of PhD holders into the private sector. Also the financing and creation of the S&T infrastructure was heavily reinforced. These instruments were integrated into the National Plan for R&D&I (2008-2011 and the new Spanish State Strategy for Innovation, 2010-2015 (e2i). This e2i strategy has reinforced several of those instruments offering extra financial support for R&D and innovation in general and specifically for risk capital. Moreover this strategy for the first time included public procurement as an instrument associated with the acquisition of innovative goods and services.

The overall impact of those new instruments is not clear. R&D policy evaluations are still not a systematic activity (CIA4OPM, 2011; Heijs/Martinez, 2011; Eparvier, 2009). The evaluation of the impact and the efficiency of the policy measures on R&D is not an important topic for policy makers, opposition and the public agencies that manage the support schemes. There exists nonetheless a range of evaluation studies – especially for national policies – carried out by different researchers and financed by different policymakers or management agencies. In particular the Centre of Industrial technological Development (CDTI), the Foundation on Science and Technology (FECYT) and the Institute for Fiscal Studies (IEF) frequently finance or carry out such studies. Moreover, several spontaneous studies exist carried out by

[35] Officially published in 2006, although available already in 2005

[36] The CENIT programme now called INNPRONTA

PhD students or researchers using the publicly available databases with microdata on a firm level without (or with only some marginal) support from the public policy agencies (see Valadéz et al, 2011; Herrera, 2008; Herrera/Heijs 2007). Most studies offer a positive view on the impact and indicate the existence of financial additionality (Heijs, 2001; Heijs/Buesa, 2007; Barajas et al, 2009; Huergo et all, 2009; Magro, 2011). The study of Saiz-Briones 2009 showed a non-linear relationship between the support intensity (amount of support by sales) and the effect on the R&D expenditures in Spanish firms. Here the effect decreases in the case of very high support intensities. The CDTI, in charge of most of the business oriented instruments, seems to function well and carried out several internal and external evaluations of their activities that prove this (Heijs,2001/2007; Barajas et al, 2009; Huergo et all, 2009). The impact assessment of the European Framework Programme "Evaluation of the impact of the FP6 in the RTD Public System in Spain" (MICINN, 2010) shows a positive, important impact on the participants in terms of an increase in R&D funds, cooperation and internationalisation. Only a few studies offer a more critical view. For example the study by Vega-Jurado et al (2009) underpins the idea that the support for public private cooperation in Spain is frequently used by the firms to obtain financial support while the incoming technology transfer of new knowledge is less important. Moreover the study of Heijs/Buesa 2007 showed that the regional public support does promote public-private cooperation and the national and European support schemes promote horizontal cooperation. However, in the case of vertical cooperation the support schemes do not affect the intensity in cooperation in R&D. The problem is that most studies analyse specific isolated aspects and evaluate whether the instruments were effective and therefore can be justified. While no study carries out a broad overall assessment neither does any of them offer a cost benefit analysis nor evaluate whether the implementation was efficiently carried out. They evaluate some specific impacts on the supported firms but do not analyse the structural changes of the production sector. Anyhow, such an effect as the result of the public support is very difficult to isolate from other possible explanatory aspects, like the changing national and international environment.

In relation to the overall policy mix it can be stated that Spain is still lacking some instruments for some specific aspects. It has no special support schemes to stimulate firms that do not perform R&D yet or to create new innovative firms in traditional sectors. Moreover, Spain does not have specific instruments to attract R&D-performing firms from abroad, which is another important problem mentioned by COTEC (2011a). No new strict measures were created in relation to the priority areas of the 'Innovation Union' flagship initiative such as commercialisation of research, getting ideas to the market, social innovation, public sector innovation, design, creativity or services innovation. Nevertheless, several of the existing instruments do meet such priorities and the E2i strategy did integrate -in an indirect way- several of them. Moreover the demand-side polices are still underdeveloped (See ERAWATCH, 2011b). Despite these facts Spain has at the present time a broad policy mix with a huge set of differentiated instruments that try to tackle almost all the barriers and weaknesses of the Spanish innovation system. Although some instruments are still lacking, the policy mix can be considered as satisfying and the existing schemes meet most of the needs of the enterprises. However, the existence of instruments is not enough because they do not handle the systemic failures related to the functioning of the R&D agents. This brings us to the most important weaknesses of the Spanish research system which are not sufficiently tackled by the policy instruments. On one side, as mentioned in section 2, the production system, with a high presence SMEs and specialised in low tech sectors lack a culture of innovation and technological capabilities. On the other hand, Spain lacks strong mechanisms that ensure a high level of excellence and productivity of research institutions. As argued in § 2 and annex 1.5 of the report, the long term impact of this more or less well balanced policy mix could be almost zero if the Spanish government does not initiate the institutional modernisation of the public research system towards excellence and specialisation ERAWATCH report 2010; Heijs, 2010). This is especially so in the case of the science-industrial relationships (Heijs, 2010), See for detail EW Country Report 2010, § 2.5.1). Some specific instruments are implemented to improve the situation (CENIT projects or The University Strategy 2015) but it is difficult to change the historical culture of inefficient assignments of funds and human resources often based on internal decisions of the research organisations. This aspect should therefore also be considered as a missing point in the policy mix.

As mentioned in section 2, several of the above mentioned challenges require a targeted industrial policy, although it is not easy to force the creation of strong clusters or high tech sectors. Some instruments for cluster policies exist on regional level and also on national level. The National Strategic Consortia for

Technical Research programme (CENIT) do support indirectly clusters forming, while the measure "Innovation Business grouping" support clusters in a direct way. The Spanish state supports some specific clusters by "Special actions" (Like Biotechnology, Aeronautics, Energy, Nano technology or ICT). The implementation of such policies that should create strong clusters or high tech sectors and virtuous circles that increase the R&D investments in foreign and domestic firms could be difficult due to the relatively low level of excellence of a large number of (public) R&D institutes and insufficient relationships with the production sector. All this, along with the deficient technological capabilities of the firms to integrate external knowledge in their daily business. Despite the fact that the Spanish government did promote such technology transfer (by creating Science and Technology Parks and reinforcing the support for academic spin offs and Public Private Cooperation) the lack of excellence and entrepreneurial culture in the public scientific system and the lack of absorption capabilities in the firms makes technology transfer between science and the production sector often very difficult. Some successful initiatives are the Technology Centres –of some specific regions such as the Basque Country or Valencia where they have an important and satisfactory role as intermediates between knowledge creators and firms (See Lopez Rodriguez et al, 2010 and Castro, 2007).

Table 2: Assessment of the effectiveness of the specific policies to address the structural challenges

Challenges	Policy measures/actions	Assessment in terms of appropriateness, efficiency and effectiveness
Technological gap in ICT sectors	The implementation strategy of the Plan AVANZA 2 (2011-2015) focuses on the diffusion of the ICT towards firms and consumers (June 2010)	The impact of AVANZA Plan is considered as very successful by several studies (OECD, 2010; COTEC, 2011; UN, 2010). Spain is nowadays a leading country in the rankings of services on line, e-participation and the use of broadband. A firm level survey showed that 46% of the respondents perceive a considerable, positive impact and another 53% reflect that the Plan AVANZA had a limited but positive effect" (OECD, 2010, P.79).
Societal challenges	Spanish Strategy on Innovation the (E2i) (2009) Law for sustainable development (March 2011)	Both are part of the EU strategy "ERA 2020 vision on economic growth towards a smart, sustainable and inclusive economy. These new instruments are still not evaluated
Lack of technology transfer between the scientific system and the production sector **Lack of critical mass**	The growing orientation to Public Private Cooperation (Increase of budgets for several programmes like the CDTI support for cooperative projects. In the past they created the Programme National Strategic Consortia for Technical Research (CENIT). Now called INNPRONTA and the Programme for Promotion of Technical Research for Singular Scientific and Technological Projects with Strategic Nature. Both promote critical mass and cooperation	The CENIT programme promotes consortia of large companies and SMEs and facilitates links between the public and private sectors. Its catalyst effect on the spirit of cooperation – including interregional collaboration- is very positive, generating a virtuous circle in terms of cooperation (AEVAL, 2007)

Challenges	Policy measures/actions	Assessment in terms of appropriateness, efficiency and effectiveness
Lack of demand for innovations and new technologies	Creation, in 2010, of a specific programme for Innovation- based public procurement	Since more than a decade several studies have been carried out to explain the importance of Innovation based Public procurement (COTEC, 1998, 2008, 2011a and 2011b) in order to put pressure on the government to create such policy. This new instrument is still not evaluated
Low level of R&D expenditures and/or innovative culture	Support schemes of the CDTI and the national Plan on R&D and innovation	Several studies proved the positive impact of the CDTI support (see text of this section)

National policy and the European perspective

The Spanish government and political parties consider R&D and innovation as a main driver for the future competitiveness of Spain and as a solution to overcome the current crisis. Therefore the Spanish Government Budget Outlays on R&D (GBOARD) for 2010 formally showed a slight increase. Spain has developed in recent decades an integrated and coherent framework of R&D and innovation policies and it has a multiannual national R&D and innovation plan. However the financial distribution is decided annually and most research organisations and universities are limited in their strategic planning by annual budget cycles (except the Spanish National Research Foundation) due to: (1) the high level autonomy of their staff members; and (2) the possible existence of a self-interested corporate attitude of their members and direction (chosen democratically by the researchers and administrative personnel themselves) (Heijs, 2010; Sanchez, 2008). To increase the critical mass the Spanish government introduced several measures that finance long term strategic research for large research groups with a high level of excellence. Some recent developments involved more coordination between the different administrative levels and a better integration between the scientific and innovation policies, such as the Spanish Innovation Strategy (e2i) or the New Law on Science, Technology and Innovation[37]. Another positive trend is the inclusion of the commercial use of the research results and the foreseen public private cooperation in the selection criteria of almost all tenders for project support. The distribution of the funds for public support for R&D is more and more based on competitive criteria and block funding apparently lost weight in the total GBOARD. Moreover, in several regions in the last few years some new regulation has been introduced to relate the block funding for research (not for education) with productivity and excellence[38]. All those trends could be an important step in normalizing the coordination between national and regional policies and integrating the R&D and innovation policies.

However, the real changes have to come from the scientific world and this requires a new open and competitive approach or culture on doing useful, high quality research. In fact, the research and educational activities of the vast majority of the universities and public research organisations are not being evaluated. Some indirect evaluations are made on the level of the individual researchers but not on an institutional level. To attract R&D from abroad and maintain the R&D expenditures of Spanish firms in

[37] For example the e2i strategy has to be approved by the GRECYT whose decision making system is based on the votes of the Spanish prime minister and the regional presidents. Also the roadmap of the national infrastructures obliged the regional government to coordinate their investments with the state.

[38] For example the Region of Madrid and Barcelona developed criteria of excellence and productivity that they apply to distribute the money between their universities..

the Spanish innovation system it is necessary to improve the level of excellence of the (public) R&D institutes and the innovation related services and infrastructure[39]. This brings us to the most important weakness of the Spanish research system which is not sufficiently tackled by the policy instruments. Spain lacks strong mechanisms that ensure a high level of excellence and productivity of research institutions[40].

Some specific instruments are implemented but it is difficult to change the historical culture of inefficient assignments of funds and human resources, often based on internal decisions of the research organisations. This aspect should therefore also be considered as a missing point in the policy mix. One of the possible solutions could be the increased autonomy of public research organisations and universities. Like will be explained below, this is a tricky question because the benefits of this freedom in terms of increased excellence depend on its efficient implementation, which in the case of Spanish public research organisations and universities is not always guaranteed[41]. In other words, the organisational setting should guarantee that more autonomy will generate a increase of the excellence. The existing lack of guarantees can be observed during the selection procedures for new personnel -characterised by endogamy and personal contacts-, the low productivity reflected in the small number of researchers that passed the six-yearly research evaluations or the mismatch between the education (study plans) and the demand of skilled human capital. In conclusion, the research institutions need more freedom (especially in the case of salaries and budget cycles) to allow long term strategic planning and to compete with R&D institutes abroad. However if such policies are not implemented simultaneously with mechanisms that guarantee an efficient and effective use of this freedom -based on competitiveness and meritocracy- the final result will be the perpetuation of the existing situation. A positive change could be the transformation of the Spanish Research Council (CSIC) into a public agency. However in this case the CSIC is still limited in its margins of autonomy. Moreover, the exact mechanisms to ensure the excellence of the R&D are not clear. Another possibility is to intensify the competitive distribution of block-funding for institutions based on excellence. In this case better criteria for the evaluation of the recipients of competitive funding and more transparency and independence of the selection process are required. Therefore, the most important challenge of the Spanish innovation system is probably not only the GERD but also the modernisation of the public institutional research framework.

Analysing the innovation activities of the production sector some specific new problems -generated during- the crisis can be mentioned. First of all the number of innovative firms decreased more than the expenditures. Spain lost in 2009 and 2010[42] almost 3,600 innovative firms, amounting to a -23.7% decrease in all innovative firms, while the BERD decreased in this period by - 7%. However, the relative indicator -BERD as % of GDP- shows only a more moderate fall from 0.72% in 2009 to 0.71 in 2010 (see table 1). And secondly, the BERD decreased in a selective way. The firms spent substantially less on capital investment and in 2010 also the basic R&D expenditures fell by 13%. At the same time the current costs decreased only slightly. If this tendency were consolidated in the future it could affect the long term efficiency of R&D and the “technological level” of the future efforts and outcomes. It could represent a decrease in the advanced R&D activities at the edge of the technical frontier and a bias in the orientation towards more incremental applied R&D. This situation might require in the short term new specific measures or adjustment in the priorities of the existing instruments. The fact that a large number of smaller and medium sized firms reduced their innovative activities has to be analysed in greater depth to see in which way they can be supported to involve themselves again in R&D activities.

Another important weakness of Spanish R&D and innovation policies that can be highlighted is the coordination of the national innovation systems. This problem is reflected in three important policy

[39] For a summary of the empiric data on the lack of excellence and integration between public and private research sector see footnote 18

[40] On one side the Spanish government introduced specific instruments to improve the level of excellence like the “Severo Ochoa Programme” or the “University Excellence Programme”. However, in Spain there are 12 centres of excellence with a higher rate than 25%. And there are 101 research institutions in Spain with a number of citations higher than the world average figure (Source: SC imago Institutions Ranking World Report 2011: Link). These programs do promote the level of excellence in specific areas or institutes but do not battle the underlying problems of the lack of excellence like mentioned in footnote 18 or in annex 1.4.

[41] For details and a broader discussion see annex 1.4: Strengthen research institutions, including notably universities.

[42] All data in this paragraph are from the Spanish Innovation Survey (See www.ine.es).

dimensions. The first dimension is the scant coordination between the policies of different administrative levels and even between the units of the same administrative levels. The decentralised structure of the Spanish State makes such coordination difficult because often it depends on the will of the regional policy makers. However, the cost of duplication of certain installations can be important. In the case of the coordination between national and regional level the Spanish Strategy for Science and Technology (ENCYT), the Spanish Innovation Strategy and the Spanish Roadmap for large R&D infrastructures did improve the coordination (see the ERAWATCH country report 20101). Moreover, the New Law of Science, Technology and Innovation face this challenge through the Information System of Science, Technology and innovation where agents of all the administrative levels have to share information in order to promote coordination and avoid overlapping. (Article 11 - Link). Despite of those changes the cooperation and coordination still depends heavily on the voluntary behaviour of the regions and national state.

The second one is the low level of integration of measures oriented to scientific research with those related to innovation and technology transfer. And the third one is the almost non-existent integration of research and innovation policies on the one hand and education policies on the other. For three basic reasons the integration of research and innovation policies with education policies is almost non-existent: (1) the academic orientation of public research: (2) the lack of influence of the private sector on education and (3) the most important decisions on higher education policies are de facto taken by the universities. Therefore a large part of the educational and research activities of the public sector is not based on societal needs or the demand of the production sector. Moreover the state and regional government do not use their political and/or financial power (based on the assignment and distribution of funds) to reorient research and education. In this case of a better integration of the academic science versus applied innovation and in the case of the integration of education versus research and innovation policies the Spanish regional governments could use the financial dependency of the universities to force them to take these aspects seriously by financing specific activities or new academic degree courses. Considering the tendencies and changes in the light of the ERA 2020 objectives it can be mentioned that the main difficulties for implementing a national ERA related policy are: (1) The low average level of excellence of the Spanish research system and its endogamy, which make Spain a less interesting international cooperation partner; (2) the strict, inflexible salary system for researchers of public R&D institutes, which makes it difficult to attract top national or foreign researchers; (3) the annual budget cycles of almost all public R&D organisations, which make it difficult to implement a long-term strategy; (4) the low level of knowledge of foreign languages –especially English. Such poor foreign language skills are an important barrier to absorbing the knowledge generated abroad and to participating in European research activities. Moreover it is an important barrier for outward mobility. In the case of inward mobility there exists a formal openness of the selection procedure for research jobs in Spain. However, inward mobility is limited by the informal application of the selection criteria during the recruitment procedures. This seriously limits openness and discourages participation of non-national and even national external applicants in the tenders for permanent positions in universities and public research institutes. The outward research mobility seems to be somewhat higher in Spain than in the rest of Europe.

Some other barriers for the ERA 2020 objectives are, on the one hand, the low and decreasing role of the high tech sectors and the low level of creation of NTBF in the emerging and most promising areas. And, on the other, we see the lack of multinational enterprises that could have a leading role in the creation of R&D-related networks or clusters based on scale and scope economies with the corresponding systemic advantages. To conclude, the very slow structural change from low tech sectors to new high-tech sectors and the limited creation of new technology based firms (NTBF) are still one of the main weaknesses of the Spanish economy that hinder the accomplishment of the ERA 2020 objectives or the Innovation Union objectives.

In relation to the effectiveness of the R&D&I policies it can be stated that Spain has made qualitative and quantitative efforts in increasing the budgets for such policies and the creation of new instruments. Most evaluation studies showed a positive impact especially in the case of the innovation policies. However in section 2 it was made clear that these policies will be useless in the long term –in terms of the creation of a competitive excellent innovation system- if Spain does not modernise its public research system. Only parts of the system function smoothly; a substantial improvement and growth can and should be reached.

Table 3: Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA dimension	Main challenges at national level	Recent policy changes
1	**Labour Market for Researchers**	• R&D related employment increased between 2002-2008 over 50% and remained more or less stable in 2009 and 2010 • Spain is not very attractive for qualified personnel from abroad (low wages and bad working conditions). • Spain has a lack of qualified workers although this shortage diminished somewhat due to the crisis • Universities protect their internal candidates against external researchers from Spain or abroad (Endogamy).. • The problem of gender discrimination still exists but improved clearly in the last years. • Mismatch of supply of human capital • The university study plans are based on the internal interest of the researchers and are not oriented to the labour market needs	• Start of a new model of Governance in universities with the participation of the production sector in the case of Catalonia • Only exceptionally the financial dependence is used to force universities to improve their excellence and productivity
2	**Cross-border cooperation**	• Spain tries to stimulate international cooperation by several policy measures and multi/bilateral agreements. • The lack of knowledge of the English language and the lack of excellence and fragmentation of the Spanish research system is an important barrier for international cooperation.	• No substancial changes were identified in this policy field

	ERA dimension	Main challenges at national level	Recent policy changes
3	**World class research infra-structures**	• Spain is still lacking a critical mass and sufficient demand or market for R&D-based services which hinder the creation of new S&T facilities.	• The ESFRI stimulated the coordination and the design of a national road map of infrastructural needs among the Spanish regions. • Active participation in the ESFRI • Creation of the national roadmap for infrastructure • The NPRDI promotes effective use of European infrastructures (EI) and wants to contribute to 25 of the 44 European facilities and try to obtain the location of 3 of them
4	**Research institutions**	• Several systemic failures impede the impact of policies for improvement of excellence: • The vast majority of the organisations protected the interests of the researchers or lecturers to the detriment of societal needs or interests. • The lack of critical mass and the fragmentation of its public research system • The lack of autonomy in aspects such as the strict regulations of wages impedes the attraction of international well talented researchers. • Low level of integration between industrial and academic research is an important weakness. • HEIs and PROs lack strategic plans to overcome the aforementioned problems • The autonomy of individual researchers and the dependence of the rectors on their voters make it difficult to design or implement strategic plans and almost impeded the success of the recent policy changes	• 110% Increase in public R&D funds in the period 2005-2008 • Development of the new Law of Science (To be approved in 2010 – beginning 2011) • "Campus of International Excellence" with special focus on the overall quality • University Strategy 2015 aimed at getting universities into the top 100 ranking in Europe by the improvement of their quality, efficiency and effectiveness in both teaching and research

	ERA dimension	Main challenges at national level	Recent policy changes
5	**Public-private partnerships**	• The role of firms is still much lower than the Lisbon objective and BERD decreased -8.8% in 2009 • Spain has a broad –more or less well balanced- policy mix with differentiated instruments tackling several barriers and weaknesses. But, this mix cannot handle the systemic failures related to the functioning of the R&D agents. (see also point 6). • The data show that the R&D effort of the PROs and HEIs financed by private funds is similar to the EU-27 average. However the state of opinion suggests a low level of (PPC) in R&D which is hindered by the lack of excellence and quality and the scientific orientation of public research. • Lack of influence of society and firms on the behaviour of PRO and especially universities.	• The INGENIO 2010 initiative of 2006- had a qualitative impact on the policy mix Reinforcing the policies towards the creation of NTBFs, academic spin-offs, Public Private cooperation (PPC) in long term strategic projects and the incorporation of PhD holders into the private sector. • The 2010 "e2i" strategy has reinforced the financial support for R&D&i in general and especially the funds for risk capital. It also reinforces the financial support for cooperation between enterprises and the scientific sector.
6	**Knowledge circulation across Europe**	• The % of the R&D funds coming from abroad of the Spanish Enterprises, HEI and PRO are below the EU-27 average	• Spain is very active in the support and participation of all types of pan-European research initiatives like the ERA-net, ESFR, JPI, JTI etc… • Internationalisation and the ERA are considered strategic by the Spanish policy makers.
7	**International Cooperation**	• The lack of knowledge of the English language is still an important barrier for international cooperation. • The unattractive working conditions (see point 1) is a barrier to attracting qualified foreign workers	• Spain has several inward/outward mobility schemes that also allow the participation of researchers from non-EU • The traditional and cultural relations with Latin America and the common language generated a high level of mobility between LA and Spain

Annex 1: Alignment of national policies with ERA pillars / objectives

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

1.1 Supply of human resources for research

As mentioned in section 1, the number of people employed in R&D activities in 2010 was 220,022 persons in Full Time Equivalent (FTE, INE data 2010). This implies an increase of more than 65% since 2002. Based on the FTE data, 42% are working in the private sector, 37% in universities and 21% in public research organisations. The number of scientists and researchers as a percentage of the total labour force in Spain (4.6%) is near the (EU-27) average of 5.4% (Eurostat data for 2009), although it is still far behind the leading European countries. Human resources in science and technology (HRST) as a share of the active population in the 25-64 age group are in Spain 39%, which is 1.1% percentage points below the EU-27 average of 40.1% (Eurostat data for 2009). In the academic year 2008-2009 Spain had over 67,000 PhD students (30.3% in health and experimental sciences (HES) and 14.6% in engineering and technology (E&T). In the same year 7,915 PhD candidates graduated (42.7% were in HES and 14.6% in E&T, INE data). The percentage of S&T-related PhDs increased from 12% in 2000-2005 to 13% in 2006-2009 while HES related PhDs fell slightly and represent 44% in the last three years. The number of persons with pre-doctoral scholarships, due to the existence of a large number of national and regional programmes and private support schemes, is not clear. An ad hoc estimation from the INE-with 2003 data- indicated a number of around 25,000 scholarships, which is around 25% of all the Spanish researchers. Since 2003 the number of scholarships has increased substantially so possibly at this moment this number is much higher, although no specific data are available.

Spanish policymakers are very active in promoting the **inward mobility** of researchers, which is reflected in the broad range of support measurements (See Country Fiche). The Spanish Foundation of Science and Technology (FECYT) has a special website for foreign researchers that want to work in Spain. Moreover each regional government has a mobility centre that offers direct information on this subject. There are a large number that facilitate–indirectly-the researchers' **inward mobility.** All the Spanish programmes focused on training have full access for students and researchers of the European Union to compete in similar conditions. A specific programme for **inward mobility** is the one to foment Incorporation and Intensification of Research Activities (I3Program). It favours the training or recovery of experienced Spanish and foreign researchers to incorporate them into the Spanish Science and Technology System. Also the different Spanish Autonomous Communities offer aid for mobility and training to the scientific and research community. Moreover around 20% of the PhD holders that obtained public support for contracting researchers were foreigners and in the case of the 427 "Starting Grants" of the European Research Council Spain obtained a relatively high number of grants (5.4%). (Press release MICINN of the 18th of April 2011).

The Spanish National R&D&I Plan 2008-2011 foments mobility in different moments of the research career, offering support for (a) the improvement of the capabilities of postdoctoral students or the young PhD holders recently incorporated into universities or research centres and (b) for the senior university lecturers or researchers. This programme pays special attention to mobility between the public and private sector in order to accelerate the diffusion and transfer of technologies and knowledge.

In relation to **outward mobility** Spanish researchers from the public research system are somewhat more mobile at an international level than the European average (for specific data see Country report 2010 § 3.1).Moreover the PhD students can easily apply for some stays abroad and the large majority of the PhD scholarships include extra finance for mobility to work on their PhD abroad. In Spain the percentages of doctoral candidates with non -EU-27 citizenship is around 5% while the EU-27 average is around 6.5% (MORE-report, 2010a). The same report shows that more than 1500 Spanish doctorate candidates are carrying out their PhD studies in other EU-27 countries. As stated, Spain has a wide range of instruments on a national and regional level that promote mobility and the funds devoted to these programmes increased substantially in the period 2004-2008. It also includes a specific measure

for inward mobility for educational visits for long (one year) as well as short stays for people with broad experience and for young talented PhD holders.

Table 4: International mobility of researchers (% of persons that were mobile)

	Spain	Europe	Nat sciences & technology	Social sciences & humanities	Medical sciences & agriculture
HEI (during the whole career)	61	56	63	60	57
HEI during the last 3 years	32	29	36	36	15
PRO (during the whole career)	82	65	82	86	78
PRO during the last 3 years	41	35	41	55	29

Source: Study on mobility patterns and career paths of EU researchers" (MORE, 2010a and 2010b).

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

1.2.1. Promotion procedures, career stability and policy for the creation of human capital in science and technology

The researchers in PRO and HEI have the status of civil servants. Preparing a career as a researcher in Spain is a difficult, time-consuming process with low salaries and unstable short term contracts. Moreover, the selection procedures for candidates in research positions or jobs in the Spanish public research system generally neglect meritocracy and competitiveness in favour of endogamy[43]. The average annual salaries of researchers in Spain (34,908€) are almost 10% below the EU-25 average (37,948€) and very low in comparison with the most advanced countries (EC, 2007). The salaries of public researchers are very homogeneous without extra payments for highly qualified and prestigious researchers. The only way to reward very talented or productive employees is the increase for the formal "level" of responsibilities and the assignment of extra R&D funds. Productivity and quality of researchers is only rewarded marginally, not exceeding 15% of the salary. However such mechanisms to determine this 15% are used to introduce, with some exceptions, a general increase of salaries and do not discriminate between the most talented and productive researchers compared to the non-productive ones. One mechanism to increase the salary is by contract research, but this option depends on the quality of the researchers, the interest of their academic field, and their personal contacts with firms or public institutions. All these arguments make the career of researchers less attractive and the best students prefer to work for the business sector in all kinds of activities even below their intellectual level. No data are available on the number of foreign researchers in the PRO and HEI.

Another aspect is the criteria to evaluate the level of excellence of the research of university lectures. The main criteria are the publication in journals included in the ISI Journal Citation Reports (JCR) while the applications of the scientific results are less valuated. Therefore the Spanish scientists are more prone to scientific activities than to responding to the demands of the production sector. This is partially the result of the evaluation system of scientific researchers based on the number of publications in scientific referenced journals while applied research or technology transfer are almost neglected in those criteria.

1.2.2.- Providing attractive employment and working conditions

[43] In 70% of the competitive examinations there was only one candidate and in 94.6% the selected person was the internal candidate (the same figures for the USA, Great Britain and France were respectively 7%, 17% and 50% (data taken from Cruz-Castro et all (2006) and Corruption (2007).

Generally the selection procedures for candidates in research positions or jobs in the Spanish public research system neglect meritocracy and competitiveness in favour of endogamy[44].Legally there exists full access for candidates of the European Union to research and teaching posts. However, the tacit mechanisms behind the formal process are still an important threshold, not only for foreigners, but for every outsider from a university, faculty, or even the departments of the same faculty (Fernandez Esquinas et al., 2006, P.167). The members of the selection commission and selection criteria are established ad hoc by the institutes or departments themselves. The final step to a stable job (lifelong contract or as a civil servant) requires an official accreditation that the applicant meets the minimum requirements of excellence. Again in this case the final selection of the candidate is made by the department and they do not offer a stable contract until the internal candidate obtains his accreditation.

On an individual level only a few Spanish universities have subscribed to the European Charter for Researchers (fewer than ten). This charter is difficult to accept for the larger institutes with a high level of decentralisation of the selection procedures and a culture of favouritism. However the Spanish government requires all universities that present applications to obtain public support from tenders for Human Resources to accept and comply with the Charter. Where all universities obtained public support, it could be said that implicitly all universities subscribed to the charter. However, the practical impact of this mechanism on the transparency and openness of the selection procedures seems to be marginal. Some other specific aspects can be mentioned. For example international advertising of research vacancies supported by public funds is not common and depends on the interest and individual decision of the department or research organisation. There is a simple, clear system for the recognition of professional qualifications in the case of standard studies. However in the case of studies not existing in Spain the validation of foreign academic degrees is more complicated.

In relation to the social security needs of mobile researchers it can be stated that In Spain all citizens receive health care and social benefits in case of needs including the (young) foreign researchers. Spain signed agreements with the European Union that the different retirement pension periods in other EU countries are added together in calculating the minimum contribution period and you may ask to have the pension paid in another country. These rules also apply to the non-EU countries with a bilateral agreement (FECYT, Mobility portal). In relation to the social security of those young researchers with scholarships it can be stated that most of them are based on contracts and include almost all social security regulations. However, some exceptions exist such as the PhD Scholarships. In this case they apply the 2+2 system (two-year scholarship and two-year contract) and afterwards scholarships holders receive unemployment benefits. Spanish Universities and public research organisations cannot be considered as researcher-friendly in terms of social security and pension systems. Avoiding payments to such a system to the detriment of the researchers is the normal money saving system of Spanish public organisations. Relatively large parts of the wages are supplements and are excluded once the pension and social security payments are calculated[45].This fact is an important barrier to attracting foreign researchers or lecturers.

1.2.3- Barriers for mobility of researchers[46]

Most support programmes in Spain are formally fully open for researchers or students of all EU countries. However there are several informal barriers that make **inward mobility** very difficult such as protection of the internal candidates, the low salaries; the instability of initial research contracts; the specific time- consuming process of recognition of academic qualifications (accreditation) and the need for advanced knowledge of Spanish and in some regions of the regional languages (such as Catalan or the Basque language). The importance of those regional languages in the evaluation criteria to select researchers or to obtain promotion affects the foreign researchers and also makes internal mobility of Spanish researchers more difficult. The use of the Scientific Visa Package is not approved and its application is only partial. However a general tax measure to attract qualified workers from abroad offers a 24% tax discount on their salaries and can be applied to foreign or Spanish employees who have not

[45]Some studies show that only 20%-30% of the total income of university professors is basic income.Source:"Federación de Asociaciones de Catedráticos de Universidades Constituidas. Taken from: http://www.aprendemas.com/Noticias/html/N606_F27102004.HTML

[46] For the case of barriers for inward mobility see § 3.1.3

worked or lived in Spain in the last ten years. Since the crisis the control of inward mobility –including for scientists- is more serious and limits the possibilities to enter Spain as an employee. On the other side, the new Law on Foreigners (Ley de Extranjeria), approved in April 2011, reduced the administrative process for foreign researchers to obtain a labour permission from 90 to 45 days (See press release).

Also in the case of **outward mobility** some barriers exist. These include the fear of losing the personal contacts with their own department, important in the Spanish "hierarchical" research system where departments select researchers and (post) doctoral students. Other thresholds are the cost of giving up a stable position as a Civil Servant or the lack of active knowledge of foreign languages (English). In any case, Spain and its regions have in recent years introduced new policies to promote inward and outward mobility and have significantly increased their budgets.

No specific policies to modify and adapt curricula to new (industrial) S&E need exist nor other specific policies aimed at making a career in science, technology and engineering more attractive.

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

Spain has a large number of instruments to foster Human Resources in science and innovation. Over 9% of funds (€313 million in 2010) in the main national R&D-related policies for 2010 are devoted to this subject. Three overall programmes can be mentioned: (1) The Programme of the Training of Researchers (with 33% of the funds) which offers support for PhD students (two year scholarship and a two-year contract as an apprentice). (2) The Programme of mobility of human resources for lecturers and doctorate students (with 8% of the funds)and(3) the programme to increase the demand for researchers in the Spanish R&D system (with 59% of the funds) support post-doctoral activities and convert temporary R&D research contracts for doctors into permanent ones to foster the integration of PhD students or Doctors in firms, R&D centres or universities. Moreover, the regional governments also offer a large number of schemes geared to HH.RR. Over 26% of the 8,096 scholarships awarded in 2007 went to engineering and technology sciences. The areas of natural and exact sciences and of social sciences received 20-21 while the scientific areas of human sciences and health sciences received 12-13% of the scholarships. Agriculture, livestock and fishery was given only 4%. It can be highlighted that the area of engineering and technology sciences obtained almost 47% of the scholarships oriented to the integration of PhD holders in the labour market. Another outstanding fact is that Philology and Philosophy obtained over 8% of the post-doc scholarships.

Specific policies and incentives to ensure a sufficient supply of science, technology, engineering and mathematics (post) graduates and an appropriate mix of skills among the population (including through strong vocational and education and training systems) in the medium-to-longer term do not exist. The education curricula do not really take into account aspects such as creativity, critical thinking, problem solving, teamwork, communication skills, or entrepreneurship. However in some specific universities such an approach can exist. Moreover the Bologna Process should include such aspects at least formally in the study plans although no specific studies exist of the real situation.

Only a few doctoral programmes exist in collaboration with foreign universities and the introduction of English as a spoken language in PhD courses or the university degrees is still in an early stage. One of the problems is to find enough experienced lecturers that can give the subjects in English. Due to the high level of autonomy in the Spanish universities a high degree of standardisation of national PhD programmes does not exist and would be almost impossible in the Spanish setting.

1.4 Promote equal treatment for women and men in research

The policies for promotion of women in general are an important topic in Spanish society. Spain had (from April 2008 till October 2010) a Ministry of Equality and each law presented in the parliament requires an impact report about the effects on "gender" aspects. Several specific measures were taken to promote women in the research system including a minimum gender representation in academic committees, and governing bodies. For example, in several universities the selection commissions of research positions should include women. The Spanish situation shows that the presence of female researchers in the public research system (42% in 2006) is high in comparison to other European countries (EU-25 – 34.8%). In spite of this figure and the political interest there is no doubt that

discrimination against women in the labour market still exists and the gender gap is not closing as rapidly as desired (EC, 2007; UMYC, 2011). Some data show clear discrimination and difficulties for women to enter the research system and a survey showed that men are more successful in obtaining the stable and better paid jobs (Villaroya et al, 2007) and despite the fact that females obtain better evaluation during their university studies they are less successful when they apply to obtain pre or post-doctoral scholarships (Villaroya et al, 2007 and UMYC, 2011). Since 2006 most contracts and scholarships include career breaks based on parental leave. However, maternity leave still has negative effects on the career of a researcher because: (1) some scholarships do not pay social security in the first two years:(2) once the women obtain a contract they do not reach the minimum time span of social security contributions to have the right to maternity leave. (3) The lack of formal contracts entails female researchers losing several rights in comparison with other mothers[47]. And(5) the 4 months of maternity leave is not always compensated for with four months extension of the maximum period to hold a scholarship (Villaroya et al, 2007). The UMYC study showed that having children is still one of the main obstacles for the productivity and promotion for women in science.

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

The ERA initiative is discussed from time to time both in the Spanish press and in society at large. However, on a policy-making level the internationalisation of the Spanish innovation system is considered a very important topic. The National Plan for R&D&i refers broadly to the ERA concept for several reasons: (1) as a benchmark for S&T indicators and good practices; (2) ERA provides funding schemes such as the R&D Framework and the EUREKA Programme and Spain wants to increase its participation and (3) The ERA and the Lisbon Strategy were some of the fundaments to develop the Spanish National Reform Programme. Therefore it can be said that the ERA did help to define the broad framework and specific instruments of the NPRDI, for example the reorientation towards sufficient critical mass and excellence which makes it possible to assume leadership in European programmes, etc (ERAWATCH Country Report, 2008). However, the tightly closed endogamic public research system with highly decentralised power impedes or hinders the successful implementation and optimal use of the ERA oriented measures. Researchers at universities and most Public Research Organisations enjoy high degrees of autonomy for pursuing particular research lines and projects (Heijs, 2010; Cruz-Castro et al 2011) independently of any scientific hierarchical approval or supervision. “Agenda setting continues at present to be the result of the aggregation of individual and research group research agendas, rather than being based on highly structured research programs at the organisational level” (Cruz-Castro et al 2011). Moreover, due to the historical culture of Autonomy and freedom, strategic planning of R&D is not common in those organisations, and this impedes or makes it more difficult to reach a critical mass.

Spain participates very actively in all kinds of ERA initiatives such as the ERA-nets, Joint Technology Initiatives, etc. Some ERA-nets execute, in an experimental manner, joint calls for collaborative R&D projects, calls with specific objectives and restricted financing in which each participating country finances its own centres’ participation. In these cases, the Spanish projects are granted by a Complementary Actions call for proposals. The information on ERA-nets is sparse and much dispersed because the Spanish participation is spread amongst all kinds of research organisations and governmental institutions on a national and regional level and no information is systematically gathered on a central level. Spain gives intensive support to the **Joint Programming** and in several fields –such as health science- Spanish Researchers are collaborating. The new Law on Science and Innovation of 2011 includes several elements for a partial solution to the legal barriers for joint programming. Spain considers the **Joint Technology Initiatives** as an important EU policy and participates in all JTIs. Spain also has an active role in the **article 169 initiatives;** also in this case they participate in all initiatives (Based on a statement by the Ministry of Science and Innovation in 2009).

Cross border cooperation is not common to the same or maybe more specific Spanish regions. A specific cross-border project is the Spain Portugal infrastructure.

[47]Including the right to get their children into the (free) kindergarten of the universities or financial state support for babies or young children (up to three years) of working mothers

Spain seems to have an open strategy in relation to the access of all kinds of national policy programmes for firms or individuals abroad. As already mentioned, the programmes for human resources are open to all EU inhabitants and also the tenders for R&D projects are accessible to foreign firms operating in Spain. No example is found of a public research funding scheme that allows researchers to transfer a research grant which they have been awarded within a national programme to other countries when moving to another position (EC, 2008). One of the main components of the international scope of the Spanish R&D&I Plan 2008-2011 is the opening up of the programmes to R&D groups from other countries. However, in most cases research grants are not portable and a researcher awarded a research grant is not normally allowed to transfer it to another foreign institution.

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

The European Strategic Forum for Research Infrastructures (ESFRI) was established in April 2002 to support a coherent approach to policy-making on RIs in Europe and to act as an incubator for international negotiations on concrete initiatives. Spain considers the ESFRI, to be an important initiative and plays an active role in its design. Spain contributes significantly to a broad range of these facilities and tries to participate in 25 of the 44 European RIs to enhance its percentage of return on that participation. It also promotes the role of Spanish industry in building and maintaining those infrastructures. In Spain at least three large ESFRI installations will be located. The first one is the construction in Catalonia of one of the five supercomputers in Europe of the Partnership for Advanced Computing. The second one is the solar research infrastructure (EU-SOLARIS) at the Advanced Technological Centre for Renewable Energy in Almeria. And thirdly, the European Spallation Source (ESS) in the Basque Country is an advanced centre for researching the atomic and molecular arrangement for materials

In recent years the Spanish government reinforced the domestic policy for research infrastructures (RI) which is reflected in a substantial increase in the annual budgets devoted to these policies and some new initiatives. The Spanish National R&D&I Plan 2008-2011 promotes the effective use of such infrastructures by the use of specific outward mobility schemes among others. The ESFRI also boosted design and interregional coordination of the national road map of infrastructural needs and in 2007 the "Conference of Presidents" of the Spanish Autonomous Communities came to an agreement to create 24 new singular scientific infrastructural installations in the period 2007-2015 which are added to the 37 existing ones. The investments foreseen for the period 2004-2010 are €774 million. As far as the Spanish RI roadmap is concerned, the NPRDI includes the **National Programme on Scientific and Technological Infrastructure** devoted to the creation and improvement of the RI, which received 16% of the total budget in the period 2008-(See ERAWATCH Mini Country report for Spain, 2011), and the investments granted for the period 2004-2010 on research infrastructures are 2.822 million € regarding the National R&D&I Plans (Statement of the FECYT).

4. *Strengthen research institutions, including outstanding universities*

The higher education panorama of Spain can be described with the official statistics of the Spanish INE (academic year 2009-2010). These show that Spain had 154 higher educational institutes (HEI) of which 49 are public universities, 25 private universities and 80 are other HEIs. The number of students is 1.4 million, of which 89.2% study in public universities and 10.8% in private ones. The Open universities registered 13.4% of the students. In the academic year 2009-2010 over 303 thousand new students were registered while 190 thousand finished their degree studies. Almost half of the students do social sciences and law, and 25.7% engineering and technical studies while 15.3% of the students are registered in experimental and health and 9.3% in humanities. However, in the case of doctoral students and approved PhDs the experimental and health area is the most important one (30.4% of the students and 42% of the approved PhD theses) followed by the social sciences (23% – 19.7%) and humanities (14%– 13.0%) while in the case of engineering the numbers for both indicators are 14.6% and 16% respectively. **The Quality of the National Higher Education System** can be analysed in two aspects, the quality of students that recently obtained their degree –of which almost no data are available- and the level of excellence of the research outcomes. As mentioned in section 1, the output with regard to

publications shows that Spain produced in 2008 51,780 publications, which implies 1,144 publications per million inhabitants (649 in 1998). This is below the EU-27 average of 1,260[48]. "With regard to publications, Spain produced in 2008 51,780 publications, which implies 1,183 publications per million inhabitants" The Spanish quotes in the total number of scientific publications all over the world in the period 1998 – 2008 went up from 2.24% to 2.72%. The quality of the publications (measured by the number of citations) seems to be low. Each Spanish publication is cited 15.3 times while the publications from countries like the UK, the USA or the Scandinavian countries are cited on average 20-25 times. Another proof of the insufficient level of excellence and productivity is the fact that a large group of academic researchers (25%) never passed or applied for the six-year evaluation of their research results (Hernandez/Perez, 2011).

A growing percentage of the Spanish scientific publications is based on international collaboration. In the period 1996-2002 around 28-30% of the publications were produced with foreign partners while in the last few years (2006-2008) this percentage went up to 39-41%. In the case of patents, Spanish production is also increasing although it is still at a very low level. Spain produced in 2007 over 32.6 European patents per million inhabitants, far below the EU-27 average of 116.5. In 1990 this number was 6.5, reaching almost 10 patents per million inhabitants in 1995 and almost 20 in the year 2000. Since the year 2004 the number has been around 30 patents per million inhabitants. (The number of the patent applications (it is not specified in the report whether the data is about patent applications or patent granted) per million inhabitants in 2007 is 32.8 (instead of 32.6) in Spain and 117.5 (instead of 116.5) in the EU-27 average. (Source: Eurostat, Patent applications to the EPO by priority year at the national level). In conclusion, the Spanish level of knowledge production is improving especially in the academic sector. The results of research activities in terms of absolute number of publications are at a satisfying level in comparison with the EU-27, albeit still far behind the leading countries. At the same time the technical gap in the form of patents is still very wide because the number of patents per inhabitant in Spain is 28% of the EU-27 average.

The scientific quality of the Spanish academic system as measured by the number of publications is just below the EU-27 level although still far from the leading European countries. Looking to the impact rate of the publications the situation is not outstanding. The 2010 report of the «Scimago Institutions Rankings» (SIR) indicates that Spain is the 10th country in the case of production of the number of publications but taking into account the impact score Spain is in 21st position. (However, since 2010 is still a provisional indicator, it should be specified that it is provisional or we suggest using 2009 data. In 2009, Spain occupied the 9th position in the scientific production rank using the Scimago Institutions Rankings.) Also the international rankings of universities show the relatively low quality of the Spanish universities due to their absence in the top 100 and their scarce appearance among the lowest ranked universities[49]. A broad comparative study is made on the quality of the Spanish universities (Buesa et al, 2009) offering a general synthetic ranking and specific rankings for both teaching (18 variables) and research (14 variables). The most outstanding university for both missions was the private University of Navarra. This ranking is based on the average quality level of the activities taking into account the number of academic staff. Therefore most of the larger universities included in the international rankings (due to their size) are not in the top ten of this "Spanish" ranking (with the exception of the "Autónoma of Barcelona").

The main instrument to improve the level of excellence is the already mentioned accreditation, which requires at least a minimum level of excellence to obtain a stable job. Initially only one national agency for accreditation was created with strict procedures and requirements. However, later on almost every region created its own agency and a certain number of them use very lax and permissive criteria. In spite of these new recruitment procedures the public research organisations and universities –at department level-still have a broad level of freedom in the application of the selection criteria. On the whole, the accreditation system at least seems to avoid the access of people with a really bad curriculum, although it does not impede the survival of the existing widespread endogamy. Two outstanding policy

[48] All data on publications are based on the SCOPUS data base of the SCImago Journal & Country Rank and are taken from the reports of COTEC, 2011 and FECYT 2011. The patent data are taken from the Eurostat, 2011.

[49] In the Academic Ranking of World Universities – 2010 the first Spanish university is in 201st place and another 9 are ranked between the positions 200-500.In the list of the 200 best universities of the Times World University Ranking only one Spanish university (is included in 186th place) and the QS World University Ranking» (2010) placed the best Spanish university in 148th place and includes 3 other universities within the 300 best universities.

initiatives can be mentioned in relation to the improvement of excellence. The first one is the **University Strategy 2015** which is an initiative coordinated between the Government of Spain, the Autonomous Regions and the universities, aimed at the modernisation of the Spanish universities by promoting excellence in education and research, internationalising the university system, and ensuring its involvement in bringing about economic change by providing knowledge and innovative improvements. The second one is the "Campus of International Excellence" Programme. This programme is aimed at making Spanish universities more internationally competitive in general, with special focus on the overall quality. However, neither of the initiatives handles the main barriers for excellence, endogamy, fragmentation and the lack of strategic planning and coordination which makes the plans partially useless.

Another important way to improve the excellence is undergoing broad renovation in legal and organisational terms. In recent years already some aspects have been changed, such as the Law of University Organisation, the "University Strategy 2015" and the new Law of Science and Innovation. Recently the OECD published two studies on Higher Education Strategies (for the regions of Catalonia and Andalusia) in which it analyses the situation and main problems and offers some recommendations for the State and each of the regions.

The "University Autonomy" is protected by the Spanish constitution and implies a broad level of self-government. On an **individual level** the academic staff of the universities has total freedom to arrange their research activities, which hampers coordination and strategic planning and created a fragmentation of the research groups. The academic autonomy on an **institutional level** is often used to defend the personal interest of the researchers (corporative behaviour) above the general interest of society as a whole[50]. Therefore most universities or research centres can be characterised as closed communities with a low level of transparency rather than an open dynamic organisation based on meritocracy. On the one hand, the university and PROs have broad freedom to organise their institutes and to decide in which disciplines they recruit more new researchers. However, they have to take into account the budget restrictions, since salaries or other payments are strictly ruled and pre-defined by the national authorities. The University has a centralised decision making process and the Rector (or vice-rector for planning) has the final decision concerning the distribution of human resources between faculties and departments. The appointments of the rector, deans of the faculty or directors are decided by direct elections based on the votes of the members of the university (lecturers, administrative personnel and students). Several authors have a critical view on the use of the Autonomy of the Universities in Spain. For example Sanchez (2008) argues that the *"democratic model is not capable of managing the university with a criterion of efficiency and rationality",* because the chosen managers have debts with their voters and the pressure groups that supported them during the elections." For example, the vast majority of the "study" plans (curricula) are designed taking into account the interests and power of the departments without any serious analysis of future needs in the labour market. Individual and institutional autonomy coexists with a reduced level of **financial autonomy.** Most financial resources come from the regional public budgets, though this economic dependency has never been used to force universities to open up and professionalize their institutions. Block funding is based on number of students, while excellence measured by research results has only a marginal role in the funding decisions. Block funding financed the salaries and current costs while specific R&D projects and activities are mostly financed by competitive tenders and contract research. Some regional governments (such as Madrid) made an attempt to base block funding of the universities on productivity indicators. However there is clear opposition from the universities and this new trend is still in an experimental phase. As a **concluding remark** it can be pointed out that the autonomy of the universities and research organisations is a tricky question. It is not the question of more or less autonomy, but its application and the use or abuse of this freedom has to be taken into account.

Evaluation and control of the level of excellence or productivity is almost non-existent. Moreover the existing mechanisms are rather weak and do not include strict high level requirements. The quality of the

[50]Study plans and new subjects are designed according to the interest of the largest departments and the teaching staff and are not based on the real needs and demand for human capital on the labour market. The selection of research subjects is mainly based on personal interest and far from the ideas or interest of the markets, although in some occasion they overlap. It is difficult to create new subjects or specialities because the "democracy" of the Spanish universities is based on the power of traditional departments (with more votes) than new small research groups or departments.

research activity in the public system is not systematically evaluated. Only some specific procedures exist to evaluate the "quality" of individual researchers. The most important one is (since 2001) the official recognition or accreditation required to access an academic position (temporary or stable). To apply for such a position you have to give evidence of a minimum level of knowledge and experience. This impedes the entrance of new personnel with a low profile without ensuring that the best researchers that apply get the job. Two other indirect mechanisms are for small increases in salaries based on productivity and quality. (1) Evaluation of researchers to establish an -often very small- annual increment on their salary. (2) The "six-year" evaluation. In this case all researchers passing a low minimum level get the same monthly amount (€130-50) for life. These payments for productivity do not exceed 5% of the salary. These lacking mechanisms are one of the main weaknesses of the public research system and higher education system. Moreover it is a major cause of the lack of sufficient excellence of the scientific research and its output.

Institutional funding or direct block funding now has a reduced internal importance and fell from 60% in the early eighties to 30% in 1989, and at the beginning of this century this percentage was 23% (Sanz, 2005). Block funding finances the salaries and current costs and is based on number of students, while excellence measured by research results has only a marginal role in the funding decisions. Specific R&D projects and activities are mostly financed by competitive tenders and contract research. Some regional governments (such as Madrid) made an attempt to base block funding of the universities on productivity indicators. However there is clear opposition from the universities and this new trend is still in an experimental phase. (See § 6.2.2). Another positive trend is the inclusion of the utility of the research results in the selection criteria of almost all tenders for project support. The distribution of the funds for public support for R&D is more and more based on competitive criteria and block funding lost weight in the total GBOARD. Moreover in several regions they introduced some regulation to relate the block funding for research (not for education) with productivity.

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

In the last decades the Spanish government has tried to strengthen the science- industry relationships (SIRE). In the last decade the Spanish government has focused the changes in R&D and innovation policies on the commercialisation of the scientific results fostering public private cooperation, the creation of clusters and important support to the creation and expansion of science and technology parks and technology centres and the promotion of spin-offs. The recently approved Law of Science and Innovation underpins the importance of the SIREs. The EU Cohesion Funds play a very important and growing role in the regional R&D policies. Several measures financed by these funds promote public-private cooperation as in the case of the support for: (1) the creation of Science and Technology Parks, (2) cooperative R&D projects in SMES; (3) the creation and maintenance of large infrastructural facilities; (4) the creation of new technology based firms; or (5) technology platforms. **Also the Spanish National R&D&i Plan boasts a specific programme to promote** technological cooperation between SMEs and universities or public R&D centres

Knowledge Transfer Offices are already in existence since 1988 although the activities, quality and success of these KTO offices are very heterogeneous. The general opinion of experts is that the Spanish KTOs have in general a very passive bureaucratic attitude and are basically administrative units that act to formalise the R&D related projects obtained by the researchers[51]. However in some cases the KTOs have a very proactive attitude by generating added value as an intermediary body between the academically oriented researchers and the production sector. The creation of academic spin-offs is considered by policy makers as an important topic and several support schemes exist. However, the fact shows that it is still an underdeveloped subject in Spain, which is partially due to the academic orientation and the lack of entrepreneurship in the universities and PROs and partially because of the lack of that venture capital which is recognised by the Union Innovation Scoreboard as an important problem and its declining availability (UISB, 2010).An important barrier is the almost non-existent integration of research and innovation policies on the one hand and the education policies on the other. The Universities have full autonomy (see also point 4 of the annex) and a large part of the educational and research activities of

[51]Based on several opinions expressed during a meeting of experts for the development of indicators to measure the quality of the Spanish universities (Meeting in January 2009 in Baeza – Andalusia)

the public sector is not based on societal needs or the demand of the production sector but on the selfish interest of the leading members of the university. An organisation that could or should guide the influence of external stakeholders on the universities could be the Social Council of the universities. However the role of these councils is marginal or symbolic due to the lack of tradition and culture in this kind of organisation and the lack of a well-defined legal framework that defines their functions and power.

Spain has no specific legal regulation of the ownership of **Intellectual Property Right** (IPR) produced by the university or PRO staff. The general IPR Law of 1986 indicates that the university owns the inventions and research results generated by its staff members. However the inventor receives a part of the benefits generated by the IPRs as established by the Statutes of each HEI or PRO. Researchers own the copyright of their publications and can contract research. In the latter case a certain percentage (between 10-20% depending on each university) of the total amount of the contract is for the university and Technology Transfer Office. The above described permissive situation is related to the traditional low salaries in Spanish universities and the researchers can be rewarded with this kind of extra income often generated by themselves.

5. Enhance knowledge circulation across Europe and beyond[52]

As discussed in point 2 of this annex Spain is very active in the internationalisation of its innovation system and participates intensively in the ERA initiatives. Spain has a high level of participation in international governmental research organisations and support schemes. Since 2007 Spain has increased its participation in the Framework programme (FP). Spain obtained a satisfying number of the projects of the European Research Council in the case of the “Starting Independent Researcher Grants” and the “Advanced Investigators Grants”. Moreover Spain participates in two of the three Knowledge and Innovation Communities (KICs) of the European Institute of Innovation and Technology. Spain also participates actively in the multilateral research programmes (for example CERN, ESA etc.). Moreover, it participates in several bi- and multilateral agreements with other ERA countries.

Spain has a specific subprogram for research stays of foreign lecturers and researchers in Spanish HEI and PRO. The measure supports research and educational visits for long (one year) as well as short stays for people with broad experience and for young talented PhD holders. Moreover the National Programme for internationalisation of R&D has specific international mobility schemes for EU countries and third countries.

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

In several reports the international cooperation outside Europe is mentioned (National R&D&I Plan, the New Law for Science and Innovation and National Innovation Strategy). Due to its traditional relationship with Latin America Spain has several cooperation programmes with that part of the world. One of the most outstanding ones is the **Iber-American Programme of Science and Technology for Development** for multilateral cooperation in the following areas: Agro-Alimentation, Health, Promoting Industrial Development, Sustainable Development, Global Change and Ecosystems, ICT, Science and Society and energy. Moreover the Spanish government has several general bilateral cooperation agreements with countries outside Europe (such as Canada, China, India Korea, USA and Japan). Besides these general programmes Spain also has bilateral cooperation programmes in some specific fields with Brazil[53] and Argentina[54]. As can be seen the cooperation programmes refer to some broad field but also address some of the grand challenges.

[52] For details on the level of participation and specific programs or projects see ERAWATCH Country Report of 2010 and the ERAWATCH Country Fiche.

[53] Biotechnology, renewable energies, process engineering, nano technology and health

[54] Biomedical, forensic and vegetal Genomics and Bioinformatics

Annex 2: Foreseen changes in the Spanish innovation system generated by the New law on Science, Technology and Innovation

The new Law on Science, Technology and Innovation (approved in May 2011) and operative since the beginning of December 2011) will generate several changes in the Spanish innovation system and its institutional setting. This Law replaces the Law of Science of 1986. An important novelty of the new Law is its inclusion of the terms "technology and innovation" aimed at the integration of those types of activities with scientific research. The new Law in order to improve mobility between private public organisations foresees an extended leave of absence of a maximum of 5 years without losing the "accumulated rights" of seniority. Such leave implies that public researchers can work in private firms running a common project and also facilitating the return of those researchers to the public research system.

The new Law on science, technology and innovation foresees some changes in the organisational structure. The current General Council of Science & Technology and the Advisory Council of Science & Technology will be substituted by a Scientific & Technology Policy Council (STPC) and an Advisory Council of Science & Innovation (ACSI). The new STPC will coordinate the R&D and innovation policies between national and regional levels and will be in charge of setting up a new scientific strategy at the state level. Half of its members will be representatives of the regional governments and the other half are assigned by the national government. This Council, presided over by the Ministry of Science and Innovation, will be in charge of design of the Spanish Science and Technology Strategy at the state level. Moreover it will also have an Information System to collect the activities of the 17 Autonomous Communities and the "Spanish Ethical Committee for Research". The new ACSI is the body that should ensure the participation of the research community and the social and economic agents (including the associations of enterprises and labour Unions). Its members are assigned by the Scientific & Technology Policy Council.

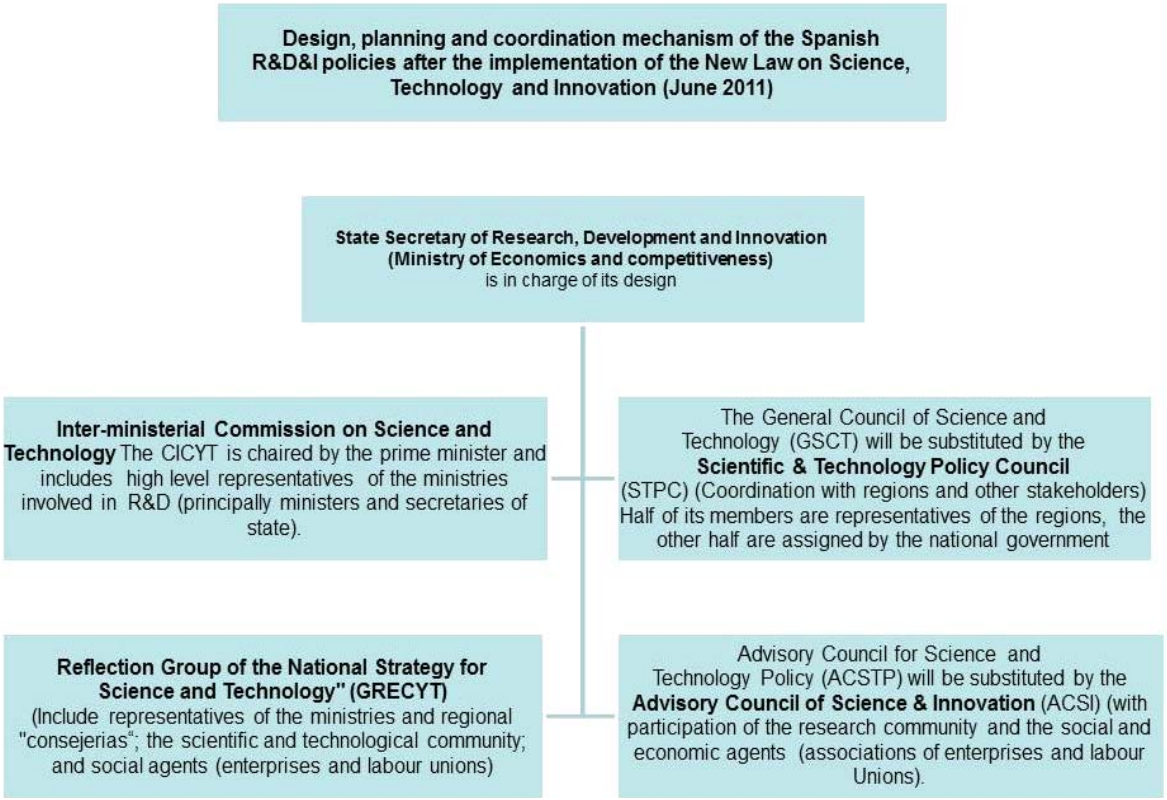
Both new Councils are involved in the design of the two new strategic plans foreseen in the new Law for Science Innovation and Technology: the Spanish Science and Technology Strategy (ENCYT in Spanish) and the State Strategy of Innovation (e2i-strategy). Both strategies are considered as a multiannual reference framework in order to achieve a series of common general objectives and priorities in relation to the R&D and innovation policies shared by all the national and regional administrations and to ensure an efficient implementation of the policies of the different political levels (regional, national and European). The implementation of the ENCYT will be developed by the MICINN in cooperation with all the ministries and departments involved to determine the objectives, priorities, selection criteria and financial budgets of the R&D and innovation policies. The e2i-Strategy, which is geared to changing the orientation of the model of the Spanish production system to an innovation based economy. Both Plans are designed by the MICINN in coordination with the State Organs of Economic Planning. They will be approved by the government after receiving a report with the opinion of the Advisory Council of Science & Technology and other bodies (where needed) and after a hearing of the government-delegated Commission Scientific, Technological and Innovation Policy (CICYT). The Spanish Science & Technology Strategy and the Spanish Innovation Strategy are created as a framework of multiannual reference in order to "achieve a set of general common objectives shared by all the Administrations" with responsibilities in R&D and innovation.

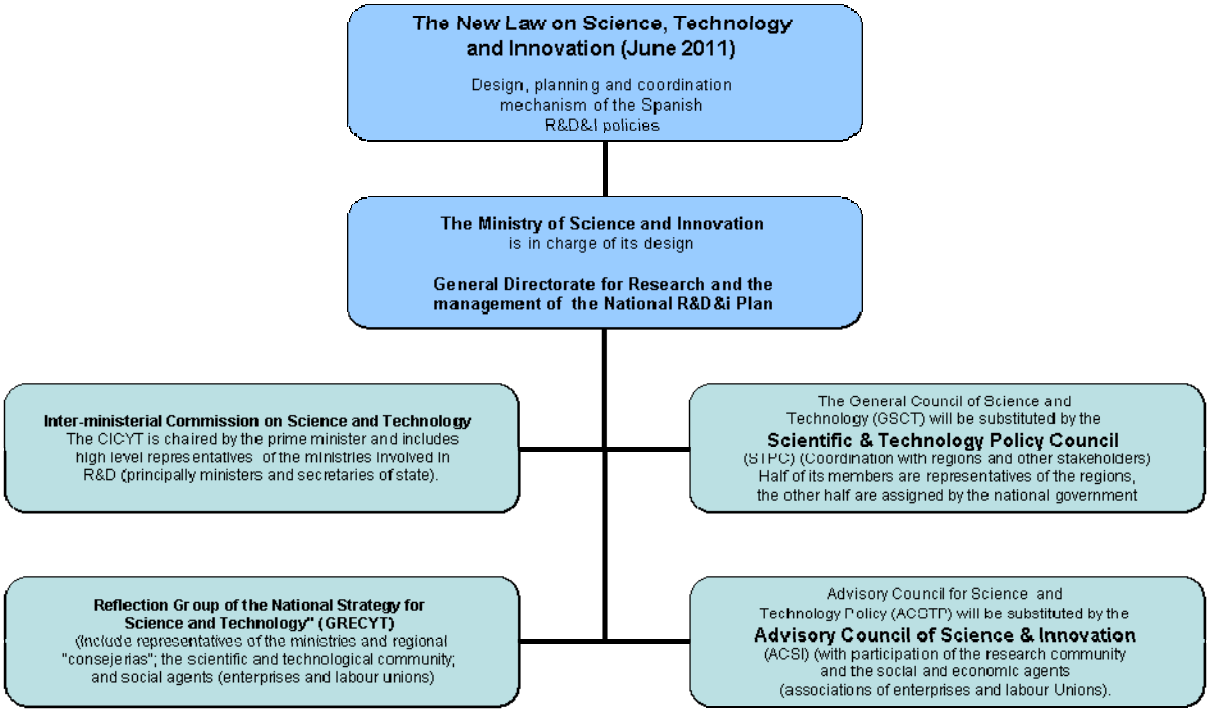
Two funding agencies of the public system are foreseen: the present Technological Industrial Development Centre (CDTI – already in existence) and a new State Research Agency (NRA). The Law does not include specific details about the structure and responsibilities of these agencies, except that their implementation will be carried out "without an increase in the public expense" and that their "statutes" have to be approved by the government during a maximum period of one year". The State Research Agency, demanded by the scientific community, will be created in order to run the science system with autonomy, efficiency, transparency, quality criteria and accountability of the results. It should also improve the coordination between the public agents and the private ones and establish stable, flexible and when needed, multiannual funding mechanisms. The CDTI is -and will be- in charge of the development and implementation and the innovation related policies for the production system.

The new Law on Science, Innovation and Technology also improves several aspects in the career of the researchers. The replacement of the 2+2 system (two years scholarship and two year contract) in the future by four-year-employment contracts. This implies the full recognition of certain rights such as unemployment benefits and maternity leave. The Law includes three types of private (non-civil servant) labour contracts: one to carry out one's PhD (four years maximum); another one of access (of five years) and another one for distinguished researchers or scientists, "of renowned prestige" who will be able to occupy key positions in management or in "important" programmes (it can be permanent). The pre-PhD contract will be delayed till 2014 and the access ones will be conditioned by the State budget and employment public supply. Moreover it created a unified professional career. The different official professional scales for scientists with a civil servant status in the public research organisations (PRO) will be unified in three comparable to those of the Spanish National Scientific Research Council (CSIC): (1) research professor, (2) scientific researcher and (3) permanent scientist. This unification facilitates staff mobility between the PROs.

ANNEX 2

Figure 2: Governance of the Spanish R&D innovation policies once the new Law on Science, Technology and Innovation is implemented.





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List of Abbreviations

ACSI	Advisory Council of Science & Innovation
BERD	Business Expenditures for Research and Development
CAS-CICYT	Monitoring and Support Commission of the Inter-ministerial Commission on Science and Technology
CDTI	Centre for the Development of Industrial Technology (Centro para el Desarrollo Tecnológico Industrial)
CENIT	National Strategic Consortia for Technical Research (Consorcios Estratégicos Nacionales en Investigación Técnica)
CERN	European Organisation for Nuclear Research
CIA4OPM	Common Impact Assessment for Optimising the Policy mix
CICYT	Inter-ministerial Commission on Science and Technology
COSCE	Confederación de Sociedades Cientificas en España (Confederation of Scientific bodies in Spain)
CSIC	Spanish National Research Council (Consejo Superior de Investigaciones Científicas)
E&T	Engineering and technology
E2i	The Spanish Innovation Strategy 2010-2015
EC	European Commission
ENCYT	National Strategy for Science and Technology (Estrategia Nacional de Ciencia y Tecnología)
ERA	European Research Area
ERA-NET	European Research Area Network
ESA	European Space Agency
ESFRI	European Strategic Forum on Research Infrastructures
ESS	European Spallation Source
EU	European Union
EW	ERAWATCH
FECYT	Spanish Foundation for Science and Technology (Fundación Española para la Ciencia y la Tecnología)
FP	European Framework Programme for Research and Technology Development
FTE	Full-Time Equivalent
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Expenditure on Research and Development
GRECYT	Reflection Group of the National Strategy for Science and Technology
GSB	General State Budget
GUF	General University Funds
HEI	Higher education institutions

HEP	High Educational Policies
HERD	Higher Education Expenditure on R&D
HES	Higher education sector
HH.RR.	Human Resources
HRST	Human Resources in Science and Technology
IBPP	Innovation-based Public Procurement
ICT	Information and Communication Technologies
IEF	Institute for Fiscal Studies
INE	Spanish national Institute of Statistics
IP	Intellectual Property
IPR	Intellectual Property Rights
IPT	Industrial Production and Technology
IST	Information Society Technologies Area
IUSB	Innovation Union Scoreboard
JCR	Journal Citation Reports
JPI	Joint Programming Initiatives
JTI	Joint Technology Initiatives
KICs	Knowledge and Innovation Communities
KTO	Knowledge Transfer Offices
LA	Latin America
MICINN	Ministry of Science and Innovation (Ministerio de Ciencia e Innovación)
NACE	statistical nomenclature relating to economic activities
NOP	Non-oriented Policy
NP	Spanish National Plan for R&D and innovation
NPRDI	Spanish National Plan for R&D and innovation
NRA	Spanish National State Research Agency (NRA).
NRP	National Reform Plan
NTBF	New Technology-Based Firms
OECD	Organisation for Economic Co-operation and Development
PERD	R&D expenditures of the Public Sector (Excluding HEI)
PPC	Public Private Cooperation
PRO	Public Research Body (Organismo Público de Investigación)
R&D&I	Research, Development and Innovation
R&D	Research and development
RI	Research Infrastructures
SIRE	Science - industrial relationships
SME	Small and Medium Sized Enterprise
STI	Science, Technology and Innovation
STI Law	New law on Science, Technology and Innovation
STPC	Scientific & Technology Policy Council
TTI	Transport, Telecommunications and other Infrastructures
UK	United Kingdom
UMYC	Unit for women and science (Unidad de Mujer y ciencia)
USA	United Sates of America

European Commission
EUR 25724– Joint Research Centre – Institute for Prospective Technological Studies

Title: ERAWATCH COUNTRY REPORTS 2011: SPAIN

Author(s): Joost Heijs

Luxembourg: Publications Office of the European Union

2013– 50 pp. – 21.0 x 29.7 cm

EUR – Scientific and Technical Research series –ISSN 1831-9424 (online)

ISBN 978-92-79-28127-3 (pdf)

doi:10.2791/5619

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

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

LF-NA-25724-EN-N

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.

ISBN 978-92-79-28127-3

Publications Office