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Analysis of policy mixes to foster R&D investment and to contribute to the ERA

Spain

Joost Heijs

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Executive Summary

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are thus at the heart of the Lisbon Strategy. This is reflected in guideline No. 7 of the Integrated Guidelines for Growth and Jobs. This advocates increasing and improving investment in research and development (R&D), with a particular focus on the private sector. This report aims at supporting the mutual learning process and the monitoring of Member States efforts. Its main objective is to characterise and assess the evolution of the national policy mixes in the perspective of the Lisbon goals, with a particular focus on the national R&D investments targets and on the realisation and better governance of the European Research Area. The report builds on the analytical country reports 2008 and on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

The specific objective for Spain is a 2% GERD/GDP with a 55% participation of the private sector. There is no doubt that Spain -in the last few years- has intensified its R&D and innovation-related policies in quantitative terms and by its qualitative aspects. Spain's total R&D expenditure increased from almost 6.500 billion in 2001 to €13.342 billion in 2007 (respectively 0.95% and 1.27% of its GDP), with a private participation of 56.1%. This trend is based on a substantial increase in both private and public expenditures. Also the policy mix was clearly reinforced by the implementation of new instruments within the framework of the INGENIO 2010 initiative of 2006. Therefore Spain seems to be moving in the right direction to reach its goals in terms of R&D expenditure proposed by the Lisbon strategy. However, it has still to close the gap with the most advanced countries.

The availability of public funds for R&D has to be accompanied with measures to assure the proper functioning and the quality of the Spanish innovation system in the long term. The substantial increase in R&D expenditure has to be accompanied by structural changes in the public research system towards an open transparent system based on meritocracy. The low average quality and the academic orientation of public research can be considered as a system failure. The lack of meritocracy, the mismatch between the research results and the needs in innovation systems and their low quality has a negative effect on the usefulness of the research results, makes technology transfer and knowledge circulation more difficult and diminishes the attractiveness of universities and public research organisations. On the other hand it impedes multiplier effects for the research institutes and for the Spanish innovation system as a whole. In the case of the research institutes the low average level of excellence generates problems to raise extra finance for their R&D activities. Because if the quality of the research results does not reach a sufficient level, Spanish firms will contract R&D abroad and foreign subsidiaries will not locate R&D in Spain, which is a problem for the Spanish innovation system as a whole. This barrier should be tackled in the planned reforms of the system to assure a continuous growth of its R&D expenditures by the policymakers.

Another important main barrier for the increase of the R&D efforts in Spain is its productive structure, with a significant weight of small and medium sized firms, oriented to the less innovative traditional sectors and with a lack of multinational

enterprises that could have a leading role for creation of R&D related networks or clusters with the corresponding system advantages. Other barriers are the lack of critical mass and the fragmentation of its public research system (in public research organisations and especially in universities), the low level of integration between industrial and academic research, and the small number of new technology based firms or academic spin-offs.

On the other hand a positive effect on the innovative culture –and therefore on the R&D expenditures- is generated by structural changes in the general economic environment. Spain can no longer be considered as a low wage country and the introduction of the Euro implies the loss of the exchange rate of the peseta as an instrument to gain competitiveness. These facts oblige the Spanish firms to compete in innovation and quality. Moreover the European support by structural funds –clearly reoriented to innovation and R&D- and the creation of the European Technical Fund also offers an improvement of the overall Spanish innovative environment. These initiatives, together with the changing economic environment (Introduction of the Euro and the end of Spain as a low wage country) generated a positive virtuous circle of an increase in the innovative culture of firms, in R&D investments and in the policy interest in R&D. However this process should be accompanied by mechanisms that ensure improvement in the excellence of public R&D.

In relation to R&D and innovation policies it can be highlighted that Spain introduced in 2006 several instruments focused on the main barriers of its innovation system mentioned in several reports (OECD, 2006; COSCE, 2005). The introduction of several new instruments clearly improved the existing policy mix. However some risks could be mentioned. They do not have specific programmes to stimulate R&D in firms that do not perform R&D, which would be important to ensure the survival of at least some firms in the traditional sectors. The fact that Spain is not a low wage country any more implies the relocation of non R&D enterprises of the traditional sectors to newly industrialised low wage countries. This fact in itself is not the problem if at the same time new firms in medium high tech sectors were created. Therefore the low number of business creations in more innovative sectors is one of the main risks that should be tackled. Moreover the reduction of the role of traditional sectors could be delayed with specific policies to foster in-house R&D in non innovative firms. Such instruments, non existing in Spain- together with the existing cluster policies or instruments focused on technology transfer, could be important to reactivate those low tech sectors. This is because the only way to maintain firms from such sectors in advanced countries is to ensure that they create innovative products with a high added value. Nor did Spain introduce policy instruments to attract R&D-performing firms from abroad. As mentioned above, the attraction of such firms could be difficult due to the low level of excellence of a large number of (public) R&D institutes. As already mentioned, solving the level of excellence is a requirement to attract foreign R&D doers.

The ERA initiative is discussed occasionally in the Spanish press and in society[1], mostly in an indirect way, such as in the context of university education and study plans. It is discussed more frequently at the policy-making level. The Spanish National Plan for R&D and Innovation refers broadly to the ERA concept and Spain tries to play an active role in its development. ERA was a reference for designing the national R&D and innovation programmes (EW Country Report, 2008). Moreover the

[1] See for example the newspaper “El Pais” 22/2/08; 4/3/09; 10/11/08; 25/10/08

first draft of the new Science Law (presented in February 2009) includes several references to enlarge the implementation of the ERA initiative. This initiative is considered as a way to integrate the Spanish innovation system in the international research scene and improve its level of excellence. In this context Spain plays an active role in the development of ESFRI, the European Joint Research Initiatives and article 169 initiatives. Moreover, specific outward and inward mobility schemes were introduced.

Barriers to R&D investment	**Opportunities and Risks generated by the policy mix**
High presence of SMEs and lack of Spanish multinational firms	National large or multinational firms could lead R&D oriented networks or clusters. A main risk is the acquisition of the few existing Spanish multinational by foreign firms, which could have a negative impact on their R&D activities. This aspect is difficult to tackle by policies.
A sectoral bias to low tech sectors	The relocation of non R&D enterprises of the traditional sectors to newly industrialised low wage countries in itself is not a risk if new firms in medium high tech sectors are created. Therefore, the low number of business creations in more innovative sectors is one of the main risks that should be tackled. Moreover the decline of traditional sectors could be delayed with specific policies to foster in house R&D in non innovative firms. Such instruments, non existent in Spain- together with the existing cluster policies or instruments focussed on technology transfer, could be important to reactivate those low tech sectors and encourage the survival of at least some of the firms
Fragmented decentralised public research system in which researchers have freedom to participate in specific projects or R&D areas.	Strategic planning of the Spanish research system is not well enough developed, in particular with regard to the mechanisms to ensure its implementation. Spain Although Spain does not possess direct measurements to reinforce centralised planning some programmes (such as CENIT and CONSOLIDER) aim to tackle the lack of fragmentation and excellence. However, a legal reform of the public research system should encourage the strategic decision making power at Institute level instead of decentralised short term ad hoc decisions by individual researchers.
Lack of meritocracy and transparency. Low multiplier effect of the public R&D system due to their low level of excellence.	The risks of these aspects are related to the attractiveness of universities and public research organisations as collaborators for the private sector. The low average quality and the academic orientation of public research could be considered as a system failure that impedes multiplier effects in which those institutes could raise extra finance for their R&D activities. If their quality does not reach a high level Spanish firms will contract R&D abroad and foreign subsidiaries will be less likely to locate R&D in Spain.

A main policy risk is the low level of speaking ability of the English language. This is an important barrier to absorbing the knowledge generated abroad, to participate in the ERA and the outward mobility. The younger generation is more prepared, although the general selection processes for researchers in most organisations do not include languages as important criteria.

Due to the lack of recent statistical data the impact of the present economic crisis on R&D expenditure and especially R&D policies are difficult to assess. Most firms interviewed for this report revealed that they downsized their R&D investments. In relation to the R&D and innovation policy programmes it can be stated that they are some of the few policy aspects that showed an increase within the total public budget for 2009. However, the publication of some tenders of large public support programmes oriented to the public research systems is formally delayed and it is not clear if they will be published in the future with the budget initially foreseen. Moreover some regional governments did downsize the number of scholarships for PhD students, mobility schemes and the funds available to support R&D projects.

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Labour market for researchers	• Despite the political interest in a European labour market the decentralised power of departments or research units impedes an open competitive selection of researchers. • The policies based on scholarships are the most open and competitive way to enter –as a foreigner- in the Spanish research system.	• The National Reform Program created new instruments for Human Resources especially oriented to both inward and outward mobility • The European Chart for Researchers is signed only by a few institutions
Governance of research infrastructures	• Spain assumed an active role in the ESFRI. This programme also generated new initiatives to create and upgrade the national infrastructural installations	• Upgrading of the national and European policy initiatives and of the budget for research infrastructures
Autonomy of research institutions	• The autonomy of public research organisations and universities is a tricky question and its benefits depend on its efficient implementation, which in the case of Spain is not always guaranteed. There is a need for more freedom (especially in the case of salaries and budget cycles) but at the same time a better legal framework should guarantee its correct and efficient use based on competitivity and meritocracy	• Two important reform initiatives should be approved in 2009 • The conversion of the Spanish National Research Council (CSIC) -in 2008- into a public agency with more although limited autonomous power
Opening up of national research programmes	• Legally almost all programmes are open to foreign enterprises or citizens. Especially in recent years the openness improved. However some informal barriers still exist.	• Spain plays an active role in the European Joint Research Initiatives and the article 169 initiatives. • Joint Programming is strongly supported by the Spanish government

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1 Introduction

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are thus at the heart of the Lisbon Strategy. This is reflected in guideline No. 7 of the Integrated Guidelines for Growth and Jobs.[2] This advocates increasing and improving investment in research and development (R&D), with a particular focus on the private sector. For the period 2008 to 2010, this focus is confirmed as main policy challenge and the need for more rapid progress towards establishing the European Research Area, including meeting the collective EU target of raising research investment to 3% of GDP, is emphasised.

A central task of ERAWATCH is the production of analytical country reports to support the mutual learning process and the monitoring of Member States' efforts in the context of the Lisbon Strategy and the ambition to develop the European Research Area (ERA). The first series of these reports was produced in 2008 and focused on characterising and assessing the performance of national research systems and related policies in a comparable manner. In order to do so, the system analysis focused on key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain has been guided by a set of generic "challenges", common to all research systems, which reflect possible bottlenecks, system failures and market failures which a research system has to cope with. The analysis of the ERA dimension still remained exploratory.

The country reports for 2009 build on and extend this analysis by focusing on policy mixes. Research policies can be a lever for economic growth, if they are tailored to the needs of a knowledge-based economy suited to the country and appropriately co-ordinated with other knowledge triangle policies. The policy focus is threefold:

- An updated analysis and assessment of recent research policies
- An analysis and assessment of the evolution of national policy mixes towards Lisbon R&D investment goals. Particular attention is paid to policies fostering private R&D and addressing its barriers.
- An analysis and assessment of the contribution of national policies to the carrying out of the ERA. Beyond contributing to national policy goals, which remains an important policy context, ERA-related policies can contribute to a better European level performance by fostering in various ways efficient resource allocation in Europe.

[2] COM(2007) 803 final, "INTEGRATED GUIDELINES FOR GROWTH AND JOBS (2008-2010)", http://ec.europa.eu/growthandjobs/pdf/european-dimension-200712-annual-progress-report/200712-annual-report-integrated-guidelines_en.pdf

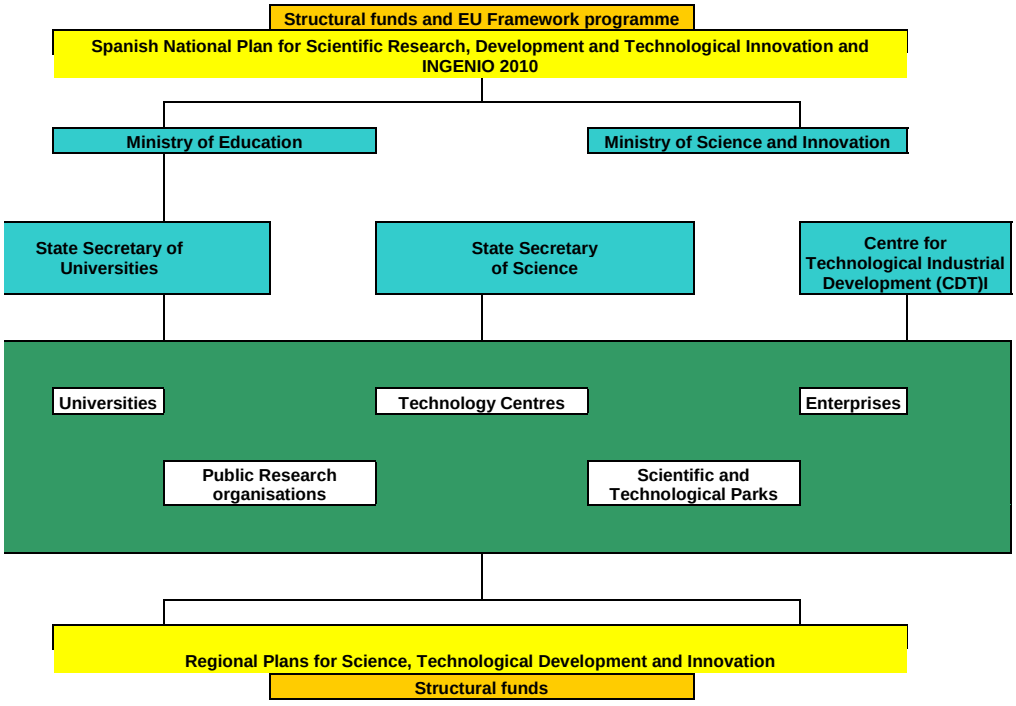
2 Characteristics of the national research system and assessment of recent policy changes

2.1 Structure of the national research system and its governance

Main actors and institutions in research governance

Spain has experienced in the last few years an important increase in its total R&D expenditures (GERD) although still lagging behind the most advanced economies in R&D activities. According to Eurostat, the latest available data (2007) show a GERD of €13,342 million. This represents 6% of the EU 27 GERD and 1.27 percent of Spanish GDP (EU 27 average of 1.83%) The GERD financed from abroad accounts for 7 percent of total GERD.

Figure 1: Overview of the governance structure of the Spanish research system



Source: Author

Figure one offers an overview of the main actors of the Spanish innovation system. As can be observed, the main player in R&D policy is the newly created Ministry of Science and innovation (MICINN, created in April 2008). For the first time the Spanish government had a ministry that was responsible for almost all public activities related to R&D and innovation. Until April 2009 the MICINN had two Secretaries of State: (Universities and Research). Moreover, the Centre for Technological and Industrial Development (CDTI) and almost all official Public Research Organisations also depend on this Ministry. The CDTI is the management agency in charge of R&D and innovation policies oriented to enterprises. Thus, this ministry was responsible for the policies of university education, academic research

and for the R&D and innovation policies devoted to the private sector. In April 2009 the State Secretary of Universities was added again to the Ministry of Education.[3]

Typical for the Spanish case are the pluriannual National Plans for R&D and innovation, which have a four-year time span, establish general and broad priorities and specify the main instruments at national level. However, the exact financial distribution of funds is decided in annual action plans.

The institutional role of the regions in research governance

Spain's political structure is a quasi-federal decentralised system and this is also reflected in its R&D and innovation-related policies. In the 80s and early 90s there was a political struggle between regional and national governments to establish who has the formal political responsibilities. Nowadays such discussions have faded away and most regions developed similar R&D plans and on both administrative levels (national and regional) and there now coexist a large number of – often overlapping – instruments, programmes and agencies and the coordination between national and regional polices remains a complex and difficult matter (Heijs, 2007). Some specific issues of R&D and innovation policies have been regionalised (for example, the universities; the R&D related with agriculture, fishery and health or industrial policy) and have opened a back door for more and more regional competences on R&D and innovation[4].

Table 1: R&D expenditures executed by type of organisation and by R&D activity (in €m: data 2007)

	Total		Basic Research		Applied Research		Development	
	Euros	(%)	Euros	(%)	Euros	(%)	Euros	(%)
Public Administration	1,912	17.6%	586	26.8%	1,096	23.2%	231	5.9%
Higher Education	2,940	27.1%	1,366	62.5%	1,149	24.3%	424	10.8%
Enterprises	5,974	55.1%	227	10.4%	2,471	52.3%	3,276	83.3%
Others	20	0.2%	8	0.4%	11	0.2%	1	0.0%
Total	10,846	100.0%	2,187	100.0%	4,727	100.0%	3,932	100.0%

Source: National Institute of Statistics (INE); Estimation based on the current R&D expenditures (excluding capital investments)

Main research performer groups[5]

R&D and innovation activities are mainly undertaken by enterprises that execute 54% of the R&D expenditures, followed by universities (29%) and public research organisations (17%) while the Non Profit Organisations have a marginal role (0.1%). However analysing the GERD by type of R&D activities (see table 1) we can state that the most important players in the **research** systems are the Public Research Organisations (PROs) and Higher Education Institutions (HEIs) carrying respectively 26 and 65% of the basic R&D in Spain while firms (8%) had a more marginal role. When compared with the EU average and the Lisbon Strategy the Spanish firms still have to gain in importance within the research system.

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[3] At the moment that this report was elaborated the exact distribution of a large number of R&D related policies between both ministries remains unclear.

[4] For example recently the Central Government decided to transfer to the Basque Country the R&D policy. This decision could open the door to other regions to ask for the same responsibilities.

[5] All data were taken from the website of the Spanish National Institute for Statistics (www.ine.es).

2.2 Summary of strengths and weaknesses of the research system

The analysis in this section is based on the ERAWATCH Analytical Country Reports 2008 which characterised and assessed the performance of the national research systems. In order to do so, its analysis is focused on the key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain has been guided by a set of generic "challenges", common to all research systems, which reflect possible bottlenecks, system failures and market failures that a research system has to cope with. The Analytical Country Report for the specific country can be found in the ERAWATCH web site.

At least formally, Spain seems to have a well developed and relatively smooth functioning research system. In the last decade it has developed a large number of new policy initiatives to tackle the main problems or barriers of the Spanish innovation system mentioned in several in-depth evaluation reports (OECD, 2006; COSCE 2005; Sebastian and Muñoz, 2006) and the R&D expenditures of all agents of the innovation system shows an important growth. There exists a broad supply of research institutions and long-standing programmes to promote links between public research systems and industry. However, the average level of excellence of the public research organisations is not always satisfying. This low average level of excellence is one of the main problems of Spanish knowledge production and implicitly generates problems of knowledge circulation, a problem reinforced by the limited absorptive capacity of firms (Azagra-Caro, J. M., 2009). For example Spanish universities do not appear in the international rankings that compare the quality of the universities. Another proof of the low average quality can be derived from the obtained number of research evaluations ("sexenios")[6]. The data of 2003 show that 37% of the university teachers (with the status of civil servants) in Spain never presented or obtained such research "sexenios" while only 51% have the maximum number that they could obtain.

The shift in the research policies implemented by the INGENIO 2010-Initiative with new instruments clearly directed to the improvement of excellence, and the critical mass of the research activities are aimed at tackling these problems. Moreover it tries to solve partially the lack of multi-disciplinarity and the focus on short-term projects. The present situation could be considered as coherent with a strategy of adaptation to the Spanish low-tech economic profile and enables Spain to catch up with its neighbours, but not to achieve a position of leadership. (Azagra-Caro, J. M., 2009).

The coordination problems are reinforced by the traditional division of responsibilities on science and technology between two ministries and the non-existence of an integrated ministry until 2008. Despite the fact that Spain, since 2006, has clearly increased its public R&D expenditure (an annual 25% growth), the separation of education and science from industrial issues is problematic to ensure a good balance between knowledge production and circulation. The creation of an integrated ministry in 2008 may constitute an opportunity to reverse the situation, but the effects remain to be seen and some division between domains still persists.

[6] These are based on the evaluation of the research activities in a six-year period and its approval requires a rather low minimum level of R&D results (publications).

Table 2: Summary assessment of strengths and weaknesses of the national research system

Domain	Challenge	Assessment of system strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	Legitimacy of devoting public resources to R&D, not under debate
	Securing long term investment in research	Considerable efforts to program long-term financing for research and participate in European funding and shared infrastructure facilities
	Dealing with barriers to private R&D investment	A theoretically generous scheme of tax incentives for R&D. However, the design of the implementation of those tax incentives can be considered as a barrier for its optimum use. Moreover: (i) the industrial structure, which is mainly composed of SMEs in traditional sectors and only a small number of high tech firms, is a barrier to private R&D spending; (ii) simultaneously the lack of venture capital and of the projects to create new technology based firms are another barrier to private R&D funding. A proactive policy for the creation of spin-offs is required
	Providing qualified human resources	Satisfactory evolution of the number of people with university degrees but brain drain of young PhDs to other countries due to low wages and the limited ability to absorb them; increasing participation of women in science but under-representation of women in senior positions and in the private sector
Knowledge demand	Identifying the drivers of knowledge demand	Existence of institutions and policies to bring together players from the scientific, technological and entrepreneurial spheres to conduct prospective and monitoring activities
	Co-ordinating and channelling knowledge demands	Although the Spanish government made increasing efforts to improve the coordination of R&D policies to channel demand for knowledge this aspect is still underdeveloped. There is no centralised priority setting mechanism that aligns the policies of different administrative levels.
	Monitoring of demand fulfilment	Introduction of the Integral Monitoring and Evaluation System (SISE) as a tool for the evaluation of the impact and the control of the management of the R&D&i policies. However, the availability of some data, the design of some indicators and the evaluation of some large numbers of programmes is still underdeveloped.
Knowledge production	Ensuring quality and excellence of knowledge production	Focus on research stemming from mono-disciplinarity, fragmentation of research groups and short-term projects, not leading to excellence. The INGENIO 2010, and especially the CONSOLIDER programme tackle these problem.
	Ensuring exploitability of knowledge	Ineffective use of existing tools to increase R&D activities in companies, endangering the exploitability of knowledge. The new selection criteria of the existing and new instruments increased the importance of the aspects related with transferability of the research results

Domain	Challenge	Assessment of system strengths and weaknesses
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	Good supply of institutions and existence of long-standing programmes to promote links between the public research system and industry but governance structure of science-innovation was still at an early stage, due to the split in responsibilities between two ministries. The new Ministry of Science and Innovation created in 2008 should overcome this duality in the future. Some specific policies, based on national or European structural funds, were introduced to improve this aspect. Like the CENIT or Torres Quevedo Programme to foster stable R&D employment or the strong financial support to the development of Science Parks. A low average quality of public research organisations and academic orientation of public R&D is a barrier for knowledge circulation.
	Profiting from international knowledge	Wide range of modalities for participation in international projects
	Enhancing absorptive capacity of knowledge users	Gap for private companies between the available human resources and technological needs in terms of human resources, hampering absorptive capacity. The academic orientation of most of the universities and public research organisations implies a more important role of some specific institutions *close to industry.* Spain boasts a relatively low number of technology centres (concentrated in a few regions). Such centres could play a bridging role between firms and the research institutes by reinforcing their cooperation with universities.

Source: Taken - with small changes - from ERAWATCH Country Report Spain 2008

The enormous increase of both, private and public R&D expenditures in Spain generated a situation in which probably the financial aspects of R&D are less problematic. Although the Spanish R&D effort is still clearly below the EU average, a very important problem for the long term of the Spanish R&D system is to assure an optimum functioning of the system. The main barrier to ensuring its good performance is the lack of quality reflected by the low average level of excellence of a certain number of its agents. The substantial increase in R&D expenditures in recent years has to be accompanied by structural changes in the public research system towards an open transparent system based on meritocracy. The lack of meritocracy has a negative effect on the attractiveness of universities and public research organisations as collaborators for the private sector. The possible lack of quality and the academic orientation of public research can be considered as a system failure. The mismatch between research results and the needs in the innovation system together with the low quality has negative effects on effective technology transfer and knowledge circulation or makes it less useful, and, on the other hand, impedes multiplier effects in firms which could take advantage of public R&D results and in those institutes which could raise extra finance for their R&D activities. If their quality does not reach a sufficient level Spanish firms will contract R&D abroad and foreign R&D oriented subsidiaries will not locate their R&D in Spain. It is this aspect which should be tackled by the policymakers in the announced reforms of the system (see also section 4.3).

2.3 Analysis of recent policy changes since 2008

The contribution of research and research policies to Lisbon goals (as well as to other societal objectives) goes beyond the fostering of R&D investment. Therefore it is also important to analyse how other remaining shortcomings or weaknesses of the research system are addressed by the research policy mix. The focus of this section is on the analysis of main recent policy changes which may have a relevant impact on the four policy-related domains.

2.3.1 Resource mobilisation

The Spanish innovation system can be characterised by its intensive level of resource mobilisation in the period 2006-2008 in combination with the implementation of new policy instruments devoted to the existing specific barriers for innovation. This increase of resources is a general pattern of almost all agents including the public budgets of the National, Regional and European (structural funds) governments completed by an important increase in private R&D expenditure. In fact the private sector increased its participation in the overall GERD. Moreover, in spite of the present crisis, the Ministry of Science and Innovation is one of the few whose budgets have not been reduced. However, some tenders for specific instruments in 2008 are delayed (or deleted) due to economic problems.

Changes in the National Reform Programme regarding the role of research in the broader economic growth strategy

R&D and especially innovation have a central role in the **Spanish National Reform Programme.** R&D&i are considered as basic aspects to ensure long term economic growth. The specific Spanish Lisbon Objective consists of the 2% GERD/GDP with 55% private sector participation. The NRP included new instruments to tackle specific barriers of the Spanish innovation system and an extraordinary increase of the governmental R&D budget -25% annually during 4 years-. The recent changes in the NRF in 2008 did not lead to substantial modifications in relation to R&D policies

Table 3: Main policy changes in the resource mobilisation domain

Challenges	Main Policy Changes
Justifying resource provision for research activities	The legitimacy of devoting public resources to R&D is not under debate. All political parties underwrite the importance of R&D and innovation to ensure the future of the Spanish economy and competitiveness. The loss of the exchange rate of the peseta as an instrument to gain competitivity and the loss of the condition as a low wage country can be interpreted as an opportunity because it obliges Spanish firms to compete in innovation and quality.
Securing long term investments in research	Considerable efforts were made to include long-term financing for research, integration of academic and private R&D and the creation of a critical mass in specific national programmes, such as the CENIT or CONSOLIDER projects and the intensification of the S&T related infrastructure investments on a European and national level

Challenges	Main Policy Changes
Dealing with uncertain returns and other barriers	Theoretically Spain offers advanced tax incentives for R&D expenditures to promote private R&D investment however for a large number of firms its implementation makes it difficult take advantages of this support schemes. Moreover, the industrial structure, which is mainly composed of SMEs in traditional sectors and only a small number of high tech firms, is a barrier to private R&D spending. Experts do not agree about the statements that there exists a lack of venture capital, as a barrier to private R&D funding, or whether there is a lack of projects to create NTBFs that can use the existing funds. Some expert from public supports schemes claim that there is a lack of venture capital for start-ups and young NTBFs, especially in the current context of financial markets drying-up. Other experts from some private funds considered that there is also a lack of good proposals. Probably this disagreement could be related with the guarantees and level of risk taken by public and private players in this field.
Providing qualified human resources	The INGENIO 2010 programme introduced new support schemes for Human Resources and intensified the old ones. Satisfactory evolution of the number of people with university degrees but the brain drain of young PhDs to other countries due to limited ability to absorb them; increasing participation of woman in science but under-representation of women in senior positions and in the private sector

2.3.2 Knowledge demand

It can be stated that public policies should orient the national R&D activities to long term strategic objectives. On the other hand, they should also support the private initiatives that are focused on the real opportunities. The national and European policy programmes do benefit certain sectors to the detriment of other ones (see section 3.3.1). This bias between knowledge demand and the policy trend is difficult to asses in positive or negative terms. It seems to be logical that both agents make strategic decision and the different orientations could be considered complementary where the firms represent the future interests of the existing industrial structure and the public support is oriented on future strategic interests.

Table 4: Main policy changes in the knowledge demand domain

Challenges	Main Policy Changes
Identifying the drivers of knowledge demand	Existence of institutions to bring together players from the scientific, technological and entrepreneurial spheres to conduct prospective and monitoring activities
Co-ordinating and channelling knowledge demands	Although the Spanish government made increasing efforts to improve the coordination of R&D policies to channel demand for knowledge this aspect is still underdeveloped. There is no centralised priority setting mechanism that align the policies of different administrative levels
Monitoring demand fulfilment	Introduction of the Integral Monitoring and Evaluation System (SISE) as a tool for controlling the management of public funding RD&I programmes, The SISE is integrated in the National Plan RD&I 2008-2011 as a mechanism for following up and evaluating research and innovation policies and is characterised by incorporating the ex-post evaluation of the results of the R&D programmes into a ongoing evaluation processes in order to review current activities and identify the need for new initiatives. However the availability of some data, the design of some indicators and the evaluation of some large number of programmes is still underdeveloped.

Several private and public organisations carry out prospective studies about the future needs. Evaluation of the R&D and innovation policies is getting more attention especially on national level. However on a regional level such studies are less common.

2.3.3 Knowledge production

The Spanish level of knowledge production is improving especially in the academic sector. The results of research activities in terms of publication are on a satisfying level. However the results of innovation in forms of patents are still very low. This trend reflects the academic orientation of Spanish knowledge production and justifies the new instruments that require technology transfer or useful results for the production sector.

Table 5: Main policy changes in the knowledge production domain

Challenges	Main Policy Changes
Improving quality and excellence of knowledge production	The new instruments –like CENIT or CONSOLIDER implemented in 2006- require private and public cooperation of several agents in long term projects and the selection criteria are based on excellence and usefulness of the results. On this way the Spanish government tries to tackle the main problems of its research systems like the mono-disciplinarity, fragmentation of research groups, prevalence of short-term projects and the lack of excellence.
Ensuring exploitability of knowledge production	In recent years public policy requires more efforts to ensure the exploitability of knowledge production including this aspect as an important criterion for selection of projects. In this case the more academically oriented policies of the nineties are converted in R&D and innovation policies.

2.3.4 Knowledge circulation

Probably one of the main changes in Spanish R&D policies in recent years is their reorientation from the support of highly academic R&D with a low level of use for industrial application to policies that combine R&D and innovation. This reorientation will - in the long term - improve knowledge circulation. However to optimise such trends the universities and public research institutes have to update their knowledge, and modernise their study programmes. Especially, the universities have to wake-up and adapt themselves to these new circumstances. The reforms –of which the draft proposals were presented recently- should insist on this aspect.

Table 6: Main policy changes in the knowledge circulation domain

Challenges	Main Policy Changes
Facilitating knowledge circulation between university, PRO and business sectors	Existence of long-standing programmes to promote links between the public research system and industry. The requirements of the technology transfer as selection criteria converted the academic oriented policies of the 80-90ties R&D and innovation policies.
Profiting from access to international knowledge	Spain introduced a wide range of modalities for participation in international projects and the outward mobility of (young) researchers.
Absorptive capacity of knowledge users	Gap for private firms between the available human resources and technological needs in terms of human resources, hampering absorptive capacity

2.4 Policy opportunities and risks related to demand for knowledge and knowledge production: an assessment

Following the analysis in the previous section, this section assesses whether the recent policy changes respond to identified system weaknesses and take into account identified strengths.

The recent policy changes respond to identified system weaknesses. The INGENIO 2010 Initiative of 2006 was designed to tackle the main problems mentioned in several studies (OECD, 2006; COSCE, 2005; Sebastian ad Muñoz, 2006). These initiatives together with the changing economic environment (Introduction of the Euro and the end of Spain as a low wage country) generated a positive virtuous circle of an increase in the innovative culture, R&D investments and policy interest in R&D. However this process should be accompanied by mechanisms that ensure the improvement of the excellence of public R&D and a major integration of public and private R&D.

Table 7: Summary of main policy related opportunities and risks

Domain	Main policy-related opportunities	Main policy-related risks
Resource mobilisation	Substantial budget increases Specific programmes to increase the participation in EU programmes Reorientation of the use of the Structural Funds to R&D related activities and approval of the Technological Fund Increased credit facilities for innovative activities in SMEs and venture capital	Drop in relative level of EU Funds received from the Framework Programme Future loss of the structural funds No specific instruments address the attraction of foreign R&D performing firms or the stimulation of R&D in non-innovative firms.
Knowledge demand	Attempt to meet demand for funding of large projects through simplified procedures Active procurement to help reduce information and communication technology gaps	Little priority setting, even in the Spanish R&D&I Plan 2008-2011, according to the industrial structure and specialisation
Knowledge production	A specific programme to tackle the problem of the fragmentation of the public research system, to raise critical mass and research excellence (CENIT or CONSOLIDER).	Lack of excellence in public research organisations that impede multiplier effects in terms of new research contracts or the later transfer of the results
Knowledge circulation	Assignment of the R&D and the innovation policies in one sole Ministry (MICINN) The growing importance of programmes that foster industrial and academic links (CENIT and CONSOLIDER). The growing importance of the possible use of research outcomes for the private sector as selection criteria	The mismatch between the research results and the needs in innovation system and the low quality has negative effects on effective technology transfer and knowledge circulation or makes it less useful. Possible lack of information of SMEs about their opportunities The almost total absence of influence of the private sector and political powers on education and R&D in universities

3 National policy mixes towards R&D investment goals

The aim of this chapter is to deepen the analysis of national policy mixes with a focus on public and in particular **private R&D investment**. The Lisbon strategy emphasises an EU overall **resource mobilisation objective** for 2010 of 3% of GDP

of which two thirds should come from private investment. R&D investment is seen as an important yardstick for the capacity of an economy to turn the results of science and research into the commercially viable production of goods and services and hence knowledge into growth. Corresponding investment policies are mainly pursued at national level and determined with a national focus.

The chapter is structured around five questions:

1. What are the specific barriers in the country that prevent the Lisbon goal being attained? What barriers exist in the country to prevent reaching the specific targets, particularly related to the private sector R&D investments?
2. Given the above, what are the policy objectives and goals of the government that aim to tackle these barriers?
3. What Policy Mix routes are chosen to address the barriers and which specific instruments and programmes are in operation to implement these policies?
4. What have been the achievements in reaching the above mentioned R&D investment objectives and goals?
5. What are the reasons for not reaching the objectives, adaptation of the goals?

The chapter aims to capture the main dimensions of the national policies with an emphasis on private R&D investment. The chosen perspective of looking at investments in R&D is the concept of Policy Mixes. The analysis and assessment follows a stepwise approach following the five questions mentioned above.

3.1 Barriers in the research system to the achievement of R&D investment objectives

One of the main barriers to increasing the R&D efforts in Spain is probably the productive structure, with a significant weight of small and medium sized firms, oriented to the less innovative traditional sectors and with a lack of multinational enterprises that could create R&D related network and system advantages. Other barriers are the lack of critical mass and the fragmentation of its public research system (in public research organisations and especially in universities), the low level of integration between industrial and academic research, the low number of new technology based firms or academic spin-offs. On the other hand, a positive effect on the innovative culture –and therefore on the R&D expenditure- is generated by structural changes in the general economic environment. Spain can no longer be considered as a low wage country and the introduction of the Euro implies the loss of the exchange rate of the peseta as an instrument to gain competitiveness. These two facts oblige Spanish firms to compete in innovation and quality. Moreover the European support for structural funds –clearly reoriented to innovation and R&D- and the creation of the European Technical Fund also offers an improvement of the overall innovative environment.

Unbalanced biased productive structure

The Spanish private R&D system is largely determined by its industrial structure, which is mainly composed of SMEs in traditional sectors with a small number of high tech firms and a few large firms. Nearly 70% of Spanish business employment is in enterprises with fewer than 50 employees while the average for the European Union and the United States is respectively 50 and 36%. Moreover, only 18% of business

employees are employed by large firms (more than 249 employees), compared to 34% in the EU and 50% in the United States. Spain lacks large internationalised firms that can play a crucial leading role for the creation of R&D based clusters related to their network of suppliers and R&D organisations. Moreover several large Spanish firms were or could be taken over by foreign firms. Taking into account that most MNES concentrate a large part of their R&D in their home country this loss of control of the Spanish large firms will probably have a negative effect on Spanish R&D activities.

The sectoral structure of the Spanish economy reflects the economic importance of supplier-dominated sectors based on the prominent role of traditional industries such as furniture, non metallic mineral products, textiles and the food industry, and has led to a low demand for R&D in comparison with other countries.

Policy objectives involving R&D investment and barriers

The long range objectives of Spanish R&D and innovation policies (the Lisbon objective) is to pursue a ratio of R&D investment by GDP of 2% with a private share of 55% and converging with the EU-15 average in the percentage of GDP devoted to ICT. The general objectives of the Spanish R&D policies are shown in the National Strategy for Science and Technology (ENCYT) (approved collectively by the central and regional governments) and in the Spanish National Plan for Scientific Research, Development and Technological Innovation (2008-2011) (NP). This new National Plan stems from experience gained from previous National Plans, the Ingenio 2010, initiative and the ENCYT. The goals of those two reports could be considered as abstract ideas or intentions which could be applied to most of the countries. Moreover, they do not include any thematic priority-setting. The NP specifies the main policy programmes and the specific instruments at national level. However, the exact financial distribution of funds - subsequently the priorities - is decided in the annual action plans.

Maybe the most important development within the Spanish R&D policy was the "**INGENIO 2010 initiative"**. Implemented in 2005 it implies a breakthrough in the R&D policy design and has an important impact on the design of the current National Plan for R&D&I Plan. INGENIO included an annual increase of the public R&D budget of 25% during four years. Moreover, this programme included new instruments that should tackle the specific problems of the Spanish Innovation system by (1) The increase in entrepreneurial participation in R&D activities; (2) the promotion of cooperation between the public and the private scenes (3) measures to avoid the fragmentation of the Spanish research landscape. In those three cases the new instruments financing key long-term co-operative large scale R&D projects. Moreover (4) in included support for the recovery of Spanish researchers from abroad (Brain drain) and to promote new technology based Firms (NTBF). The 2008 update of the National Reform Plan does not include new support schemes. It announced new reforms of the Spanish R&D system (see section 4.3) and the renewal of some existing measures such as the "Plan Avanza".

As mentioned in section 2.1, an important institutional change in the Spanish innovation system was the creation of the Ministry of Science and Innovation, which was changed in order to address the lack of integration between the R&D activities of the scientific-academic community and the private sector. Initially this Ministry included almost all R&D related policies including the State Secretary of Universities.

However, recently (April, 2009) this State Secretary was assigned again to the Ministry of Education.

3.2 Characteristics of the policy mix to foster R&D investment

3.2.1 Overall funding mechanisms

Spain experienced in the last few years an important increase in their total R&D expenditure (GERD). In 2007 the public and private Spanish GERD was €13.342b, equivalent to 1.27% of GDP (The same figures for 2001 were 6.496 billion and 0.95%). In 2007, the expenditure by the private sector (companies and non-profit institutions) represented 56.1% of the total funds while the public sector (Administration and universities) represented 43.9% of the funds (For 2001 the percentages were 55.1 and 44.9%). The R&D-related funds included in the National State Budget (GBAORD) rose 25% annually in the period 2005–2008 reaching €9,349m in 2008 and the increase of this year (3.3%) brings the foreseen budget for 2009 on €9,651m. (€4,360m in 2004) (see also table 8 and figure 2).

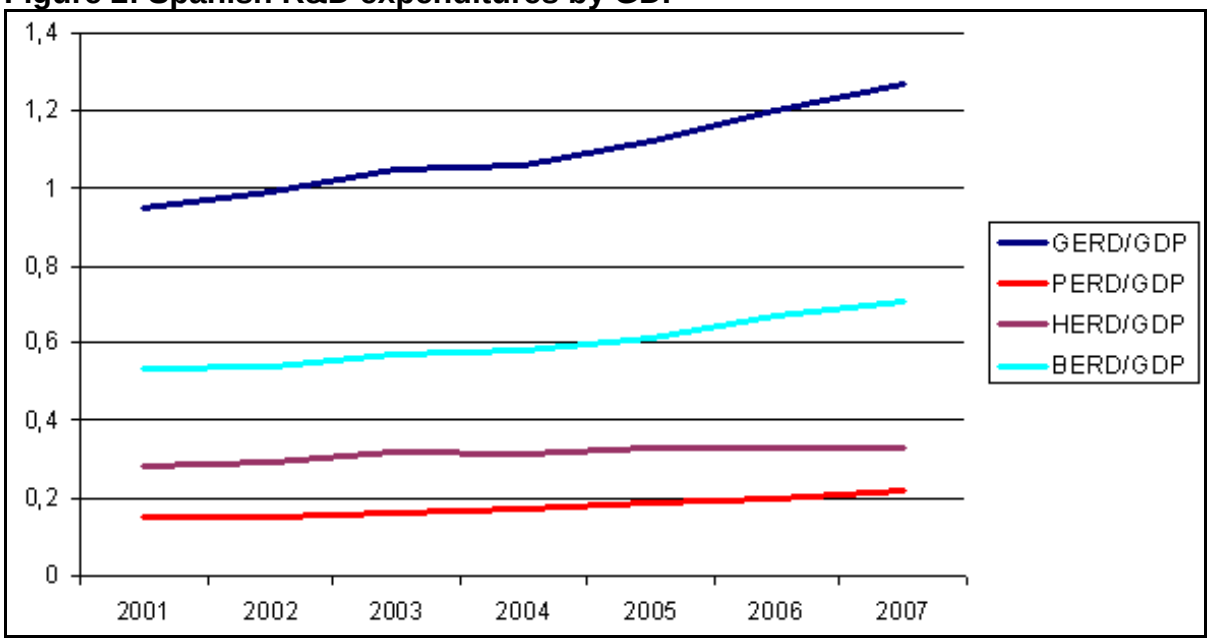
An important part of the annual budgets of the public research organisations and universities comes from the Spanish state (Ministry of Science and Innovation – MICINN) essentially covering wages and maintenance expenses (block funding). The Annual Report of R&D&i activities of 2006 of the Spanish Government shows that public R&D related expenditure was €1,369m of direct block funding for Public Research Organisations (excluding universities) which is almost 15% of the total GBOARD.

Table 8: Execution and origin of the fund for R&D and innovation in Spain

Execution of the funds	Origin of the funds					Total
	Public Administration	Higher Education	Enterprises	Others	Abroad	Total
Public Administration (PERD)	2.029.131	5.440	145.460	12.945	155.868	2.348.843
Higher Education(HERD)	2.572.118	436.884	317.193	40.969	151.430	3.518.595
Enterprises (BERD)	1.217.866	1.907	5.596.244	11.176	626.708	7.453.902
Others	5.518	279	6.137	7.587	1.511	21.031
Total	5.824.632	444.509	6.065.035	72.678	935.517	13.342.371

Source: National Institute of Statistics (INE) (in thousand of euros: data 2007)

Figure 2: Spanish R&D expenditures by GDP



Anyhow, block funding is getting less important while consequently competitive project funding is gaining weight. In the early 80s around 60% of funds were transferred directly to PROs. At the end of the 80s this percentage fell to 30% and at the beginning of this century this percentage was 23% (Sanz, 2005). A substantial part of their funds goes to salaries (40%), operational costs (10%) and investments (17%) while the "operational transfers" – mainly used for research – count for less than 7% of the received block funding. University funding for teaching and operational costs is the responsibility of the regions, which offer institutional funding to universities, based mainly on the number of students and teachers and other related criteria. When evaluating public budget devoted to R&D (€9,349m in 2008) it has to be taken into account that around 57% of the public funding consists of subsidies and 43% are reimbursable loans. The main instrument of Spanish R&D policies for public R&D is subsidies (84% of the received funds), while for private R&D and public–private initiatives the main funding takes the form of loans (63 and 53% respectively). Almost 58% of the total funds are devoted to **generic public competitive tenders for projects.** Another 11% is devoted to **infrastructural support** and 16% to **human resources (HH.RR)**.

Officially the priority setting should be arranged in the National Plan for R&D&i although the way the budget is distributed is not clear. Despite the inclusion of formal priorities in the National Plan, the distribution of the funds is in the hands of each of the administrative units and ministries involved (OECD, 2006). The thematic focus was not a real policy intention but the factual consequence of distribution of generic funding. By 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 National R&D&I Plan includes 25 National Programmes grouped in nine broad areas or fields completed with "non-oriented" research. In global terms the "non- oriented" support (NOP) area received the largest amount of support (22.5%), 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– are only specified for the public tenders for R&D projects and special actions representing 68% of subsidies and 79% of loans involved in the NP.

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 2006 the Spanish state financed 13.6% of the total private R&D (support intensity). In the service sector this percentage (19%) is clearly higher than in the industrial sector (9.4%); the agriculture (11%) and the construction (12%). Within the service sector "other business services" and "public, social and collective services" shows the highest support intensity (30%), followed by the "R&D services" (21%) and the communications sector (17%). Also some industrial sectors are supported more intensively: such as Aerospace (30%) and "other transport material" (24%). An important sector (spending 13% of all industrial R&D) with a low support intensity (4.4%) is the chemical one. It is somewhat higher in chemical products (6.1%) and lower pharmaceuticals (3.7%). Some sectors with a marginal role in the Spanish innovation system showed high support intensities, such as "Paper and cardboard" or recycling. In these sectors the state finances respectively 23% and 20% of the R&D expenditures.

A substantial number of support **schemes for human resources** are available at both national and regional level. Around 16% of funding from the main national programmes is targeted at this area, and the regional governments also offer a large number of schemes directed to HH.RR. Although this type of instrument gained importance in political terms its percentage within the overall national budget for R&D decreased due to the extraordinary increase of funds for R&D projects.

3.2.2 Policy Mix Routes

Route 1: Promoting the establishment of new indigenous R&D performing firms[7]

The Spanish policymakers on national and regional levels introduced a broad number of instruments to promote the creation of new technology-based firms (NTBFs). Experts do not agree about the statements that there exists a lack of venture capital, as a barrier to private R&D funding, or whether there is a lack of useful ideas and suitable projects to create NTBFs that can use the existing funds. Some experts from public support schemes claim that there is a lack of venture capital for start-ups and young NTBFs, especially in the current context of financial markets drying-up. Other experts from some private funds considered that there is also a lack of good proposals. Probably this disagreement could be related with the guarantees and level of risk taken by public and private players in this field. Private firms are more prone to avoid a financial involvement in the first phases of NTBFs, when the risk of failure is more important. However, a pro-active policy not only based on financial support but based on a more intensive connection with organisation that generates knowledge could increase the supply of entrepreneurial technology-based projects and consequently the need for financial venture capital. Good and successful examples are the regional support programmes in Catalonia and Andalusia.

[7] The conclusion of this section is based on the opinion of experts of some public agencies and representatives of some associations of enterprises

Route 2: Stimulating greater R&D investment in R&D performing firms

Spain boasts a broad set of policy instruments, mostly based on low interest credits, to stimulate greater R&D investments in R&D performing firms. The share of BERD financed by the Spanish governments (excluding the tax incentives) was 16.3 percent of total BERD in 2007. (21% for SMEs and 11% for large firms) and another 1.4% was financed by foreign funds. This 16% of public support is financed through a broad range of specific instruments; some in support of individual firms while other measures require cooperation with other public or private R&D performers (see Route 5). It is important to stress that most of the instruments oriented to enterprises are based on (low interest) credits.

The Spanish tax incentives for R&D expenditure has been considered as the most generous among OECD countries for the past few years, however, the uptake by companies was lower than expected and there were difficulties in applying the law (IPTS, 2006).The bureaucratic processes necessary to obtain the deductions are complex and uncertain, which diminishes the incentive effect. Anyhow it seems that the recent available data of the MICINN show a more intensive use of this scheme in the last years.[8]

Route 3: Stimulating firms that do not perform R&D yet

No specific measurements exist to stimulate firms that do not perform R&D. Such instruments would be important to ensure the survival of some firms in the traditional sectors. The only way to maintain a certain number of firms from such sectors in advanced high wage countries is by changing them into innovative firms generating specific non-standardised products with a higher added value (niche strategies). It could be argued whether such firms should have sufficient technological capabilities to implement own R&D activities, taking into account that some of those firms even have difficulties to define and understand their problems (Heijs, 2001). Although the Spanish central and regional governments introduced policies to make those sectors more dynamic (like access to external R&D, creation technology centres, innovation clusters or technology platforms and other policies focused on technology transfer) specific pro-active support (including consultancy) for non innovative firms could help them to convert themselves into innovative firms and to encourage their competitiveness. This would be especially important for regions or sectors characterised by the absence of large firms that could lead such collective initiatives. The design of such policies is not easy although some specific existing policy schemes exist[9].

Route 4: Attracting R&D-performing firms from abroad

Also no specific measurement exists to attract R&D-performing firms from abroad. On a regional level there exist programmes to attract foreign direct investment (multinational firms), with some specific conditions for R&D activities. However often those advantages are based on existing R&D support schemes. The attractiveness of Spain for foreign R&D activities is somehow related to the low level of excellence of most (public) R&D institutes. Solving the level of excellence –which can be

[8] Conclusion based on a not published presentation of the MICINN (January 2009).

[9] The Spanish National Plan for R&D and innovation includes specific programmes for innovative cluster; technology platforms; technology centres S&T parks etc...

considered as a system failure- is essential to promote Spain as an option for R&D location and a requirement to attract foreign R&D doers.

Route 5: Increasing extramural R&D carried out in cooperation with the public sector

Despite the fact that industry finances 7.9% of the R&D expenditure of universities (higher than the OECD average, though below the EU-15 average of 8.8%) the state of opinions suggests that the level of public-private cooperation in R&D and innovation is low (COTEC, 2005; OECD, 2006) and the mobility of researchers between the public and private sectors are almost non-existent. Over the past years the government adapted the legal and administrative framework to promote cooperation between universities and firms. Nowadays Spain has a large number of support schemes to foster public private cooperation in R&D and innovation. A successful instrument is the programme National Strategic Consortia for Technical Research (CENIT) introduced in 2006. This programme, part of the Ingenio 2010 initiative, promotes consortia of large companies and SMEs and facilitates links between the public and private sectors and its catalyst effect on the spirit of cooperation –including the interregional collaboration- is very positive generating a virtuous circle in terms of cooperation (AEVAL, 2007). CENIT finances large integrated and long term cooperative projects of industrial research, with ambitious objectives, oriented towards strategic technologies with international potential. These projects foster cooperation among different players in the research and development process, including enterprises, universities, public research organisations, technology centres, enterprise incubators and science and technology parks.

Route 6: Increasing R&D in the public sector

It is not easy to separate the policies aimed at the increase in R&D in the public and in the private sector. In Routes 2 and 5 we mentioned different programmes and instruments. The Spanish National R&D Plan includes project support primarily oriented to the public R&D system although they also are accessible to private organisations. This project support is focused on the generation of new knowledge, the application of existing knowledge for problem solving and the use of knowledge for innovation. The programmes have a dual aim: the advance in scientific and academic knowledge and the improvement of the competitiveness of enterprises. Although those national programmes are longstanding policy measures changes were introduced in their design and implementation (especially the selection criteria) to promote excellence and to overcome the fragmentation of the Spanish research system. Moreover some new instruments were introduced like the already mentioned CONSOLIDER and CENIT programme. The Consolider Programme is a strategic effort to achieve high quality research by increasing cooperation among researchers and to build large research groups to overcome the existing fragmentation of the Spanish research system. The evaluation study of AEVAL (2007) considered its impact as very positive.

No specific polices are aimed at the promotion of Centres of Excellence. However the CENIT and CONSOLIDER programmes do implicitly foster this concept to a certain extent. These instruments promote excellence, but not through the creation of institutions. This is partly the case in the domain of health research. The CIBER projects encourage quality research by the creation of permanent cooperative research bodies (AEVAL, 2007).

Assessment of the importance of policy mix routes and their balance

The INGENIO 2010 initiative –implemented in 2006- 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 (CENIT) 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. Spain has at the present time a broad –more or less well balanced- policy mix because it offers a broad set of differentiated instruments that are trying to tackle almost al the barriers and weaknesses of the Spanish innovation system. However, the existence of instruments is not enough if they can not handle the system failures related with the functioning of the R&D agents (see section 4).

The importance of policy coordination and integration of innovation, science and education

The coordination of the research related policies is one of the main problems of the Spanish national innovation systems. This lack of coordination exists between policy makers on national and regional governments and even between the different departments and ministries at national or regional level (OECD, 2006). This also means that integration of the policies for innovation, science and education are highly unrelated. Two or three recent developments could imply an improvement. First, the creation of the Ministry of Science and Innovation (MICINN inaugurated in April 2008) could improve the coordination and integration of those policies. Although it is too early to asses this improvement, it can be stated that the MICINN was preparing important reforms (a New Science Law and The Strategic University 2015 Initiative) that try to foster more intensively the higher level of integration between industry, education and science. However the recent restructuring of this Ministry –moving the State Secretary of Universities again to the Ministry of Education- could undermine the expected positive effects on coordination. A second positive development which could encourage cooperation and coordination, as explained before, is the National Strategy for Science and Technology (ENCYT). A third factor can be derived from the practice of policy making of certain policy fields. On the one hand, the new implementation structure of the European Regional Development Funds and the Technology Fund require bilateral Operation Plans between the Spanish State and each of the regional Governments. Moreover the discussion about the new national roadmap for S&T infrastructures also required intensive interaction and coordination. These tendencies could be a first step to normalising the coordination between national and regional policies. On the other hand, coordination between the policies of research, education and innovation is not easy, due, among other reasons, to the high degree of autonomy of the Universities who are often used to following their own interest rather than looking to the general interest of society as a whole (see section 4.3).

Table 9: Importance of routes in the national policy and recent changes

Route	Short assessment of the importance of the route in the national policy	Main policy changes since 2008
1	Gained in importance and was highlighted in recent political debates	All routes (except 3+4) were reinforced in budgetary terms. The main changes were implemented in 2006 (INGENIO 2010 Initiative) and in 2007 (The new National R&D&I Plan). In 2008 only some minor budgetary changes were introduced.
2	Always was important	
3	Low importance. Almost non existent.	
4	Low importance. Almost non existent	
5	Gained in importance and was highlighted in the recent political debates	
6	Always was important. Lost some relative importance due to the a above-average increase of the resources in route 1 and 5	

3.3 Progress towards national R&D investment targets

There is no doubt that Spain intensified its R&D and innovation related policies through its reinforcement in quantitative terms and through its qualitative aspects. Spain's total R&D expenditure increased from almost 6.500 billion euros in 2001 to 13.342€ billion in 2007. This tendency is based on a substantial increase of both private and public expenditure. The R&D-related funds included in the National State Budget (GBAORD) rose 25% annually in the period 2005–2008 reaching €9,349m in 2008. Moreover, the structural funds –highly reoriented to R&D- and the Technical Funds also imply an extra generous financial input for the Spanish Innovation System. In fact, Spain increased its GERD by GDP from 0.95% in 2001 to 1.27% in 2007, at the same time increasing the participation of the private sector. Although the GERD/GDP ratio is still below the desired level, the economic resources devoted to R&D policies are satisfactory. In fact some policy makers expressed their concern that –due to the sharp increase of the availability of the funds in a very short time span- the different actors in the innovation system probably could not absorb –in the short term- all the available extra funds (for example, in the case of the European structural funds or the funds for venture capital). This generated a situation in which probably the availability of public funds for R&D is not the basic problem, rather, the main problem to ensure the good functioning of the Spanish innovation system is the quality of the R&D activities of the different agents, especially related to the fragmentation and the low level of meritocracy of the public research system. (see section 3.4 and 4.3).

It is obvious that the EU Cohesion Funds play a very important role in the Spanish R&D system especially in the eligible regions. In the period 1986–2006 Spain spent around 12% of the Cohesion Funds (€6,500m) in R&D-related activities (Sanz, 2005) In the new programme (2007-2013) almost 35% of the funds (€8,419 million) are earmarked for R&D related activities. So there is a clear reorientation of the structural funds towards R&D&I. As a final remark it can be stated that the potential role of these funds for each of the regions is very important and some of them consider it as a last "big push" to create a better regional innovation system before losing -in 2013 - the support based on the European Cohesion Funds.

Table 10: Main R&D indicators for Spain and the European Union (EU)

	2005	2006	2007	EU-27 (latest year)	
				Average	Year
GERD (euro million)	10197	11815	13342	*226120*	**2007**
R&D intensity (GERD as % of GDP)	1.12	1.20	1.27	*1.83*	**2007**
GERD financed by government as % of total GERD	430	42.5	**na**	*34.2*	**2005**
GERD financed by business enterprise as % of total GERD	46.3	47.1	**na**	*54.5*	**2005**
GERD financed from abroad as % of total GERD	5.7	5.9	**na**	*9.0*	**2005**
GBAORD (euro million)	7634	9799	11141	*87639*	**2007**
GBAORD as % of general government expenditure	2.18	2.59	2.73	*1.55*	**2007**
BERD (euro million)	5485	6558	7454	*144089*	**2007**
Business sector R&D intensity (BERD as % of GDP)	0.60	0.67	0.71	*1.17*	**2007**
BERD financed by government as % of total BERD	13.6	14.4	**na**	*7.2*	**2005**

Source: Eurostat; Note*:* Values in italics are estimated or provisional; na = not available

Due to the lack of recent statistical data the impact of the present economic crisis on R&D expenditure and especially the R&D policies is difficult to assess. Where firms are often more open to admitting the downsizing of R&D investments the policy makers are more prone to give "official" opinions. It seems that a large number of firms reduced their R&D investments[10] although some firms on the edge of the technological frontier do maintain their R&D expenditures. In relation to the R&D policies it can be stated that the innovations and R&D related programmes are one of the few aspects that showed an increase in the assigned funds of the public budget for 2009. The Minister of Science and Innovation argues that R&D is important to survive and fight against the crisis[11]. However, on the other hand, the publication of some tenders of large public support programmes oriented to public research systems is formally delayed (CENIT or CONSOLIDER) and it is not clear if they will be published it in the future with the budget initially foreseen. Moreover some regional governments did reduce the number of scholarships for PhD students, mobility schemes and the funds available to support R&D projects.

[10] The following statements are based on opinions collected from informal conversations with some entrepreneurs, firms, associations of enterprises and policy makers. Quantitative data are not available.

[11] El Pais 8th of December, 2008; El País 4th of February 2009; The same was argued by Paul Krugman during his conference -in Spain- about the economic crisis ("Expansión" 16 of Februari, 2009).

Table 11: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
High presence of SMEs and lack of Spanish multinational firms	Large national or multinational firms could lead R&D oriented networks or clusters. A main risk is the acquisition of the few existing Spanish multinational by foreign firms, which could have a negative impact on their R&D activities. This aspect is difficult to tackle by policies.
A sectoral bias to low tech sectors	The relocation of non R&D enterprises of the traditional sectors to newly industrialised low wage countries in itself is not a risk if new firms in medium high tech sectors are created. Therefore, the low number of business creations in more innovative sectors is one of the main risks that should be tackled. Moreover the decline of traditional sectors could be delayed with specific policies to foster in-house R&D in non innovative firms. Such instruments, non existent in Spain- together with the existing cluster policies or instruments focused on technology transfer, could be important to reactivate those low tech sectors and encourage the survival of at least some of the firms
Fragmented decentralised public research system in which researchers have freedom to participate in specific projects or R&D areas.	Strategic planning of the Spanish research system is not sufficiently developed, in particular the mechanisms to ensure its implementation. Spain Although Spain does not possess direct measurements to reinforce centralised planning, some programmes (such as CENIT and CONSOLIDER) aim to tackle the lack of fragmentation and excellence. However, a legal reform of the public research system should encourage the strategic decision making power on an Institute level instead of decentralised short term ad hoc decisions by individual researchers.
Lack of meritocracy and transparency. Low multiplier effect of the public R&D system due to their low level of excellence.	The risks of these aspects are related to the attractiveness of universities and public research organisations as collaborators for the private sector. The low average quality and the academic orientation of public research could be considered as a systemic failure that impedes multiplier effects by which those institutes could raise extra finance for their R&D activities. If their quality does not reach a high level Spanish firms will contract R&D abroad and foreign subsidiaries will be less likely to locate R&D in Spain.

4 Contributions of national policies to the European Research Area

ERAWATCH country reports 2008 provide a succinct and concise analysis of the ERA dimension in the national R&D system of the country. This Chapter further develops this analysis and provides a more thorough discussion of the national contributions to the realisation of the European Research Area (ERA). An important background policy document for the definition of ERA policies is the Green paper on ERA (EC, 2007b) which comprises six policy dimensions, the so-called six pillars of ERA. Based on the Green Paper and complementing other ongoing studies and activities, this chapter investigates the main national policy activities contributing to the following four dimensions/pillars of ERA:

- Developing a European labour market of researchers facilitating mobility and promoting researcher careers
- Building world-class infrastructures accessible to research teams from across Europe and the world
- Modernising research organisations, in particular, universities, with the aim of promoting scientific excellence and effective knowledge sharing

- Opening up and co-ordination of national research programmes

In the ERA dimension, the *wider context of internationalization of R&D policies* is also an issue related to all ERA policy pillars and is normally present in the dynamics of national ERA-relevant policies in many countries.

4.1 Towards a European labour market for researchers[12]

The number of people employed in R&D activities in 2007 was 201,108 people (INE, 2007, provisional data). Compared to the rest of the EU nations, the number of scientists and researchers as a percentage of the total labour force in Spain (4.6%) is near the average for Europe of 25 (4.8%), although it is still far from the European countries at the top of the list (Finland, Sweden or Germany with respectively 6.7%, 6.5% and 5.8%; Eurostat data for 2008). According to information from the Spanish Statistics Institute (INE), 37.9% of all individuals with full-time jobs employed in R&D in 2006 were women. In the case of technicians this percentage went up to 48%. Female participation was highest in private non-profit institutions, with a 57% participation level, followed by the Public Administration (50%) and universities (43%). Their representation in private companies was 30%. On the supply side it can be pointed out that the latest available INE data show for 2007 that 4,100 PhD holders and another 440,200 persons with higher education (except doctorate courses) were unemployed. For both groups the unemployment rates (2.7% and 5.4% respectively) were clearly below the 8.3% of the overall Spanish unemployment rate.

In 2007 over 89,000 students were enrolled in PhD studies and 7,150 PhD candidates graduated that year (INE, 2007). The duration of PhD studies is relatively long in Spain compared to other countries: up to six years instead of the four years common elsewhere. The number of persons with predoctoral scholarships is, due to the existence of a broad number of national and regional programmes and private supports schemes, not clear. An ad hoc estimation off the INE -with data of 2003- indicated that around 25,000 researchers were working with a scholarship which is around 25% of all the Spanish researchers (FJI, 2008). Since 2003 the Spanish government has made a great effort to increase the number of scholarships so possibly at this moment there is a higher number of researchers with scholarship, although no specific data are available.

Preparing a career as a researcher in Spain is a difficult, time-consuming and badly paid process. It takes over 12 years –with low salaries- to achieve a stable position and personal contacts are very important to gain promotion. The average annual salaries of researchers in Spain (34,908€) is almost 10% below the EU-25 average (37,948€). However if we compare Spain with the largest and most advanced countries of Europe the difference is clearly greater (Germany and the UK with around 56,000€ or France with almost 51,000€) (EC, 2007c). So Spain is not very attractive for most European researchers except maybe for those from Eastern Europe countries.

Also within Spain there exist differences in salaries for researchers. In the Spanish Business Enterprise sector they received an annual average 40,500€, in government organisations this salary is 37,800€ and in the universities it is 36,800€ a year.

[12] A data item of the Spanish National Institute of Statistics (INE) refers to the data available on its website consulted in February 2009 except if indicated otherwise http://www.ine.es/

Moreover the salaries of researchers in the public sector are very rigid without bonus payments for the most productive or talented full researchers (See section 4.1.2.).

Referring to the training of young researchers it can be stated that the standardisation of programmes to European System is still an ongoing process. This so called "Bologna Process" has strong public support among policymakers and universities, but there exists a strong resistance on the part of students. In relation to the PhD studies some "Erasmus Mundus" programmes and English speaking doctoral courses do exist although their number is scarce. One of the problems is to find enough - well experienced - lecturers that can give the subjects in English.

4.1.1 Policies for opening up the national labour market for researchers

In the following pages we discuss the problematic situation of inward and outward mobility of researchers to and from Spain. These include the legal and informal aspects, the specific barriers for inward mobility and the selection procedure or recognition of research qualifications of foreign researchers. Afterwards we analyse the existing policy measurements to promote inward and outward mobility. At the end of this section we analyse the Social Security and supplementary pension system, health insurance, and the scientific visa package for third non-EU countries.

Inward mobility, legal access and selection procedures for research positions

In the Spanish research system there is low mobility of researchers. Generally the selection procedures for candidates on research positions or jobs in the Spanish public research system neglect meritocracy and competitiveness in favour of endogamy. Legally there exists full access for candidates of the European Union to the research and teaching posts. The number of foreigners working in Spanish universities is growing though it is still a marginal group. The tacit mechanisms behind the formal process are still an important threshold, not only for foreigners, but for every outsider from a university, faculty, and even for outsiders of the departments of the same faculty. The so called "oppositions" to obtain a contract are a struggle of internal candidates on the internal market of the institution (Fernandez Esquinas et al., 2006, P.167). The selection criteria and profile for jobs such as research assistant, or assistant in a university are established by the institutes or departments themselves within a general framework. The departments and selection commissions have a broad discretional power which permits ad-hoc interpretation of the selection criteria[13]. The final step to a stable job is subject to a stricter, more formal regulation. Subsequently only when the researcher has clearly advanced in his career and wants to obtain a stable job as a researcher (long life contract or as civil servant) will he be evaluated seriously. The final selection is carried out by a commission of "experts", however, also in this case the influence of the department or institute is quite large. They designate directly the experts of the commission. This explains why only a few Spanish research organisations (fewer than ten) subscribe to the European Charter for Researchers. In general they are relatively new or small research institutes. 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.

[13] 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 al (2006) and Corruptio, 2007).

The access to predoctoral scholarships is possibly the most competitive way to get access to the university because most of the applications for such scholarships are evaluated in a centralised way (by the Ministry of Research and Science or the regional governments) and the organisations or departments were they will work do not participate in the selection. This means that foreigners have a higher possibility of competing in the same conditions as national applicants.

Governmental policies for inward and outward mobility of researchers

Spanish policymakers are very active in the promotion of the **inward mobility** of researchers which is reflected in the broad range of support measurements. The Spanish Foundation of Science and Technology has a special website http://www.eracareers.es/fecyt/mapa_en.jsp that offers good and very complete information 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 broad number of regional, national and international support programs that facilitate –indirectly- the researchers' **inward mobility.** All the Spanish programmes focused on training (pre doctoral scholarships) and incorporation of researchers into the R&D system (post doctoral scholarships or contracts) offer, as mentioned before, full access for students and researchers of the European Union and the foreigners compete in similar conditions. A specific programme for **inward mobility** is the one to foment Incorporation and Intensification of Research Activities (I3 Program). It favours the training or recovery of experienced Spanish and foreign researchers to incorporate them into the Spanish Science and Technology System. It also seeks to motivate the incorporation of young researchers with a high level of research potential in consolidated and developing groups within the national R&D system. Also the different Spanish Autonomous Communities offer aid for mobility and training to the scientific and research community[14].

Although legal access to the Spanish research system for PhD holders does exist for foreigners and especially researchers from the EU. there are several formal and informal barriers that make mobility more difficult or less attractive. The protection of the internal candidates, the low salaries and the instability of research positions as barriers are already mentioned. Also the specific process of recognition of academic qualifications (accreditation) is an important threshold. This is a time consuming process in which the “associations” of each scientific field have an important role. These organisations often delay the procedure and require extra qualifications which could be considered as deliberate ways to protect national graduates or PhD holders.

Also in the case of the **outward mobility** some barriers exist. One of the main reasons that make outward mobility less attractive in the Spanish context is the fear of losing the personal contacts and relationships with the department or Spanish researchers. Spain has a highly “hierarchical” research system where professors select researchers and post doctoral students. In such a system personal contacts and relationships are very important to assure access to stable positions. Another threshold is the Civil Servant character of most research positions. The opportunity cost to give up a stable position is high and return is not always guaranteed. Also the lack of active knowledge of foreign languages (English) is often an important impediment. Anyhow, in the last decade the Spanish policy makers were very active

[14] Successful programmes are the ICREA or the Beatriu de Pinós programme in Catalonia and the IKERBASQUE of the Basque Country. In the last two programmes respectively around 80% and 40% of the inward mobility contracts were obtained by foreign researchers.

in promoting international mobility and the national and regional governments implemented a broad number of specific **outward mobility** programmes for their PhD students to get training abroad. Also researchers with a stable contract can benefit from different support schemes for stays abroad from a few days or weeks to one or two years. Moreover most Universities and research organisations offer mobility schemes for their own employees.

To conclude, Spain has introduced in the last few years new policies to promote inward and outward mobility -and reinforced the existing ones-. The budgets devoted to those kinds of policies –and so the number of persons that take advantage of it- has increased clearly in the last decade.

Researcher friendly social security and pension systems

In the following pages we analyse the Social Security and supplementary pension system, health insurance, scientific visa package for third non-EU countries. The Spanish Constitution guarantees that all citizens are to receive healthcare and social benefits in case of need. Social Security is the channel through which this care is guaranteed for all citizens and their families including the (young) researchers. If you have worked in more than one EU Member State or in countries that have signed agreements with the European Union, the different retirement pension periods are added together in calculating the minimum contribution period. If you now have the right to retire, you may request to have the pension paid either in your own country or in Spain. These rules are also applied outside the EU with those countries that have signed a bilateral agreement. Each insurance body will pay according to the time insured with each of them (FECYT, Mobility portal).

In relation to the social security of those young researchers with scholarships for researchers financed by public support schemes it can be stated that most of them are based on contracts. This means that they include almost all social security regulations. However, some exceptions exist such as the PhD Scholarships. In this case they apply the 2+2 formula (two years scholarship and two years contract) and after the end of the contract the holders of such PhD scholarships do have the right to unemployment payments.

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. Only a small part of the income of researchers is considered as “basic salary” and a substantial part defined as extra supplements is not taken into account to calculate the pension or the social security payments in the case of illness etc…[15]. This fact is an important barrier to attracting foreign researchers or lecturers.

The use of the Scientific Visa Package is not approved and its application is only partial. However the general measure to attract qualified workers abroad does permit their entrance into Spain and offers to those employees a 24% tax discount on their salaries. This measure can be applied to foreign or Spanish employees that have not worked or lived in Spain in the last ten years.

[15] 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

Other aspects that affect the European research labour market and mobility

The ERA is still a heterogeneous set of countries with very different languages and cultures. Especially for those countries where a good knowledge of a second foreign language is not generalised the outward and inward mobility will be limited. This is especially the case of Spain where still no minimum level of English is required to obtain access to research positions. Moreover the inward mobility is affected because the foreign researchers need advanced knowledge of Spanish. Also the inward mobility to some specific Spanish regions is more difficult not only due to the existence of the regional languages (such as Catalan or the Basque language) but also because of the importance of those languages in the evaluation criteria to achieve access to positions as a researcher and their importance to obtain promotion. These aspects affect not only the foreign researchers but they even make internal mobility of Spanish researchers more difficult.

4.1.2 Policies enhancing the attractiveness of research careers in Europe

Policies based on salaries

As can be deduced from the introduction of section 4, the salaries for researchers in Spain are an important barrier for inward mobility. The salaries for researchers of the public R&D system are low and very homogeneous without extra payments for highly qualified and prestigious researchers. In fact the remuneration of R&D personnel in public R&D organisations or universities is based on a very rigid and detailed regularisation –at a national level- of the recruitment and emoluments of university academic staff. Universities do not have many possibilities of creating a system of bonus payments for the most productive or to attract excellent external researchers. The only way to reward very talented or productive employees is the increase or the formal “level” or responsibilities and the assignment of extra R&D funds. This aspect makes it very difficult to implement a strategic plan based on the attraction of the best academic scientists.

Productivity and quality in the work of researchers is only rewarded marginally. Some specific evaluations of the productivity or quality are the so-called educational “quinquenios” or research “sexenios”. Referring to periods of five and six years which, after a positive evaluation generate an increase in the salaries. These extra payments are small (not exceeding 15% of the salary). Also their discriminatory effects are small because, with some exceptions, these mechanisms are used to introduce a general increase of salaries[16]. On the other hand, a large number of regional governments also introduced a plus for productivity. In general the amounts are small and moreover there exist broad differences between regions[17]. Another mechanism to increase the salary is doing contract research, making use of the infrastructure and installation of their organisation. In this case the possibility of earning extra income depends on the quality of the researchers, the interest of the academic field covered, and on their personal contacts with firms or governmental organisations.

[16] For example, the educational quinquenio” is assigned almost automatically.
[17] In some cases the theoretical amount that could be gained does not exceed the annual amount of 2000 Euros and in other regions it is over 10.000 euros.

All these arguments create an environment in which the career of researchers is less attractive and it means that the best students prefer to work for the business sector in al kind of activities instead of starting a career as a researcher.

Policies promoting women

The policies for promotion of women in general are an important topic in the Spanish society. Spain has (since April 2008) a Ministry of Equality and each law presented in the parliament requires an impact report about the effects on "gender" related aspects. This Ministry, the specialised press and the politicians responsible for policy in the Ministry of Science and Innovation underline the importance of this question. Several specific measures were taken to promote women in the research system, for example in several universities the selection commissions of research positions should include women.

In spite of this political interest and measures, there is no doubt about it that discrimination against women on the labour market still exists and the gender gap is not closing as rapidly as desired. Two differentiated aspects of the discrimination against women should be borne in mind. The first question would be the problems of women to enter the research system. And the second aspect is the discrimination against women that entered –with a lot of difficulties and ceilings- to advance in their career and their problems to get promotions. Some indirect data found on this last question is based on the comparison of the salaries of researchers by the number of years of experience. These facts show that the salary gap is larger for the researchers with broad experience. In the first ten years of the research career the differences of salaries between Spanish male and female researchers is between 1% and 5% to the advantage of male researchers. However, this discrimination increases to 12% in the case of researchers with 11 to 15 years of experience and male researchers with more than 15 years experience earn 22.3 percent more than their female colleagues (EC, 2007c).

In relation to the first question, the problems of women to enter the research system, 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 the case of the private sector those percentages were respectively 24.8 and 17.5%. In the Spanish culture it seems normal that women are involved in such activities (FECYT, 2007). However some data show clear discrimination and the difficulties for women to enter in the labour market for researchers (Villaroya et al, 2007). Comparing the percentages of women that apply for scholarships or contracts and the percentage of women whose applications were rewarded shows clearly the discrimination against women in the evaluation process. Where the applications of women represent more or less between 45 and 56% of all applications, the percentages of women that obtained those positions are 4 percentage points below those figures. The percentage of women in the Spanish university is clearly higher and they seem to be more likely to finish their studies[18]. The percentage of female doctoral students is 51% although the percentage of women of all the PhD students that finished their PhD is only 43%. So although they are better graduate students they have more problems to finish their PhD projects than their male colleagues (Hernandez Moya, 2006).

[18] For example in 2002-2003 54% of the students were women and in the case of graduates this percentage was 59%.

A survey showed that women have worse jobs because their male colleagues are more successful in obtaining the stable and better paid jobs (Villaroya et al, 2007). Possibly this explains the high number of students who do not finish their PhD thesis. Other circumstances that could explain the dropping out of female PhD students are their family and personal circumstances. The young researchers are aged between 24-34, while the average age to have the first child in Spain is 30 years. Until 2006 not all types of contracts and scholarships included 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 get a contract they do not accomplish the minimum time span of "cotización" (social security contributions) to have the right to maternity leave (Villaroya et al, 2007). (3) The lack of formal contracts implies that female researchers lose several rights in comparison with other mothers. These include the right to get their children in the (free) kindergarten of the universities or financial state support for babies or young children (up to three years) of working mothers. And (5) the 4 months of maternity leave is not always compensated with four months extension of the maximum period to get a scholarship (Villaroya et al, 2007).

4.2 Governing research infrastructures

In recent years the Spanish government reinforced the policy for research infrastructures which is reflected in the increase in the annual budgets devoted to these policies and some new initiatives.

Traditionally the Spanish policy-makers want to optimise the benefits of existing European policies by increasing participation in large-scale **international** infrastructures. Spain considers the **European Strategy Forum on Research Infrastructure** (ESFRI)[19], as an important initiative and plays an active role in the design of the European Road map for Research Infrastructure. The Spanish R&D&I Plan 2008-2011 promotes the effective use of such infrastructures among others by the use of specific outward mobility schemes (see also section 4.1.1.). Spain contributes significantly to a broad range of these facilities and tries to enhance its percentage of return on that participation. It also promotes the role of Spanish industry in building and maintaining those infrastructures. Regarding the Spanish participation in large-scale European facilities, in practice, the benefits of these R&D contracts are less significant or only as significant as the contribution paid by Spain in the first place, so in fact they are own national funds being returned to Spain (ERAWATCH Research Inventory, 2008). Spain also promotes the role of Spanish industry in building and maintaining those European infrastructures, and competes to construct three of them on their territory. The real effects of ESFRI on the Spanish research system will be clear in 2009 or the beginning of 2010 once the main decisions on the exact investments and locations are made.

The ESFRI stimulated not only a profound reflection about the needs and the coordination for research infrastructure in Europe but also stimulated the coordination and the design of a road map of infrastructural needs among the Spanish regions. The policies related to **research infrastructure and singular R&D related installations** on **a national level** were given an important boost. The INGENIO 2010 programme increased the budget for such infrastructure based on co-finance by the central and regional governments. In 2007, after a long multilateral discussion and

[19] ESFRI was launched in 2002 as the European coordinating body for such facilities.

negotiations between the central and the regional governments, 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.

4.3 Research organisations

After a significant increase in budgetary terms in the last few years, the Spanish science and research system is at present undergoing a broad renovation in legal and organisational terms. The creation of the Ministry of Science and Innovation in April 2008 can be considered as the beginning of this organisational reform and their activities and decisions could mark the near future of the Spanish R&D system. In recent years already some aspects have been changed, such as the Law of University Organisation or the changes in the Spanish National Research Council (CSIC) (see below). However, the main reforms will be carried out in 2009. At this moment the Ministry of Science and Innovation is preparing a legal review of the Law of Science. Moreover this Ministry is preparing the "University Strategy 2015" project that should improve the quality of the Spanish universities. The objective of these strategic proposals is to modernize the Spanish innovation system and its legal framework including the subject of property rights; foster its level of excellence; increase its social role and the cooperation or interaction with the private sector; make them more open and transparent and situate Spain within the 10 most innovative countries. For both initiatives the draft proposals have been published recently. In any case, due to the fact that the public discussion and the pressure of the stakeholders of the research system will generate important changes in the initial drafts

A remarkable change in 2008 was the conversion of the Spanish National Research Council (CSIC) into a public agency with an additional degree of autonomy concerning management, although with some limitations. This conversion should foster the transfer of knowledge and technology developed by the CSIC to the private sector in an agile, flexible and transparent manner. This will afford the CSIC the ability to use the same tools as companies: short response times, the ability to negotiate, simplified administration, etc. Moreover this new agency is not limited by annual budget cycles and therefore can implement long term strategic plans in a more direct way. Other aspects like their role in the policies of research funding or the property of the research results are not affected by this change.

Funding of research organisations

The basis of block funding of the universities is mostly related to their educational function (number of students), while excellence measured by research results has only a marginal role in the funding decisions. In the other public research organisations the block funding financed the salaries and current costs. In all public R&D-performing organisations the specific R&D projects and activities are mostly financed by competitive tenders and contract research

Progress of educational reforms of universities

The Spanish system of higher education had in the last decade two main reforms. The first one was the Organic Law of the Organization of Universities (LOU) of 2001 and the second one was its modification in 2007. One of the main motives was the creation of new contractual occupational positions to improve the stability of the

existing group of lecturers and their formalization in combination with the regulation of the access of the researchers to those more stable jobs by establishing some minimum requirements. Until 2001 no minimum requirements existed. The LOU of 2001 created a system in which the possible candidate had to obtain a certificate that ensures a minimum level of knowledge and experience, which can be considered as an improvement. Initially only one national agency 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 organizations and universities –at department level- still have certain freedom in the application of the selection criteria. Concluding the accreditation system at least seems to avoid the access of people with a really bad curriculum, although it does not impede the existing broad spread endogamy (see also section 4.1.1.).

The role of users and stakeholders in teaching, research and innovation activities of the universities

The regulation on universities in Spain distributed the power and decision making system among three actors: the universities and the national and regional government. The State is responsible for the general framework conditions of the organisational structure and the legal situation of personnel; the regional government is responsible for the financing and the planning of higher education while the universities are autonomous –within the legal limits- in their internal organisation, recruitment of personnel, the organisation of educational activities and the management of the financial funds. The principle of “University Autonomy” in aspects related to research and educational activities is protected by the Spanish constitution and offered the Spanish universities a broad level of self-government. This implies that they have a very high capacity to defend the personal interest of the researchers (corporative behaviour) above the general interest of society as a whole. This possibility generated a situation in which most universities or research centres can be characterised as a closed community with a low level of transparency rather than an open dynamic organisation based on meritocracy.

In the case of education the negative impacts of this situation can be exemplified by the “study” plans (curricula) of the universities. The vast majority of those plans are designed taking into account the interests and power of their lecturers without any impact from other stakeholders or a serious study about future societal needs. Also the present day model of research in the Spanish university is still based on the idea that the freedom of the scientific community –making their own decisions on what has to be investigated followed by a public debate about the quality of the results- is the main guarantee for academic progress. This model where the choice of subjects, the organisation of their activities and the selection of their personnel are regulated by the researchers themselves is a model that does not promote the connection with their social and economic environment and impedes clear influence by stakeholders. The fragmentation of the research groups (lack of critical mass) and lack of coordination of the public research in Spain is caused by this absolute freedom of each researcher concerning his own research activities. Actually their exist a large number of centres and levels and a broad number of intermediary organisations with decision making power which impedes or makes it very difficult –even for the universities themselves- to coordinate the structure or to implement a strategic plan that integrates the different partial interests all 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), and a broad regularisation of the recruitment and compensation of the personnel. However, this economic dependency has never been used to orient the research or educational activities of universities or to force universities to open and professionalize their institutions.

An organisation that could or should guide the influence of external stakeholders on the universities could be the **Social Council.** Such a council exists by law in all universities. In these Councils are represented the university and the different stakeholders of society. However, their role 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. Moreover it is difficult to generalise about their role because their responsibilities are defined also by the different regional governmental regulations.

As concluding remarks for this section 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, however, its application and the use or abuse of this freedom has to be taken into account. In recent decades the autonomy of the Spanish research organisations and universities is used by the vast majority of the organisations to protect the interests of the researchers or lecturers to the detriment of societal needs or interests. Therefore extending this autonomy probably will generate the opposite effect -less competitiveness and meritocracy-. On the other hand, the lack of autonomy in relation to specific aspects (like the strict regulations of salaries or the annual budget cycle) impedes the application of a strategy of excellence and the attraction of internationally recognised researchers.

Technology transfer from public research organisations

In the last decade the Spanish political authorities tried to strengthen the science-industry-university relationships. Since 1988 the Spanish government offers specific financial support for the creation and development of the Transfer Offices for Research Results (OTRI) to reinforce of the "third mission" of universities and Public Research Organisations (PRO). The activities and success of these offices are very heterogeneous. Some of them are merely administrative units in charge of the burocratic paperwork deriving from the contract research while in other cases the OTRIs have a very proactive attitude to generating added value as an intermediary body between the academic oriented researchers and the production sector. A study by Elena Castro Martínez et all (2005), reflected an increase in research contracted by the OTRIs. Moreover this study indicates that an important number of these contracts are between the public administration and the public R&D centres (Universities or PRO), especially n the case of the more backward regions.

Opening up national research programmes

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 for all EU inhabitants and also the tenders for R&D projects are accessible to foreign firms operating in Spain. Another question is that national firms, in general, have better contacts and can press more to ensure the assignment of public support. 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 Plans 2004-2007 and 2008-2011 is the opening of the Spanish R&D&I Plan programmes to R&D groups from other countries. Both Plans have included a national programme for international cooperation on R&D that aims to respond to the challenges of globalisation and the internationalisation of R&D. The specific objectives of such programmes are to encourage Spanish participation in international programmes and projects; to promote the mobility of researchers; to improve R&D training of researchers from developing countries; to promote the creation of multinational expert networks; to promote international networks of technological centres and scientific and technological parks; to stimulate the participation of companies in international programmes and consortia; to improve technological cooperation with other countries; to increase the dissemination of advances made by Spanish science; to coordinate R&D policies with foreign affairs policies; and to increase research in the areas of cooperation and development (IPTS, 2006).

Spain has been supporting the Joint Programming since the beginning. This support was especially clear during the French Presidency and in relation to the “great challenges”. Moreover in some fields –such as health science- Spanish Researchers are collaborating. The first draft of the new Science Law (to be approved in 2009, (see section 4.3) includes several elements for a partial solution of the legal barriers for joint programming. Spain considers the Joint Technology Initiatives as an important EU policy. This is reflected by its active role in this area. Spain participates in all JTI´s, their contribution is around €12.3m and the Spanish government is satisfied with the participation of Spanish enterprises. Spain also has an active role in the article 169 initiatives; also in this case they participate in all initiatives.

4.4 National ERA-related policies - a summary

The ERA initiative is discussed from time to time both in the Spanish press and in society at large, normally in the context of university education and study plans. It is, however, more usually discussed at policy-making level. The Spanish National Plan for R&D and Innovation 2008-2011refers broadly to the ERA concept and tries to play an active role in its development. This Plan mentions the ERA very often for several reasons. First, it is a benchmark for S&T indicators and case studies of good practices. Second, the ERA defines the framework for the Plan, for example through the Lisbon Strategy, the National Reform Programme, the 2002 European Council in Barcelona, etc. Third, the ERA provides funding schemes like the R&D Framework Programme and the EUREKA Programme in which there is an explicit interest in participating, in order to increase Spanish cooperation with Europe. Fourth, the ERA becomes a reference for designing the National Programmes and Strategic Actions within the Plan, for example in the justification to reach sufficient critical mass, assume leadership in European programmes, etc. (EW Country Report, 2008)

The extent of the impact in the form of Europeanization of Spain could be assessed by a mention of the wide range of programmes, starting from the national context, for mobility of researchers; the existence of possibilities for foreign participation, still restricted although opening-up; the emerging experience in joint programming with other Member States; and the recent strategy on the further development of research infrastructures in an ERA context.

The ERA initiative is considered as a way to integrate the Spanish innovation system in the international research scene and improve its level of excellence. In this context Spain plays an active role in the development of ESFRI, the European Joint Research Initiatives and the article 169 initiatives. Moreover, specific outward and inward mobility schemes were introduced.

The policy makers make real efforts to develop the ERA within the Spanish context. However the tightly closed endogamic research system with highly decentralised power does not pick up or implement all the ERA oriented measures. In some aspects they even try to impede their application to protect their own personal interest above those of society in general. In general Spanish researchers -especially senior ones- have a poor knowledge of English or other foreign languages. This often impedes their cooperation and communication with foreign colleagues and therefore constitutes a serious barrier for developing the Spanish contribution to ERA.

Table 12: Importance of the ERA pillars in the ERA policy mix and key characteristics.

	Brief assessment of its importance in the ERA policy mix	Key characteristics of policies
Labour market for researchers	• Despite the political interest in a European labour market the decentralised power of departments or research units impedes an open competitive selection of researchers. • The policies for young researchers (scholarships) are the most open and competitive way to enter –as a foreigner- in the Spanish research system.	• The National Reform Program created new instruments for Human Resources especially oriented to both inward and outward mobility • The European Chart for Researchers is signed only by a few institutions
Governance of research infrastructures	• Spain assumed an active role in the ESFRI. Moreover this programme also generated new initiatives to create and upgrade the national infrastructural installations	• Upgrading of the national and European policy initiatives and of the budget for research infrastructures
Autonomy of research institutions	• The autonomy of public research organisations and universities is a tricky question and its benefits depend on its efficient implementation, which in the case of Spain is not always guaranteed. There is a need for more freedom (especially in the case of salaries and budget cycles) but simultaneously a better legal framework should guarantee its correct and efficient use based on competitivity and meritocracy	• Two important reform initiatives should be approved in 2009 • The conversion of the Spanish National Research Council (CSIC) -in 2008- into a public agency with more, albeit, limited autonomous power
Opening up of national research programmes	• Legally almost all programmes are open for foreign enterprises or citizens. Especially in recent years the openness improved. However some informal barriers still exist.	• Spain plays an active role in the European Joint Research Initiatives and the article 169 initiatives. • Joint Programming is strongly supported by the Spanish government

The main difficulties -mentioned in this section- to implement a national ERA related policy are: (1) The low average level of excellence of the Spanish research system and its endogamy which makes Spain a less interesting cooperation partner; (2) the

strict inflexible salary system for researchers of public R&D institutes, which make it difficult to attract foreign researchers. And (3) the annual budget cycles of almost all public R&D organisations, which makes it difficult to implement a long range strategy. Another very important difficulty is (4) the low level of speaking foreign languages – especially English. The 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. The younger generation is more prepared in this aspect although Spain has still a long way to go. The general selection criteria for researchers do not include languages as important criteria. However, some organisations do include them in their own specific selection mechanisms.

5 Conclusions and open questions

5.1 Policy mix towards national R&D investment goals

In relation to the balance of the policy mix it can be highlighted that Spain implemented –in 2006- a broad number of new instruments oriented to the most important problems of the Spanish innovation system. Moreover it substantially increased the government budget for R&D (an annual increase of 25% during four years). These changes generated a R&D policy that can be considered as a clearly improved mix of instruments that are focused on some specific important barriers of the Spanish research barriers. Although some particular instruments could complement the current -well balanced- policy mix, it can be stated that the main barriers are probably an inherent part of the research system and the production structure, not easy to solve with public policies. The main problems are the high presence of SMEs in traditional less innovative sectors and the low average quality of its innovation system. Both aspects cannot be solved in the short term and require a long standing effective policy.

The fact that Spain is not a low wage country any longer implies the relocation of non-R&D enterprises of the traditional sectors to newly industrialised low-wage countries. This fact in itself is not a risk if at the same time new firms in medium high tech sectors are created. Therefore, the low number of business creations –in Spain- in the more innovative sectors is one of the main risks that should be tackled. Moreover the decline of traditional sectors could be delayed with specific policies to foster in-house R&D in non-innovative firms. Such a policy can be considered as important for the survival of at least some firms or activities in the traditional sectors. Although Spain introduced policies to make those sectors more dynamic (such as clusters or technology platforms or specific policies focused on technology transfer) specific proactive support for non-innovative firms could encourage their competitiveness.

Another policy lacking in the Spanish Policy Mix is the instruments to attract R&D-performing firms from abroad. Anyhow, to attract R&D from abroad it is necessary to improve the level of excellence of most (public) R&D institutes and the innovation related services and infrastructure. This brings us to another weakness of the Spanish research system which is not sufficiently tackled by the policy instruments or the general distribution mechanism of research funds. Spain is lacking strong mechanisms (in relation with the distribution of the funds and evaluation of the

research activities) that assure the level of excellence and productivity of research institutions. Some specific instruments are implemented but it is difficult to change the accumulation of inefficient assignments of funds and selection of researchers, 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. However this is a tricky question because the benefits of this freedom in terms of an increased excellence depend on its efficient implementation, something which in the case of Spanish public research organisations and universities is not always guaranteed. This can be observed during the selection procedures for new staff -characterised by endogamy and personal contacts- or the low productivity reflected by the low number of researchers that passed the six-yearly research evaluations. To conclude, the research institutions need more freedom (especially in the case of salaries and budget cycles) to make long term strategic planning possible and to compete with R&D institutes abroad. However, this has to be implemented simultaneously with a legal framework and mechanisms that guarantee an efficient and effective use of this freedom based on competitiveness and merit. A positive change could be the transformation of the Spanish Research Council (CSIC) into a State Agency with more administrative freedom and management flexibility. 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 could be the supply of more 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 independency of the selection process are required.

Spain seems to be moving in the right direction to achieve its goals in terms of R&D expenditure proposed by the Lisbon strategy (in the Spanish case a 2% GERD/GDP ratio with a 55% stake from the private sector). In the last few years an important increase in the public funds devoted to R&D and innovation can be observed. This extraordinary increase in a short period of time (coming from national funds and the European funds for regional development) is justified by its giving an extra push to the development of the Spanish innovation systems. However, probably it generated –in the short term- a problem of absorption capacity. In other words it is difficult to allocate all the funds in an efficient way. Theoretically this would be a temporary problem which would be sorted out in the short term due to the increasing dynamic of the Spanish innovation system. However, taking into account the problems of transparency of the selection processes, the lack of meritocracy and endogamy a certain danger exists that a suboptimum allocation of funds perpetuates the current situation of low quality, dispersed funding, fragmentation etc. In conclusion, the increase in the budgets for R&D policies generated a situation in which probably the financial aspects of R&D policies -in terms of quantity- are not the main problem. However, the design of key funding instruments –especially the selection and evaluation mechanisms- are an important problem.

Although these weaknesses -related to the efficient and effective implementation of the instruments- are important, the basic shortcoming of the public research system to ensure the satisfactory functioning of the Spanish innovation system is the average level of excellence of the different agents. The substantial increase in R&D expenditure has to be accompanied by structural changes in the public research system towards an open transparent system based on meritocracy. The lack of meritocracy has a negative effect upon the attractiveness of universities and public research organisations as collaborators for the private sector. The mismatch between

the research results and the needs in innovation systems, the possible lack of quality and the academic orientation of public research can be considered as systems failures. Those problems complicate the circulation of knowledge and impede multiplier effects in which those institutes could raise extra finance for their R&D activities. If their quality does not reach a sufficient level, Spanish firms will contract R&D abroad and foreign subsidiaries will not locate R&D in Spain. It is this aspect which should be tackled by the policymakers and the planned reforms of the system (see also section 4.3), and the design (or implementation) of the support measures play an important role in this respect.

One of the main barriers to increasing the R&D efforts in Spain is probably the productive structure, with a significant weight of small and medium sized firms, oriented to the less innovative traditional sectors and with a lack of multinational enterprises that could create R&D related network and system advantages. Other barriers are the lack of critical mass and the fragmentation of its public research system (in public research organisations and especially in universities), the low level of integration between industrial and academic research and the low number of new technology based firms or academic spin-offs.

On the other hand, a positive effect on the innovative culture –and therefore on R&D expenditure- is generated by structural changes in the general economic environment. Spain can no longer be considered as a low wage country. The introduction of the Euro implied the loss of the peseta exchange rate as an instrument to gain competitiveness and obliges the Spanish firms to compete in innovation and quality. Moreover, the European support from structural funds –clearly reoriented to innovation and R&D- and the creation of the European technical fund also offers a possibility to improve, if they are implemented in an efficient and effective way, the overall innovative environment. An important challenge is to ensure good complementarity and synergies between all levels of funding: EU, national and regional.

Due to the lack of recent statistical data the impact of the present economic crisis on R&D expenditure and especially R&D policies is difficult to assess. It seems that a large number of firms downsized their R&D investments. In relation to the R&D and innovation policy programmes it can be stated that it is one of the few policy aspects that showed an increase within the total public budget for 2009. However, on the other hand, the publication of some tenders of large public support programmes oriented to public research systems have been formally delayed and it is not clear whether they will be published in the future with the budget initially foreseen. Moreover some regional governments reduced the number of scholarships for PhD students, mobility schemes and the funds available to support R&D projects.

A final weakness of the Spanish R&D and innovation policies that can be highlighted is the coordination of the national innovation systems. This problem is reflected in two important policy 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 second one is the low level of integration of measures oriented to scientific research with those related with innovation and technology transfer. Some recent developments went in the right direction, such as the creation of the Ministry of Science and Innovation, the procedures to approve the Operational Plans related with the European Structural Development Funds and the approval of the National Strategy for Science and Technology (ENCYT) and the Spanish National Roadmap for S&T infrastructures. A final positive trend is the

inclusion of the utility of the research results and quality of the plan of diffusion of those results in the selection criteria of almost all measures of project support (including the support for non-oriented fundamental research). These tendencies could be an important step to normalise coordination between national and regional policies and integrate the R&D and innovation policies. However, besides these legal changes, the real changes have to come from the scientific world, and that requires a new approach or culture on doing research.

5.2 ERA-related policies

The ERA initiative is discussed occasionally in the Spanish press and in society[20], mostly in an indirect way, such as in the context of university education and study plans. It is discussed more frequently at the policy-making level. The Spanish government considers the ERA initiative as strategic for the future of Spain and its research system. The Spanish National Plan for R&D and Innovation refers broadly to the ERA concept and Spain tries to play an active role in its development (EW Country Report, 2008).

Moreover the new Science Law includes several references to extending the implementation of the ERA initiative. The ERA initiative is considered as an opportunity to integrate the Spanish innovation system in the international research scene and improve its level of excellence. In this context Spain plays an active role in the development of ESFRI, the European Joint Research Initiatives and the article 169 initiatives. Moreover, specific outward and inward mobility schemes were introduced.

The main difficulties -mentioned in section 4- to implementing a national ERA related policy are: (1) The low average level of excellence of the Spanish research system and its endogamy, which makes Spain a less interesting cooperation partner; (2) the strict inflexible salary system for researchers of public R&D institutes, making it difficult to attract foreign researchers, and (3) the annual budget cycles of almost all public R&D organisations which make it difficult to implement a long range strategy. Another very important difficulty is (6) the low level of speaking foreign languages – especially English. The 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. The younger generation is more prepared in this aspect although Spain has still a long way to go. The general selection criteria for researchers do not include languages as important criteria. However, some organisations do include them in their own specific selection mechanisms.

[20] See for example the newspaper “El Pais” 22/2/08; 4/3/09; 10/11/08; 25/10/08

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Abbreviations

ANEP	Agencia Nacional de Evaluación y Prospectiva (National Evaluation and Foresight Agency)
CAS-CICYT	Comité de Apoyo y Seguimiento de la CICYT (Support and Follow-Up Unit of the CICYT)
CDTI	Centro para el Desarrollo Tecnológico Industrial (Centre for the Development of Industrial Technology)
CEEI	Centro Europeo de Empresas e Innovación (European Business Innovation Centre)
CENIT	Consorcios Estratégicos Nacionales en Investigación Técnica (National Strategic Consortia for Technical Research)
CERN	Conseil Européen pour la Recherche Nucléaire (European Organization for Nuclear Research)
CES	Consejo Económico y Social (Economic and Social Council)
CICYT	Comisión Interministerial de Ciencia y Tecnología (Inter-ministerial Commission on Science and Technology)
CNEAI	Comisión Nacional Evaluadora de la Actividad Investigadora (National Evaluation Commission of Research Activities)
COSCE	Condeferación de Sociedades Cientificas en España
CSIC	Consejo Superior de Investigaciones Científicas (Spanish National Research Council)
EMBL	European Molecular Biology Laboratory
EMBO	European Molecular Biology Organization
ENCYT	Estrategia Nacional de Ciencia y Tecnología (National Strategy for Science and Technology)
ENISA	Empresa Nacional de Innovación, S.A. (Spanish National Innovation Enterprise)
ERA	European Research Area
ESA	European Space Agency
ESF	European Science Foundation
ESRF	European Synchrotron Radiation Facility
ESFRI	European Strategic Forum on Research Infrastructures
ESO	European Southern Observatory (official name: European Organisation for Astronomical Research)
FECYT	Fundación Española para la Ciencia y la Tecnología (Spanish Foundation for Science and Technology)
FAIR	Facility for Antiproton and Ion Research
GRECYT	Grupo de Reflexión ENCYT (Think tank of the ENCYT)
ICO	Instituto de Crédito Oficial (Official Credit Institute)
ILL	Institut Laue-Langevin
IRC	Innovation Relay Centre
ITER	International Thermonuclear Experimental Reactor
MEC	Ministerio de Educación y Ciencia (Ministry of Education and Science)

MICINN	Ministerio de Ciencia e Innovación (Ministry of Science and Innovation)
MITYC	Ministerio de Industria, Turismo y Comercio (Ministry of Industry, Tourism and Trade)
NRP	National Reform Plan
OTRI/OTT	Oficina de Transferencia de Resultados de Investigación/Oficina de Transferencia de Tecnología (Industrial Liaison Office/Technology Transfer Office)
PETRI	Programa de Estímulo de Transferencia de Resultados de la Investigación (Transfer of Research Results Support Programme)
PRO	Organismo Público de Investigación (Public Research Body)
PROFIT	Programa de Fomento de la Investigación Técnica (Technical Research Support Programme)
SISE	Sistema Integral de Seguimiento y Evaluación (Integrated Monitoring and Evaluation System)

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Abstract

The main objective of the ERAWATCH Policy Mix Country reports 2009 is to characterise and assess in a structured manner the evolution of the national policy mixes in the perspective of the Lisbon goals, with a particular focus on the national R&D investments targets and on the realisation and better governance of the European Research Area. The reports were produced for all EU Member State and six Associated States to support the mutual learning process and the monitoring of Member and Associated States' efforts by DG-RTD in the context of the Lisbon Strategy and the European Research Area. The country reports 2009 build and extend on the analysis provided by analytical country reports 2008 and on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

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