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# ERAC Peer Review of the Spanish Research and Innovation System

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*Independent Expert Group Report prepared for the Spanish Ministry of Economy and Competitiveness, for the Spanish Secretary of State for Research, Development and Innovation and for the European Research Area and Innovation Committee.*

## **Final report**

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## Key messages

The Panel of experts thanks the Minister and State Secretary for the privilege of being invited to review the Spanish research and innovation system. During our review we have received excellent cooperation from a wide range of senior stakeholders and valuable support from the secretariat and from the European Commission. This summary sets out our key findings and recommendations. These are elaborated in the full report.

We recognise the levels of excellence that exist in the Spanish system. However, if we take the system as a whole rather than the islands of excellence that are present, we found that its functioning has been inhibited by fragmentation in governance, both vertical and horizontal. The system has been subject to institutional rigidities preventing effective flow of people and knowledge. There is also a lack of an effective system of evaluation at policy, institutional or research quality levels and only a partial existence of a policy intelligence system.

The Law and Strategy both contain many positive factors and to a significant degree offer an agenda to go forward but key areas remain without convincing paths to implementation:

- In the domain of **science** we find what has been called a dualised system with high quality peak performance but a low average.
- In the domain of **business** the economic structure itself is challenging. There are very few large firms able to act as the anchors of an innovation ecosystem. Conversely there is a large number of micro-firms and significantly smaller number per capita of businesses with R&D or innovation capability than in comparable EU member states. These firms experience low levels of internationalisation and weak domestic markets for innovation;
- Among the **regions**, insufficient levels of coordination lead to a high risk of duplication at strategic level between national and community agents. There is a consequent lack of exploitation of economies of scale and scope. This situation creates difficulty in exercising policies for system improvement in areas with divided governance (notably for the university system).

In the light of this diagnosis our key recommendations are:

1. **It is clear that Spain's R&I system needs increased resources but these must go hand in hand with structural reform for a more efficient and effective use of public investment. This will ensure a faster and more sustainable recovery for the Spanish economy. The additional resources should be used exclusively to incentivise reform**

Research and innovation are core to Spain's success and need to be at the heart of economic policy. An increase in resources is needed but this should be based on a strategic framework which maps expenditure over a 10 year period with broad political agreement. Stability of finance is necessary for success in research and innovation. The forward strategy should be based on a **sustainable growth package** in which the R&I System develops and commits itself to the established roadmap for delivering results including the adoption of structural reforms. The implementation of this roadmap will be systematically rewarded with increased resources to raise the public sector contribution to GERD to a peak in three years of 0.7% of GDP as a means to initiate a growth path for business R&D spend to reach the target established in the Spanish Strategy for Science, Technology and Innovation (2013-2020).

2. **Human resources are the most pressing problem and rapid action is needed**

The demography of the research system is a major cause for concern as a result of the virtual freeze on recruitment through the mandate on 'rate of substitution'. It is critical to restore a career path for young talent to enter the system, beginning, as a short-term measure, with the specific group in receipt of Ramon y Cajal fellowships. New positions can in part be paid for by incentivising the retirement of higher paid researchers near the end of their careers. This could include use of 'Late-career fellowships' which offer a 20% part-time appointment and the right to use research facilities if they are active in approved projects. **At the same time the structure of research careers needs to change.** Throughout the system (institutes and universities) an alternative path is needed to move research careers away from the standard civil service model. This could include immediate use of the Access Contract (as set out in the Science, Technology and Innovation Act, 2011) as the basis for a tenure-track. Beyond this further scope for structural reform should be explored. There are several examples across Europe where researchers remain technically part of the civil service but operate in an environment conducive to flexibility, mobility and reward for excellence.

**A radical change in the management of scientific careers is also needed.** This should allow accelerated promotion to positions of research leadership and autonomy for the most talented and establish mobility as the norm, both between research institutions and between research and the private sector.

3. **Institutional reform is critical**

The panel was impressed with the high achievements of institutes operating under private contractual law but also concluded that this could in part be ascribed to a 'creaming-off' of talent from the system as researchers sought a working environment that matched leading international standards. Hence, while we support the continuation

of such institutes, the main focus should be on reform of the great majority of the system.

At the core of our suggestions is that for each public research organisation (OPI), university and for the laboratories and departments within them, much greater autonomy is needed. This autonomy needs in turn to be matched by a strategic approach and by greater managerial accountability (including regular independent evaluation and assessment). We note that the institutes nominally have autonomous status (or in the case of CSIC, that of an agency) but this is far from the common international understanding of the level of managerial freedom that research organisations should enjoy.

Spain should also undertake a programme of reorganisation of its public research organisations. There is scope to merge some OPIs with related CSIC institutes and for dispersal of some CSIC institutes to universities. Others could migrate to become foundations under private contractual law. These proposals have merit but there is no one-size-fits-all solution and in-depth analysis is needed to identify where the most beneficial changes are to be obtained.

**4. Research institutes and universities need to be subject to an assessment system that influences resource allocation both directly and indirectly. There is also a need to increase the proportion of competitive funding**

Most successful research systems are driven by higher degrees of evaluation and accountability than are found in Spain. A common feature is the presence of institutional assessment, normally associated with the allocation of at least a proportion of core funding. It is a major cultural change to introduce such systems and most have been implemented progressively through multiple cycles of increasing influence rather than in one step. We suggest that Spain proceeds in the first stage by allocating a fixed proportion (say 10%) of national funding on the basis of institutional assessment. The easiest way forward is to base the assessment on indicators (bibliometric, funding etc.) but attaching peer review with a strong international component would make the incentive stronger. Some weighting should be reserved for production of convincing research strategies. Criteria should include both excellence and impact on the economy, society and culture. We consider the introduction of assessment to be a 'viral reform' which could mobilise change beyond the relatively small resource allocated directly and also cascade to individual incentives. While university funding is the responsibility of Autonomous Communities we would expect that when confronted with performance ratings (and comparisons), regional governments will be incentivised to invest more in research and reform.

At the same time funding should focus on competitive grants to ensure that resources are focussed upon the most excellent research and researchers.

5. **A new level of coordination between actors is required for effective innovation. We propose national consortia, termed Strategic Innovation Arenas**

We had a strong impression that the norm was for actors in the research and innovation system to work in silos which keep separate the public research system and the business sector. There were exceptions, including the CENIT programme (described by most witnesses as successful) and its recent successor, the CIEN programme. The broader point is that there is a need for nation-wide public-private partnerships geared towards innovation and gathering the best resources from both private and public sectors, with the addition of government partners (for example regulators and procurers in the relevant sector). We also foresee that these initiatives should encompass cooperation between the national agencies and the Autonomous Communities. Spain is lacking critical mass and needs to maximise the benefits from concentrating its resources. **The step that is needed now is to establish business-led initiatives in key areas of focus and targeting global competitive environments.** We refer to these initiatives as Strategic Innovation Arenas. Only a limited number of such initiatives are feasible and hence there is a need for government to work with the community to establish strategic priorities reflecting market opportunity, existing strength and future potential. Public institutions should regard participation as a core part of their mission.

6. **Bringing more business actors into the innovation system is critical**

The absence of a sufficient number of small and especially medium-sized players is a major weakness of the innovation system. This comes from problems of capability which also block absorptive capacity for externally generated knowledge. Without employees possessing at least basic knowledge of R&D it is very unlikely that such companies can make effective use of R&D and innovation support schemes either at national or European level. There are examples of fiscal incentives to engage R&D staff but our preference is to build on pro-active initiatives to engage these companies. This would reflect the successful experience of several countries in putting supervised early career researchers and research managers into a company to work on a specific innovation for product development or process improvement. A long-standing success is the UK's Knowledge Transfer Partnerships scheme. The researcher should be supervised by a senior scientist in an institute or university, both to give assurance to the company and to build future links. The scheme can be applied to both masters and doctoral level graduates and has the important added benefit of creating employment paths. The expectation is that the company will retain the employees after the subsidised period (say 18 months). Existing Spanish initiatives such as such as Torres Quevedo and EMPLEA form a basis but there is a need to accelerate the process. The most challenging aspect of this proposal is one of scale. Spain will not progress unless several thousand companies enter the innovation ecosystem. This scheme alone cannot achieve this but measures need to match the problem. The cost of this scheme and of support for the Strategic Innovation Areas can be met by reduction of the fiscal incentives for R&D. Our judgement was that focussed direct measures are more effective.

## **7. A market and a culture for innovation**

The low engagement of business with research and innovation can partly be ascribed to the lack of innovation-friendly framework conditions and to a culture which does not value innovation sufficiently. This hampers the competitiveness and subsequent internationalisation of Spanish firms. The success cases we saw were good examples of the benefits of competing in international markets where a premium for innovation and the forces of competition were operating. This suggests that explicit assistance and incentives for international cooperation and for technological exports are needed. Strengthening of instruments in this area is a priority.

In parallel, it is urgent to foster domestic markets for innovative products and services. Framework conditions for business innovation include competition law, education and training, availability of finance, infrastructure and services and conditions for entrepreneurship. All need work but the area of most immediate potential is on the demand side and the creation of a market friendly to innovation. These seem to be well embedded in the strategy and in public documents. The two key challenges are to accelerate the implementation of this agenda and to ensure that the goal is shared by the ministries with procurement budgets and their equivalents in the Autonomous Communities. Fostering innovation should be a part of the formal mission statement of all ministries. The revised European procurement directives provide further opportunities in the direction of incentivising innovation.

## **8. The need for an autonomous agency to implement the reform programme**

There is an urgent need to implement the national Research Agency as foreseen in the Law and Strategy. Things will not change simply by the designation or re-labelling of existing administrative units as an agency but with the right powers and modes of operation this creates a real opportunity to address many of the deficiencies already identified including:

- a. Provision of stability in terms of funding and procedures. It is important to move quickly to a situation where research and business communities are able to plan ahead in terms of knowing which level of resources and policy instruments will be available.
- b. We have noted a plethora of policy instruments, some of which appear to exist only on paper and others which operate with sub-critical budget levels. We recommend strongly that the Agency should have a minimum of instruments but that these should be broad and include a degree of flexibility to allow their evolution in the light of experiment and experience.
- c. We foresee two main functions for the Agency. The first is promotion of excellence through grants and fellowships. Funding should only be provided on a competitive basis assured by substantially greater use of independent peer review which includes making use of international experts. The second function is Knowledge Exchange to promote contribution of the research system to the economy and to societal challenges. We deliberately use the term exchange to emphasise that instruments under this programme should not be based on linear model assumptions but rather be based on engaging research, business and other



stakeholders in co-creation around strategic agendas (see Recommendation 5). To be clear, this does not mean compromising on excellence but will involve more proactive measures to facilitate impact.

Substantial coordination between the CDTI and the Research Agency will be needed, including joint programmes (see for example Finland's SHOK programme).

The Ministry itself should retain the core functions of allocation of resources across the agencies, setting national strategic priorities and operating accountability for performance, including again monitoring and evaluation. Some hard choices may be needed here including a review of international commitments (which have greatly increased their share of the budget) and accepting that funding may concentrate in the best performing institutions. However, two bigger challenges are to work to engage the whole of government such that research and innovation are seen as part of the mainstream economic agenda, and to be drivers of reform, preparing the necessary legislation for this agenda.

#### **9. Incentivising regional synergies in support of business and business creation**

There is a wide variety of innovation support actors including technological centres, science and technology parks, incubators and accelerators. These need to be integrated into more strategic approaches so that they can achieve sufficient entrepreneurial energy, scale and scope to act as world-class competitive innovation clusters. Such an approach needs to be driven by more rigorous interpretation and application of smart specialisation strategies operated in a complementary manner between national agencies and agents of the autonomous communities.

The policy mix for R&I in firms needs to be fine-tuned in several ways but most important is to significantly reduce the hurdles and time needed for companies to gain innovation support. A national scheme for innovation vouchers to supplement regional versions would be a useful addition to the mix.

#### **10. Effective monitoring and evaluation to support evidence-based policy**

We recommend the introduction of a strong evaluation culture shaping R&I policy and decisions. The panel has been impressed by the quality of information provided to us by the Secretariat and by FECYT. However, we have noted significant gaps, notably at regional level and a certain fragmentation of evidence. No initiative should be launched without a clear statement of rationale and measurable objectives (normally informed by *ex ante* evaluation and or foresight) and all should be regularly monitored for performance and delivery and periodically evaluated with a view to testing the rationale, the quality of implementation and the impact. Such evaluations should be independent of those managing the programmes, regularly involve international experts and be published and publicly debated. Engagement with and capability-building in the Spanish community of R&I policy analysts is also desirable. This effectively completes the policy cycle and allows a learning system.

## ERAC Peer Review of Spain: Panel Members

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*Panel members acted in their personal capacities and their views do not necessarily represent those of their organisations.*

## Introduction

In November 2013, the Spanish authorities forwarded a request for a peer review of their research and innovation system to the European authorities. The European Research and Innovation Area Committee (ERAC) approved this request and took the decision to establish a group composed of ERAC peers from Germany, France, Belgium, Estonia and Sweden and four independent experts. The Commission (DG Research and Innovation) assisted the Peer Panel and the Spanish Ministry of Economy and Competitiveness, provided documentation and organised a series of meetings with key stakeholders of the system. The Peer Panel conducted its work during the first semester of 2014, including two sessions in Madrid in April and June.

The Peer Panel bases its analysis and recommendations on three main sources of evidence:

- Hearings conducted in Madrid (9-11 April and 9-10 June 2014) during which close to 100 actors in the Spanish system gave evidence and provided opinions to the Panel (list of interviewees in annex);
- Analysis of a range of documents on various components of the Spanish research and innovation system; and
- Experiences and knowledge of the peers of policies in other countries and more general analyses and statistics related to science, technology and innovation systems and policies.

The aim of the Peer Review is to provide independent advice and concrete recommendations to the Spanish authorities in view of the implementation of their recently approved Spanish Strategy for Science and Technology and Innovation 2013-2020, as well as to consider the need for more systemic reforms. The recommendations are based on: an analysis of the specific challenges of the Spanish Research and Innovation (R&I) system, a critical review of the various policies and mechanisms at play, and experiences and lessons learned from other Member States, in particular in the countries of the Peer Reviewers<sup>1</sup>. Since the main audience of this report is the Spanish authorities as well as stakeholders of the research and innovation system, there is no detailed description of that system in the report, which instead focuses on assessment and recommendations.

The Spanish authorities have underlined the following policy challenges in their request to ERAC:

- identification of ways and means to optimise R&I policy tools and make the policy mix more effective;
- improvement of the governance and funding systems for R&I, simplification and streamlining of funding rules and processes;
- reinforcement of knowledge transfer and circulation, in particular between public research institutions and firms;
- reorientation of R&I efforts and policies to better tackle societal challenges and develop new markets around these challenges;
- improvement of framework conditions and effectiveness of policies aiming at stimulating private R&I; and

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<sup>1</sup> The Panel members are willing to provide more explicit (technical) details (on demand) about the various programmes from their own countries that are mentioned in the report.

- reinforcement of mechanisms to measure the impacts of R&I; and the maximisation of synergies between regional smart specialisation strategies and the national strategy.

Accordingly, the Peer Review panel started its analysis around three broad – and interlinked – questions:

- 1) How to ensure greater effectiveness of the public research and innovation system?
- 2) How to boost research and innovation in the private sector? and
- 3) How to improve synergies between the national and the regional research and innovation systems?

These questions are addressed in Chapters 2, 3 and 4 of this report. Chapter 1 provides key observations on the general economic and policy context for research and innovation in Spain. Chapter 5 focuses on the creation of Spanish Strategic Innovation Arenas and on the establishment of a monitoring and evaluation system, two recommendations that cut across the three above themes.

**1. Context**

**1.1. Economic context and research and innovation system**

Historically the Spanish economy was characterised by a growth path from the middle of the 19th Century to the mid-1970s. The increasing openness of the country to international trade, fostered by accession to the European Community in 1986, helped the country to evolve from a mainly agrarian economy and catch up with other Western economies towards the last part of the 20th Century. When the European Cohesion Fund was established in 1992 to address regional disparities in the Union, Spain became, together with Greece, Portugal and Ireland a main beneficiary of this policy which helped upgrade the country’s infrastructure. During the period 2000-2006, Spain was engaged in a strong catching up process with an increase in overall R&D investments well above 10%, placing the country in 4<sup>th</sup> position for growth in R&D investments in the EU-27, after Austria, the Czech Republic and Estonia (while the trend for EU-27 was negative during that period) (Veltri et al. 2009). The growth in business investments as a percentage of GDP was also notable: from 0.38% in 1995 to 0.61% in 2005 (ERAWATCH 2007).

Spain is one of the EU Member States that has been hardest hit by the financial and economic crisis started in 2008. In 2014, the competitiveness of the Spanish economy still remains at risk. The last available data point to the economy remaining in recession in 2013 (with real GDP falling by 1.5%) and unemployment rate reaching a peak of 27 % (European Commission 2013). The unemployment rate in Spain is the second highest<sup>2</sup> in the OECD area (26.9% in May 2013), well above the OECD average (8%). This unemployment rate combines with a recent trend showing that economic emigration of Spanish graduates has increased in the last two years. In 2010, the unemployment rate of human resources in science and technology in Spain was the second highest among the EU Member States, after Greece (European Commission 2014). Notwithstanding the more optimistic OECD and EU projections on GDP and unemployment for 2014 and 2015 (Figure 1 and Table 1), creating new and strong impulses towards job-rich growth paths is a vital need for Spanish society.

**Figure 1. GDP Growth and Unemployment rate evolution over 2008-2015 - Spain and OECD**



Source : OECD Economic survey, 2014. Note: Spain in red, OECD average in blue

<sup>2</sup> Greece has the highest unemployment rate amongst OECD countries, 27%.

**Table 1. GDP Growth and Unemployment rate data and forecasts over 2012-2015 - Spain**

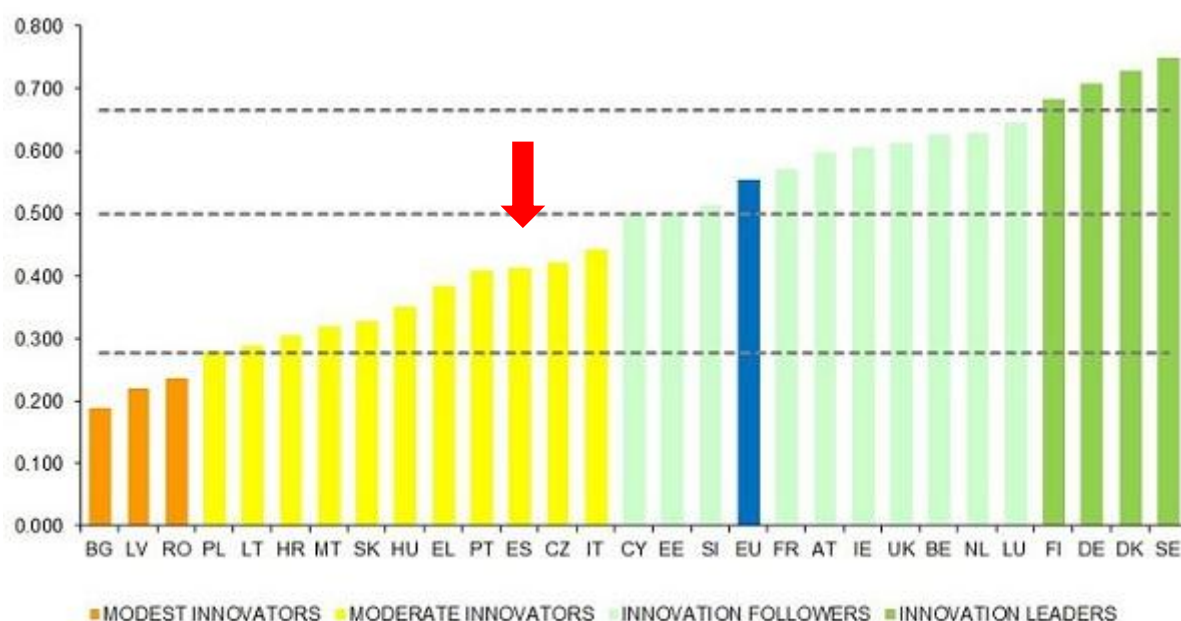
	2012	2013	2014	2015
<b>GDP growth (% , yoy)</b>	-1,6	-1,2	1,1	2,1
<b>Inflation (% , yoy)</b>	2,4	1,5	0,1	0,8
<b>Unemployment (%)</b>	25,0	26,4	25,5	24,0
<b>Public budget balance (% of GDP)</b>	-10,6	-7,1	-5,6	-6,1
<b>Gross public debt (% of GDP)</b>	86,0	93,9	100,2	103,8
<b>Current account balance (% of GDP)</b>	-1,2	0,8	1,4	1,5

Source: European Economic Forecasts, Directorate-General for Economic and Financial Affairs, 5 May 2014

Boosting research, technological development and innovation (R&I) is a key element to overcome the crisis in a sustainable way. By building on the knowledge base, improving productivity and developing new products and services, production in existing sectors and companies can be made more sustainable, growth potential in new sectors and the creation of new companies can be enhanced, and the country can become more attractive for talent and for investment, both of domestic and foreign origin.

Despite the strong catching up process experienced by the country in the last decades, Spain is lagging behind on the R&I front: the country is only a “moderate innovator” in the wording of the Innovation Union Scoreboard (IUS). That category is the third one among four in the IUS, and it includes three Southern Member States, Spain, Portugal and Greece (Figure 2). A number of new Member States, which have a much shorter tradition in knowledge-based activities, have succeeded in catching up and overtaking Spain.

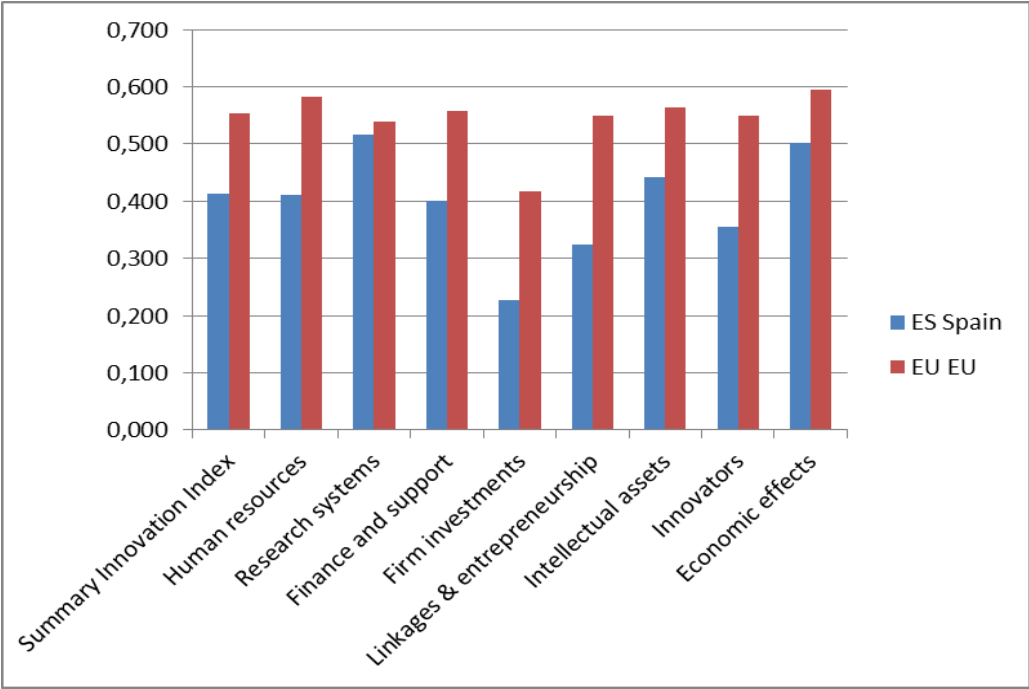
**Figure 2. Spain’s aggregated innovation performance- Innovation Union Scoreboard Index**



Source: European Commission (2014a)

This underperformance of Spain is present in all components of the Innovation Index (Figure 3), but the gap is particularly large for all business-related indicators: firms’ investments in R&I<sup>3</sup>, entrepreneurship and linkages<sup>4</sup> and innovators<sup>5</sup>. In contrast, the performance of the public research system<sup>6</sup> is closer to the EU average. In Spain, total R&D expenditures originate approximately equally from the private and public sectors, a fact that underscores the weakness of private R&D investments. This poor performance of Spain on the business side of R&I is visible in the ranking of Spain on the EU Innovation output indicator<sup>7</sup>, an index that focuses on the use of R&I for growth and economic development (Figure 4).

**Figure 3. Spain’s disaggregated innovation performance in Innovation Union Scoreboard Index**



Source: European Commission (2014a)

<sup>3</sup> This category compares the value of country indicators with a EU28 average of 100: 1) Business R&D expenditures (52); and 2) non-R&D expenditures (69).

<sup>4</sup> Cfr. above footnote: 1) SMEs innovating in house (69); and 2) Innovative SMEs collaborating with others (50); and 3) public-private co-publication (74).

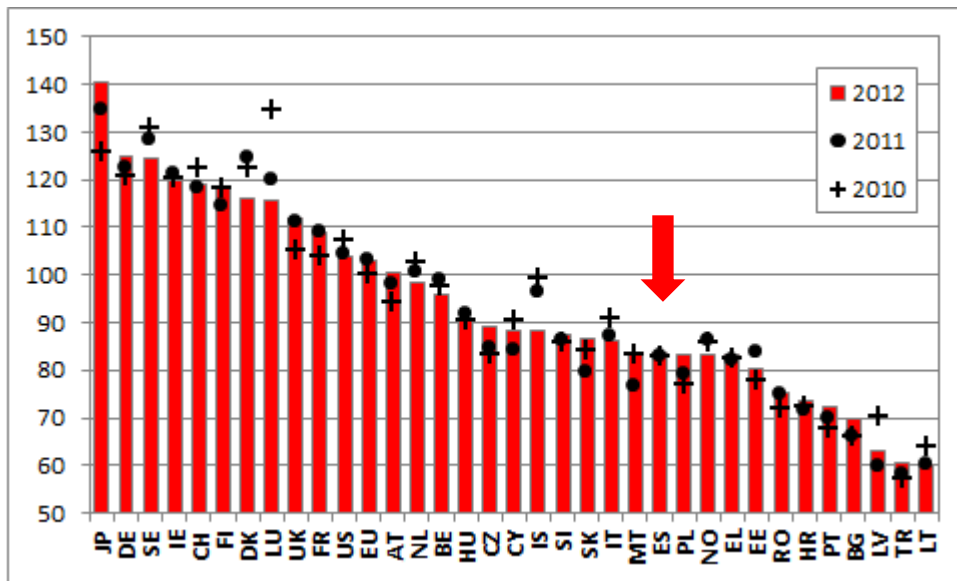
<sup>5</sup> Cfr. above footnote: 1) SMEs introducing product or process innovations (73); SMEs introducing marketing or organizational innovation (69); fast-growing firms in innovative industries (96).

<sup>6</sup> Cfr. above footnote: 1) international scientific co-publications (184); 2) scientific co-publications amongst the 10% most cited (95); and 3) number of non-EU doctorate students (74).

<sup>7</sup> This indicator is based on four components : 1) Technological innovation as measured by patents; 2) Employment in knowledge-intensive activities as a percentage of total employment; 3) Competitiveness of knowledge-intensive goods and services; 4) Employment in fast-growing firms of innovative sectors.



**Figure 4: Innovation output indicator scores: ranking of EU Member States**



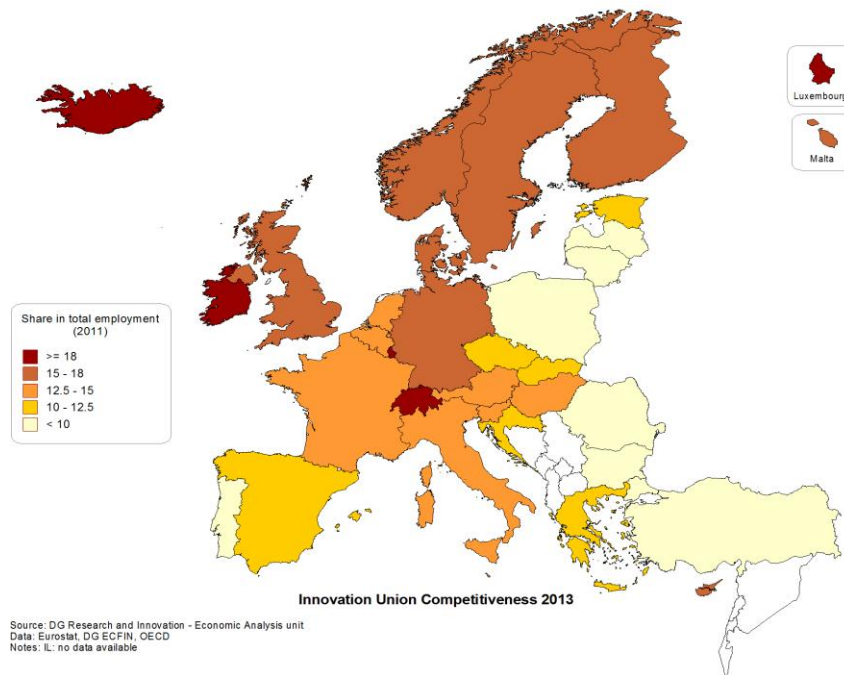
Source: European Commission (2013e). EU average set to 100 in 2010.

This main weakness of the Spanish economy may be linked to its low specialisation in knowledge-intensive industries and services (Figure 5). Spain displays at the same time a very high share of population having achieved third level education (40% against 34.7% for the EU) and a share of young population having only attained lower secondary education level and not in further education which is double of the EU average (25% against 12.5%). The latter population can be absorbed in part by the low-tech sectors but with a catching up process in place towards more knowledge-intensive activities, the skills mismatch will become a heavy burden. The share of workers with tertiary education affiliated as graduates has increased from 48% in 2007 to 60% in 2012 while 17% work as manual workers (28% in 2007).

The crisis has had a dramatic impact on R&D investments in Spain. Before the crisis, during the period 2002 - 2008, Gross Expenditure on R&D (GERD) had doubled in absolute terms and the increase in relative terms was remarkable too: GERD as a percentage of GDP (i.e. R&D intensity) reached an intensity of 1.39% in 2009. Since 2009, overall R&D intensity decreased, moving back to 1.3% in 2012. This places the country far from the Europe 2020 objective of R&D expenditures reaching 3% of GDP, an objective that Spain had initially endorsed but recently adapted to a more realistic target of 2% by 2020. This cutback concerns both public and private R&D. Public budgets for R&D from the State have been strongly reduced: from €9,662m in 2009 to €5,925m in 2013 (representing 2.5% to 1.72% of total central budget respectively). The evolution of private investments in R&D is worrying too: it shifted from a positive average annual growth rate of 13.7% over the period 2000-2007 to a negative rate of -2.9% over the 2008-2011 period.

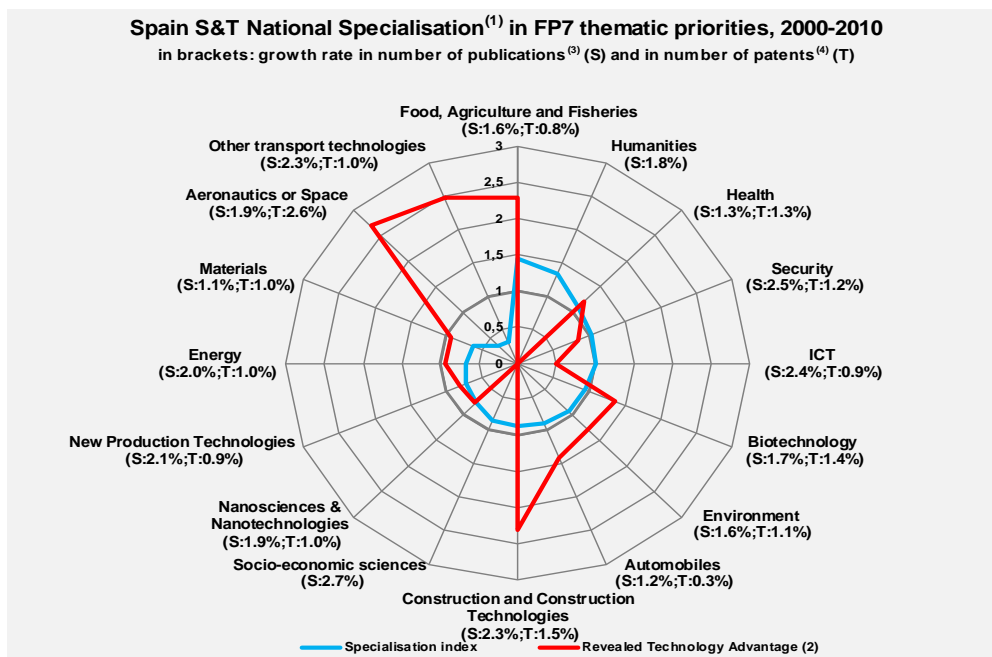
Apart from the food and agri-food scientific and technological fields (and to a lesser extent health), Spain is also characterised by a mismatch between the areas of scientific and technological specialisation (Figure 6).

Figure 5. Employment in knowledge-intensive industry, share of total employment 2011



Source: European Commission (2014b)

Figure 6. Spain Scientific and Technological specialisation



Source: DG Research and Innovation - Analysis and monitoring of national research policies

Data: Science Metrix - Canada, Univ. Bocconi - Italy

Notes: (1) Values over 1 show specialisation, under 1 lack of specialisation.

(2) The Revealed Technology Advantage is calculated based on the data corresponding to the number of patent applications by country of inventors. For the thematic priorities with less than 5 patent applications over 2000-2010, the Revealed Technological Advantage (RTA) is not taken into account. Patent applications in "Aeronautics or Space" refers only to "Aeronautics" data.

(3) The growth rate index of the publications (S) refers to the periods 2000-2004 and 2005-2009.

(4) The growth rate in number of patents (T) refers to the periods 2000-2002 and 2003-2006.

Source: European Commission (2014b)

Due to the size of the country and the institutional context where there is a large degree of autonomy for regions, the regional dimension is important for Spain. There is an important difference in economic development, and in R&I capacity and absorptive capacity between Extremadura (recognised as a “less developed region” in the framework of European Cohesion policy), Andalucía, Canarias, Castilla-La Mancha, Melilla and Murcia (labelled as “transition” regions), and the other regions which are more developed. The picture is highly fragmented with public R&I investments by Spanish Autonomous Communities being carried out largely independently of each other. The regional disparity is also visible in R&I potential and capabilities, with four regions displaying a higher R&I intensity (Madrid, Catalonia, País Vasco and Navarra) than the rest of the country.

This short snapshot provides a starting point for the Peer Review exercise, by highlighting the main overall challenge of the Spanish research and innovation system: the co-existence of, and lack of synergies between a public research system with large margins for improvement and a weak private research and innovation system, within a fragmented national R&I landscape.

## **1.2. Policy context for R&I**

The Spanish authorities have reacted to the crisis situation by implementing a programme of structural reforms with the view of alleviating barriers and finding new sources for growth and jobs. Along with fiscal consolidation, restructuring of the banking sector, and modernisation of public administration, structural reforms are being implemented in the labour market and new strategies have been adopted to promote R&D, innovation, the digital economy and entrepreneurship.

Government Budgetary Appropriations and Outlays for R&D (GBAORD) were rising from 2001 to 2009, but then started to decline in the midst of the crisis, reinforcing the downward trend rather than acting as a counter-cyclical engine: GBAORD as a share of total general government expenditure shifted from 1.94% in 2007 to 1.52% in 2011 (European Commission 2013)<sup>8</sup>. The allocation of competitive funding from the State has, since 2008, registered a reduction as consequence of the relatively fixed nature of other budget items (Figure 7).

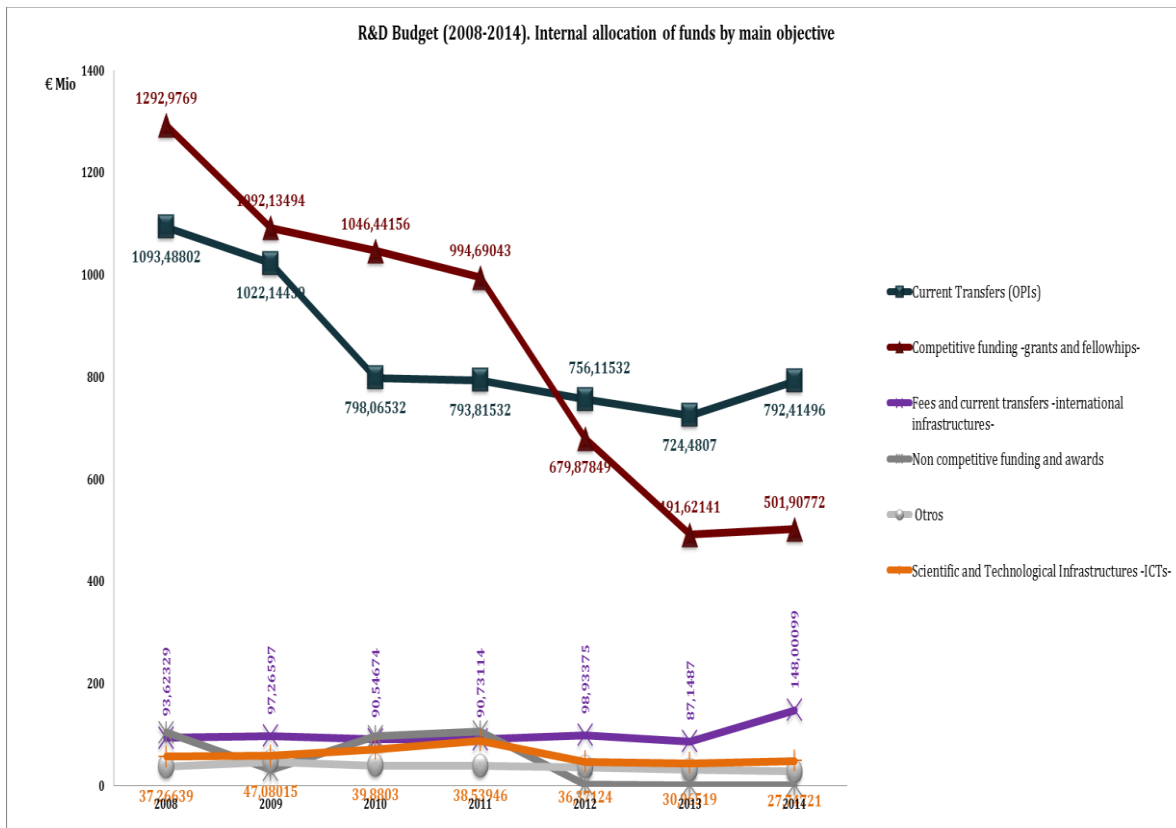
Despite this drop, the Spanish authorities have officially acknowledged that R&I is crucial for economic recovery of the country:

*“the social welfare of the country and its future development and economic growth are linked to education, to the capacity for generating know-how in the areas of science, technology and innovation and to the need for business leadership in RDI. These will act as levers of change and progress in a context of accelerated transformation and strong international competition.”* (Spanish Strategy for Science, Technology and Innovation).

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<sup>8</sup> 2007 data include refundable loans that have been excluded from GBAORD statistics since 2008 accordingly to Frascati Manual.

**Figure 7. State R&D Budget (2008-2014). Internal allocation of funds by main category**



Source: Ministry of Finance and Public Administration.

In 2013, after a wide consultation of stakeholders, the Spanish government in agreement with the Autonomous Communities, approved a new Spanish Strategy for Science, Technology and Innovation for the period 2013-2020 (henceforth, the Strategy). The Strategy in a nutshell pursues four main goals:

1. Promoting talent generation and employability of human resources in RDI, including mobility within the public sector and between this and the private sector;
2. Raising excellence in research;
3. Boosting business leadership in RDI;
4. Responding to societal challenges.

A national Plan for Scientific and Technical Research and Innovation (PECTI) (2013-2016) has been established to implement the Strategy (Ministry of Economía y Competitividad 2013). The main changes brought by the current, compared to the previous strategies are:

- the integration of science, technology and innovation into a single strategy (compared to two separate strategies as before);
- a wider consultation process and an active involvement of regional policy-makers;
- an increased focus on coordination of the action of public administrations;
- and a stronger accent on societal challenges.

Apart from this, the key orientations of the Strategy remain in substance similar to those of the previous distinct Strategies<sup>9</sup>.

In addition, Spain has adopted a Law to support entrepreneurs and their internationalization, which includes specific references to RDTI activities. The 2013 law is supposed to inter alia provide for the creation of a regime of limited liability for entrepreneurs, the establishment of out-of-court settlement mechanisms to allow formerly bankrupt entrepreneurs a fresh start, and fiscal, financial and other measures to support company growth. To promote business growth it extends the list of activities not subject to municipal licenses and reduces obstacles for entrepreneurs to gain access to public contracts.

The evolution of Industrial policy in Spain, moving from a thematic approach around priority sectors to a current more generic approach also needs to be mentioned here. New programmes to foster alternative funding for businesses, to compensate for weak contribution of the banking sector, have also been launched.

Autonomous Communities in Spain have political and administrative responsibilities for research and innovation, and are responsible for university funding. This role is important for the health of the Spanish research and innovation system, as the share of Autonomous Communities in total Government Budget Appropriations for R&D (GBAORD) in Spain is significant. Unfortunately micro data from GBAORD statistics are not publicly available but information received by the Panel indicates that regional budgets represent 60% of total GBAORD (2012). About 50% of regional R&D budgets are allocated to General University Funds: they include estimates related to personnel costs and other university funds, but do not include R&D competitive funding. In addition, R&D budget is complemented by European Funds (Structural Funds and Framework Programme Research Funds). R&D funding by Structural Funds allocated to R&D represents 12% of total public expenditures accumulated during the period 2007-2012. Total FP7 subsidies allocated to Spanish researchers represent about 3.212 Mio €. As result, European funding in this period represents 19,6% of total public funding (2007-2012). The contribution of these various sources of funding is highly skewed: European Structural Funds targeting R&D are heavily concentrated in less developed regions (almost 60% of this source for 2007-2013 went to just two regions, Andalucía (39%) and Galicia (19%)).

Within the frame of the preparation of their programmes for EU Cohesion policy, Spanish Autonomous Communities are developing bottom-up smart specialisation strategies: their aim is to focus R&I investments on areas of strengths in order to reinforce their contribution to regional growth, respecting the important differences across regions which are characteristic of Spain. The co-existence of 17 regional strategies and one national strategy means that efforts are

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<sup>9</sup> The National Strategy on Science and Technology approved in 2007 included the following objectives: (1) to position Spain at the forefront of knowledge; (2) to promote a highly competitive business network; (3) to achieve the integration of regional areas in the Science and Technology System; (4) to promote the international dimension of the Science and Technology System; (5) to construct a favourable environment for investment in RDI and (6) to provide good conditions for the diffusion of science, technology and innovation. The objectives of the 2010 National Strategy on Innovation were: (1) the creation of a favourable environment for innovation; (2) the promotion of innovation from public demand; (3) international projection; (4) the strengthening of territorial cooperation, and (5) human capital, placing the transfer of knowledge in the centre of these lines.

needed to realise horizontal synergies between regional policies, on the one hand, and of vertical synergies between the national strategy and instruments and the regional policies and policy mixes, on the other hand. This question of nation-wide synergies is vital in a context where regional sources of funding (including General University Funds) represent a large share of total public funding for R&D along with national funding. The impact of the National Strategy (the focus of this Review) will hence depend not only on its own effectiveness but also on positive interactions with the policies implemented by and for the Spanish Autonomous Communities.

### **1.3. Conclusion**

Reflecting on the key challenges for the Spanish R&I system, as summarised in Section 1.1, and on recent policy orientations spelled out in Section 1.2, the ERAC Peer Review Panel is of the opinion that finding new sources for sustainable growth and employment in the Spanish economy requires deep changes on three fronts:

1. A reform of the public research system so that it can increase its productivity, quality level and relevance to the needs of the Spanish economy and society (Chapter 2);
2. The upgrade and expansion of innovation capacities in the private sector in view of changing the economic specialisation towards more value-added, more knowledge-intensive activities (Chapter 3);
3. A better exploitation of the R&I potential present all around the country through the creation of national-regional synergies in resources and policies (Chapter 4).

The Panel thinks that the required integration between research and innovation foreseen in the Spanish Strategy, and efforts to increase science-industry collaboration will fail if barriers and flaws within the public research domain and within the productive sector are not removed. The promotion of linkages between both areas will lack of effectiveness if present bottlenecks and limitations persist. This report provides arguments and recommendations to ensure that these bottlenecks are addressed in the implementation phase of the Strategy.

In particular, the Panel sees the need for more attention to the creation of favourable environments for the co-creation of innovation (which differs from knowledge transfer), involving public and private actors, as well as a range of business support tools and agencies acting in synergy rather than in a sequential mode. This attention led the Panel to examine the possibility of establishing Spanish Strategic Innovation Arenas. Furthermore, a need was identified to provide policy-makers at all levels with better information tools in order to support overall governance: improving monitoring and evaluation of public action geared towards R&I is a key requirement to ensure effectiveness of the various individual elements and of the Strategy as a whole.

Establishing Strategic Innovation Arenas and a robust Monitoring and Evaluation System for the policy, are two recommendations of a cross-cutting nature, i.e. with the potential to address the three above issues. They are addressed in Chapter 5.

## 2. Public system of Research and Innovation

### 2.1. The challenges

#### ***Extensive scientific activity, but of unequal quality and with fragmented science***

The public research sector in Spain consists of two pillars<sup>10</sup>:

1. Higher Education Institutions (HEI), placed under the responsibility of Autonomous Communities: in 2012 HEIs employed 157,297 R&D-related personnel and executed €3,716m total R&D expenditures;
2. Public Research Bodies (OPIs): in 2012 PROs executed €2,557m total R&D expenditures with a total staff of 56,338 R&D personnel. Among these, large Public Research Institutes are under the responsibility of the State while the rest are regional and local institutions and hospitals under the responsibility of Regions. There are 8 big National OPIs (Public Research Bodies), the largest one is the Spanish National Research Council (CSIC) with 71.7% of the OPIs personnel and 53.4% total budgets for OPIs.

The landscape of public research in Spain is dual as it includes some very research-intensive and internationally-oriented universities and PROs, as well as institutions that are poor research performers.

Spain has a large supply of qualified researchers and a high number of scientific publications: bibliometric indicators show that Spain was one of the European countries with the strongest growth in scientific production in the last decade. The internationalisation of the system has also been progressing well: the number of international scientific co-publications in Spain has grown by 8.8% between 2002 and 2012, while the scientific quality, as measured by the 10% most cited publications, has grown by 5% over the same period (European Commission 2014c). In the last Innovation Union Scoreboard, the index of scientific co-publications for Spain stands at a very high level of 184, compared to an EU-28 average of 100. Spanish researchers have been increasingly successful in attracting funding from the EU Framework programme.

However, despite improvements reported above, measures of average scientific quality are less positive. The index for scientific quality in the last Innovation Union Scoreboard is below EU average (95). The European Commission has calculated an index of research excellence, which covers HEI and public research performance (based on rankings of top universities and research institutions), ERC grants and PCT patents. The index for Spain is 76% of the EU average (Figure 8) and the average annual growth trend for this index is well below that of the EU (0.38% compared to 2.94% for 2007-2012).

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<sup>10</sup> Data in this paragraph extracted from (ERAWATCH 2013).

**Figure 8. Composite indicator of research excellence**

	Composite indicator of research excellence 2010
EU27 average	47,9
EU27 70% threshold	33,5
<b>Member States below 70% of the EU27 value</b>	
Latvia	11,5
Croatia	12,2
Lithuania	13,9
Malta	17,5
Slovakia	17,7
Romania	17,8
Luxembourg	19,8
Poland	20,5
Bulgaria	24,7
Estonia	25,9
Portugal	26,5
Slovenia	27,5
Cyprus	27,8
Czech Republic	29,9
Hungary	31,9
<b>Member States above 70% of the EU27 value</b>	
Greece	35,3
Spain	36,6
Ireland	38,1
Italy	43,1
France	48,2
Austria	50,5
United Kingdom	56,1
Belgium	59,9
Germany	62,8
Finland	62,9
Sweden	77,2
Denmark	77,7
Netherlands	78,9

Source: DG Research and Innovation - Economic Analysis Unit  
Data: Eurostat, DG JRC - ISPRA

Source: European Commission (2014b)

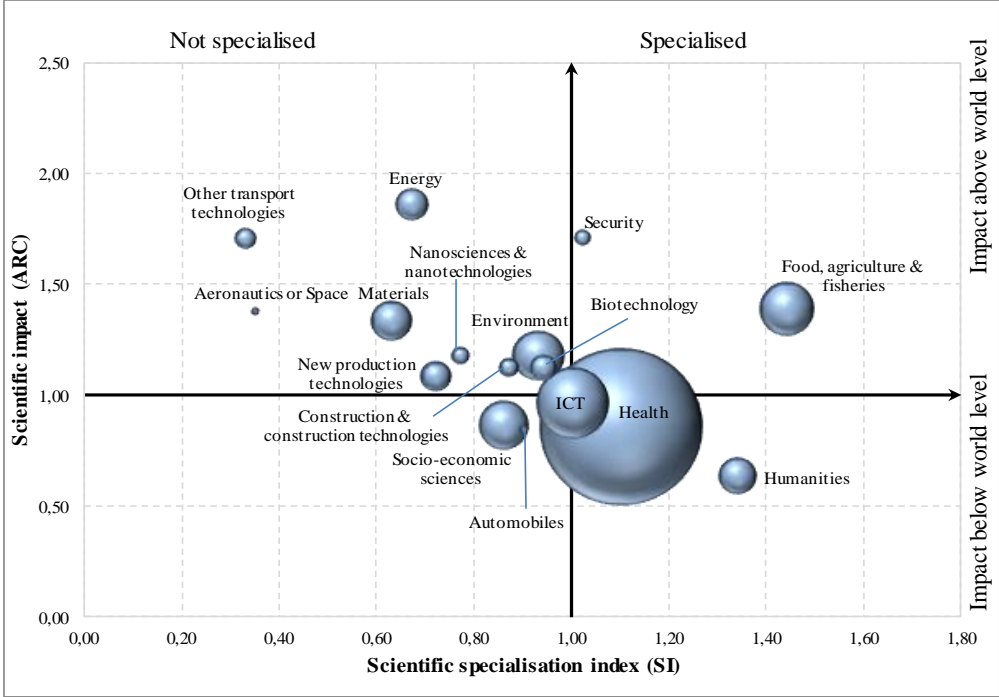
Spanish scientific research also appears as fragmented. Food, agriculture and fisheries are the only domains where Spanish publications show both a degree of specialisation and a reasonable impact (Figure 9). This result should be put in perspective with (even if not necessarily correlated with) the weak linkages between universities and Public Research Organisations (PROs), on the



one hand, and the large number of universities with little incentive to create critical masses at the level of laboratories and cross-country and cross-regional linkages on the other. The graph suggests, e.g., that more specialisation could be achieved by means of inter-regional cooperation in the areas of energy and security, where Spanish research already has a high impact. It also points towards the need for incentives to raise quality in humanities research, in which Spain is specialised but for which impact is low.

**Figure 9. Spain Scientific specialisation and impact**

**Positional analysis of Spain publications in Scopus (specialisation versus impact), 2000-2010**



Source: DG Research and Innovation - Economic Analysis Unit  
 Data: Science Metrix - Canada, based on Scopus  
 Notes: Scientific specialisation include 2000-2010 data; the impact is calculated for publications of 2000-2006, citation window 2007-2009

***Lack of flexibility and inadequate incentives in the public research system***

PROs and Universities are part of the public sector and its employees are subject to general civil servant rules: this causes inflexibility in management and human resources policy. For example, the linguistic requirements for hiring civil servants are not adapted to the international mobility required by the research sector. Drastic budget cuts which have resulted in freezes in hiring new personnel have added to the inflexibility of the system.

The system gives little empowerment or autonomy to research leaders at unit or institutional level, thus hampering its move into new directions and the creation of research units with a critical mass, good productivity and an entrepreneurial spirit. Research directors lack empowerment in terms of strategic planning of human resources. Budgetary cuts leave few resources available to research units once salaries are paid.

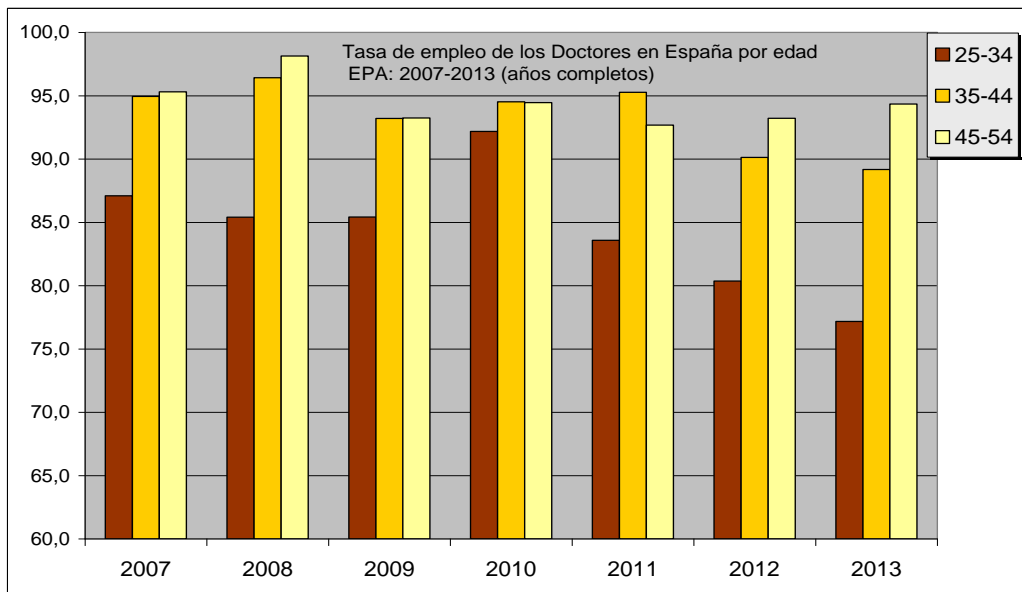
The problems with incentives in the public research system can be summarised under two headings:

1. Weak incentives for research performance: funding to universities (under the responsibility of Autonomous Communities), uses criteria that relate mainly to number of students and teachers but do not capture education and research performance. OPIs are funded by the State through negotiated procedures which take into account mainly size (fixed costs and investments), rather than performance criteria. Within CSIC itself, there is an incentive of very limited scope, which promotes the capacity to attract external funding: the central CSIC management rewards those institutes that have a better ratio of competitive funding over operational costs by allowing those institutes to contribute less than its indirect costs to the total operational costs. Given the fact that these amounts only relate to operational costs and not to personnel costs (which represent the bulk of the Institutes' budget) this kind of incentive is not likely to have a sizeable impact on CSIC's institutes' strategies. There is a general lack of sanctions for non-performers in the public research system;
2. Weak incentives and organizational barriers for third mission activities in general, and for collaboration with industry and commercialisation of research in particular. Public servant culture is not favouring such activities, public-private cooperation is not part of institutional funding criteria nor integrated in individual promotion schemes. There is a lack of institutional support and collective recognition in terms of promotion, reputation and so forth that inhibits the creation of open environments for research and innovation. Hence university and PRO management as well as individual researchers and professors lack incentives to enter into such cooperation.

### ***Human resource constraints in the public research system***

The budgetary situation has resulted in the drastic reduction of the prospects of securing a position for a generation of early career researchers, which adds to the problem of the ageing profile at universities and research organisations. Falling PhD employment rates, particularly for the youngest (25-34 years old), illustrates the erosion of the Spanish research and innovation system from 2010 (Figure 10). The average age of permanent researchers in Spain is significantly higher than in the rest of the EU (e.g. 53 years in CSIC, compared to 45 in CNRS in France). This imbalance can have significant impacts on scientific production and the budget structure of the Spanish public research system, and nurtures a potential loss of young researchers leaving Spain. Research skills decay rapidly for those who are leaving the research profession altogether: if the situation is not corrected, Spain will lose the essential fuel for its knowledge economy engine.

**Figure 10. Employment rate of PhDs in Spain by age category 2007-2013**



Source: Spanish Ministry of Economy and Competitiveness

In addition, Spain as a whole has one of the highest rate of endogamy in its university system (measured by the share of staff having obtained their PhD in the same university), although this problem differs across universities and PROs, some of them having been very successful in attracting researchers from other Spanish institutions and from other countries. The problem seems also much more acute for older researchers than for younger ones thanks to new criteria introduced in selection mechanisms for post-doctoral positions.

The insufficient incentives system in the public research sector has consequences for the weak mobility of researchers, which is another element of its lack of flexibility. Both mobility within the system (e.g. between universities and PROs and between different universities) and between public research and the economic sector are weak in Spain.

### **Broader governance problems**

There is a combination of lack of autonomy (despite formal agency status for some PROs) and lack of managerial accountability and empowerment in the management of public research institutions. These shortcomings apply to the institutes as a whole and to the constituent departments and laboratories within them. This situation is reinforced by an apparent lack of trust between the scientific community and the government, thus hindering an open culture of evaluation. The lack of autonomy is also related to the administrative division of labour between the central administration and Autonomous Communities regarding University Rectors and their level of autonomy and accountability.

The system displays a weak reliance on international evaluators for funding R&D: evaluations of R&D projects to be funded by public money are still usually involving domestic experts only.

## 2.2. The recommendations

Spain's knowledge base has been progressively consolidated, building on the first Law of Science in 1986. The large expansion of the public research system achieved in Spain due to rapid increase of public investment before the crisis, followed by the reduction in this funding in recent years, has left the system in a difficult situation. This sudden freeze has generated well-catalogued difficulties, and the lack of flexibility of the system leaves little possibility to adjust. This crisis situation creates an important opportunity to both grow and re-direct funding and to improve system governance so as to stimulate better individual and collective performance and restore confidence of the actors.

### ***Increase public funding for research***

The first main recommendation of the Peer Panel is thus to increase public funding for research (this recommendation covers total public budgets, towards both public and private sector) to progressively reach a target of 0.7% of GDP in three years, as strategy to drive recovery and growth of business R&D spend. As GDP rises the public share can reduce to the 0.67% consistent with the 2% overall GERD/GDP target. This requires the government as a whole to accept that the increase should not await economic growth to be affordable but rather to see it as a core part of its immediate economic strategy. In turn the research and innovation systems will have to accept the necessary reforms to convince external stakeholders that they can deliver. We term this a **sustainable growth package**. Almost as important as the absolute level of funding, is the need for a stable financial outlook to allow planning and development. Spain needs to establish a political consensus around a **5-10 year investment framework for research and innovation**.

### ***Set in motion a reform of the public research system***

Without change, injecting more money as such is not sufficient to solve the problems faced by the Spanish public research system. Like other countries, Spain faces the challenge of adapting its system to the ongoing changes, worldwide, in the nature of public research and the role of various institutions. One important change comes from the observation that the distinction between pure science research institutions and applied science research institutions is becoming less relevant. Newly emerging sciences and technologies tend to combine both (this is very clear in nanotechnology). Science, technology and innovation policies have to take this into account, at the very least by allowing institutions and research groups to adapt to the new context, rather than keeping them bound to procedures and arrangements that may well be conservative. The current lack of flexibility of the public research system impedes the country from benefiting from its assets and the talent of its researchers.

In fact, enlightened STI policy may push institutions in new directions. This requires both a reform of the existing system (a long-term endeavour) and support for positive developments that have arisen around the core of the system under private law (what this means is discussed below), that can help in the short and medium term.

Thus, the second bold recommendation of the Panel is to set in motion a reform of the public research system with additional budgets used in priority to incentivise such a reform. This reform will require action on several fronts:

1. Improving funding and evaluation mechanisms as well as governance of the system;
2. Better human resources management within public research organisations and universities;
3. Creating focus and mass in public research;
4. Reinforcing internationalisation;
5. During the transition: allow for an evolutionary approach under private law which maximises learning to reinforce policy instruments that work and stop or amend those which do not. We use the term policy experiments to denote this learning approach;
6. Operationalise a Research Agency.

### ***Improve funding and evaluation mechanisms as well as governance in public research sector***

The Panel recommends changes towards a funding system for public research which is more objective, transparent and performance-based. The funding should be distributed based on sets of clear indicators, ensuring transparency, objectivity and avoiding administrative burden:

- Increasing the share of competitive funding to incentivise research performance: this has two components: i) in the existing system (universities and PROs), reserve a share (e.g. 10%) of budget to be allocated competitively according to an agreed set of research metrics (typically, publications and citations<sup>11</sup>). At a later stage metrics may be combined with an internationalised peer review (see below); and ii) restoring an adequate proportion of competitive grant funding;
- Improving incentives for societal relevance and science-business collaboration in the public research system by introducing the concepts of entrepreneurship, relevance and valorisation of the research results in public research funding and career promotion mechanisms<sup>12</sup>; and by establishing incentives for mobility (see below, under human resources management);
- The two types of targets incorporated in performance-based funding mechanisms for institutes (promoting research quality and research relevance) can be either included in institutional funding or in separate dedicated funds (see Box 1, examples from Sweden and Flanders). Following the Swedish model, the rules for attributing these additional funds between institutions could be defined in the following way: according to the aggregate score of each performance criteria separately the top tier institutions would be allocated a larger share of the additional budget (e.g. 12.5%), the second tier a medium

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<sup>11</sup> The indicators should be normalised taking into account the scientific and technological characteristics of each research field. Data sources should be transparent and when relevant internationally recognised, e.g. the Scopus database for scientific publications and the CORDA database for EU research funding projects.

<sup>12</sup> Scientific quality should be measured by a combination of field-normalised publication in peer-reviewed international journals and field-normalised citations of scientific publications (where international practice considers the share of 10% top citations). A third component of scientific quality is the success of research proposals in international competition, measured by the EC funding achieved from Horizon 2020 (including ERC grants). Each of these three components should be equally weighted for an overall score of scientific quality.

Societal relevance should be measured by the amount of external funding of the institutions. A particular emphasis should be given to external funding which reflects cooperation with the industry (contractual research commissioned by the business sector), technology production relevant for the market (revenues for patents and licensing agreements), and revenues from services provided to the public sector and citizens' organisations. Each of these three components should be equally weighted for an overall score of scientific quality.

share (e.g. 6.5%) and the third tier a small increase (e.g. 1%). This model ensures a budget increase for all institutions;

### **Box 1. Performance-based allocation of basic funding to universities: Sweden and Flanders**

#### **Sweden**

A new system for the allocation and redistribution of the appropriations for research and postgraduate education to the university sector was introduced in Sweden in 2009. The aim of the model is to reward quality in research and give higher education institution managements the incentives to take measures to increase quality and relevance of the research undertaken at their institutions. This is done by allocating parts of the research appropriations on the basis of quality, based on two indicators: publications/citations, and external funding of research.

This new system also gives incentive to the universities to cooperate with the private sector since the more external R&D funds they receive from i.e. the Swedish firms, the more they receive from the state through the redistribution of appropriations. The impacts are visible: as a result of the introduction of the new system, external funding from foreign firms to Swedish universities, which has been more or less constant up to 2008, starts to grow steadily.

The proportion of public funding that was annually redistributed along the new model was initially 10%, and increased to 20% from 2014 onwards.

The competitive funding model spurs competition between universities, since better performers will receive more basic funding than others, which promotes a more strategic approach to the specified quality and efficiency criteria. The model can be implemented without necessarily increasing the total funding, and does in practice not need to result in major shifts in the basic funding, since all universities tend to increase their performance and efficiency.

At present Sweden investigates possible future developments of the resource allocation system, which may include peer/expert review as well as performance/output with the surrounding society.

#### **Flanders**

The Special Research Fund (BOF) in Flanders awards funding to Universities based on the following parameters: bachelor and initial masters diplomas (25%); doctorates (35%); annual operational remittance/number of scientific personnel (2%); publications (17%); and citations (17%). To this is added a mobility and diversity parameter (4%). A weighting factor for disciplines is applied to the indicator for bachelors and masters diplomas and doctorates, and the impact factors of publications within the different disciplines are taken into account.

The establishment of the Industrial Research Fund (IOF) is an initiative of the Flemish government. The Fund aims at the valorisation of the university knowledge in the form of community and/or commercial applications. The Flemish government budgets a large amount to be used by the Flemish universities to make a substantial contribution to this goal. The budget is distributed among the universities on the basis of several parameters related to valorisation: doctorates (15%); publications and citations (15%); industrial contract income (30%); income from the European Framework Programme (10%); patents (15%); and spin-offs (15%).

- Developing and implementing a wider system of institutional research evaluation. The performance of the institutions should be evaluated by an independent operator using international standards and acting on request of the government. Indicators may include bibliometrics and the amount of competitive funding secured from all sources. Impact on the economy and society may also be introduced as criteria. This approach would deliver neutral, comparative and efficient evaluation of the institutions. A fixed proportion, say 10% of funding in the first instance, should be allocated on the basis of this institutional assessment (see below). Every four or five years, the performance of the institutions under the new funding system should be evaluated by a peer review, to correct any distorting effects of the indicators or of the field normalisation ensuring that the funding is allocated based on the two performance criteria. The peer review should also recommend improvements in any other dimension of this new funding allocation system;

- The peer reviews should be made based on international best practice and with the participation of peers from other countries. There is a need to establish clear criteria to differentiate between research-oriented universities and others and ensure that resources for research are focused on the former group;
- Supporting research excellence and meritocracy in public research funding mechanisms: a system of recognition of excellence at national level could be established, with the introduction of a system of excellence bonus for the best researchers (based on international benchmarks, scientific production, national or international awards, etc.). The Sexenio does not fulfil this role insofar as it is an assessment of “minimum production and evidence of quality”: its role and criteria should be reviewed and updated.

The new funding model should be applied, using the same criteria, to institutional funding of Public Research Organisations (PROs) since they are under direct State responsibility, and to Universities as a top-up funding allocated from the national budget, in addition to Autonomous Communities funding. It is to be expected that more visible performance indicators (with inevitable production of informal rankings) will encourage the Autonomous Communities to invest in performance improvements in universities in their regions. New competitive programmes can also be launched under joint programming by State and Regions.

Promoting public-private cooperation in research should also be at the heart of the reform. This big challenge for the Spanish system can be stimulated by dedicated funding programmes - these are discussed in Chapter 4 focusing on boosting private R&I - and by structural public-private consortia for R&D and innovation (Spanish Strategic Innovation Arenas) which deepen collaboration mechanisms - the fifth Chapter discusses this opportunity. Existing PROs and universities can also be encouraged and rewarded to cooperate with industry through the establishment of institutes involving universities, PROs (in particular CSIC) and interacting with companies around selected topics of excellence, taking inspiration from the German Fraunhofer and French Carnot Institutes (Box 2).

### **Box 2: Carnot Institutes in France**

The Carnot Label is part of the global “Pact for research” programme endorsed in France at the end of 2005. The philosophy of this measure corresponds to the Competitiveness clusters measure in place since 2005 that is to say the necessary development of partnership research between public research entities and socio-economic actors (mainly companies).

The idea is to award a limited number of public research entities (group of laboratories, research units or PROs) or private research organisations with general interest goals, for their implication with the socio-economic partners (enterprises). The Carnot award is obtained for a four years renewable period by public research laboratories called “Carnot Institutes”. There are 343 Carnot institutes gathering 27000 FTE (amongst 8000 PhDs) have received funding up to € 1,3 billion between 2006 and 2012. This measure also intends to enhance the visibility of the awarded Carnot institutes and reflect the high quality and effectiveness of their activity. The Carnot institutes creation was directly inspired by the Fraunhofer Institutes in Germany.

The selection committee (including foreign and industry experts) awards the label (for a 4-years duration), based on criteria specified in the Carnot Charter:

- Quality and professionalism
- Ability to take into account the private sector’s demand when designing its strategy and programmes
- Knowledge of socio-economic actors expectations

- Ability to develop an active industrial property policy
- Ability to develop strong links with academic research
- Ability to develop or strengthen its cooperation with research entities abroad, in particular with European laboratories
- Commitment to mutualise its means with other Carnot institutes.

The total budget of allocated to the Institutes represent amounted to €1,900,000,000 2.2 billions in 2012. They benefit of € 420 M/y of private funding. Carnot institutes encompass 15% of the French research staff and over 45% of the research financed to the French public laboratories by enterprises.

Source: ERAWATCH, ANR

Improving governance of universities and PROs involves the following changes:

- Introducing more flexibility in management of research departments, securing more room for manoeuvre for research managers;
- Change from annual towards multiannual institutional and department budget procedures;
- Introduction of modern management practices, e.g. broadening the procedure for Rector election to outsiders, taking inspiration from Norwegian or Danish models.

Grant management systems for public research should also be improved:

- A fragmented system can generate loads of paperwork for the scientific community with limited effectiveness. The possibility of increasing the average size of grants with more integrated funding schemes could be explored;
- Evaluation procedures and criteria for project proposals (e.g., including aspects of internationalisation, co-operation of academia-industry), should impose the normal participation of international experts in the evaluation procedure, define an adequate acceptance threshold for project proposals (e.g. 20-30%) to increase the competitiveness and hence excellence of the proposals, reduce the administrative burden by accepting a fixed percentage of operational costs without any further detailed checks and audits on how this amount was spent (e.g., declaration in good faith and spot checking);
- Cost-benefit analyses for all PROs and universities before buying new advanced machines/infrastructures (to avoid underutilisation of capital purchased) should be made compulsory, also with Cohesion programmes at regional level.

Here again, it is expected that Autonomous Communities might wish to adopt similar practices and contribute to their improvement in coordination with the State, so that these become common procedures across several instruments.

### ***Better human resources management in the public sector***

The expected increase in retirements of professors and researchers recruited during the establishment of universities in the 70s may allow implement a policy of correcting the age pyramid, while ensuring recruitment procedures at international standards so as not to be constrained by the effects of mass recruitment. The following measures can help address the human resources bottleneck in the public research system:

- As a short-term measure, a remedial measure is to end the current effective freeze on Ramon y Cajal fellowships through the 'rate of substitution' restriction to ensure that the



best of the current generation are able to enter the system. From a strategic perspective this also creates a space in which the following reforms may be enacted;

- Help universities and PROs to implement a recruitment process to international standards, with an incentive system of the state government to foster the development of talented young researchers. These new rules should include evaluation mechanisms. Assess and adapt the 2007 Sistema de Acreditacion to evaluate researchers careers according to new funding systems as proposed above;
- Implement a new profile of the civil servant researcher in which researchers enjoy more freedom to operate (autonomy) but at the same time have a number of criteria to meet at the end of a five-year period (evaluation). These criteria not only include international scientific high impact publications, but also co-operation with industry, patents, participation in H2020 projects. If criteria are extremely well met, the researcher can access faster to the next level (in terms of grade and/or salary). In the other case, the researcher (financial career) can go slower or be frozen, or terminated. The evaluation is done by local staff and international peers. There are cases in other countries, e.g. within the Belgian federal context, where researchers, while remaining subject to civil servant status, are recruited, evaluated, paid and promoted under different rules than civil servants from other sectors;
- For young post-doc researchers, the new “researcher profile” can be implemented as a tenure track system so that they can acquire more certainty on their future career (and at the same time know what their targets are). In principle, all young researchers, irrespective of the funding source should enter the tenure track system as otherwise there is a risk that young researchers still get stuck in a parallel system without any stability regarding their future career. The new step recently introduced in the scientific career in HEIs, the Access Contract (“Contrato de Acceso”) should be also a common practice within PROs. The possibility of creating permanent positions outside the civil servant status will contribute to an increase in quality since evaluation and performance indicators may be adopted. That will add also flexibility for internal management of institutions and new opportunities for young researchers;
- Accelerate the correction of the age pyramid, by supporting voluntary measures and end-of-career arrangements for researchers/teachers through improved part-time schemes allowing access to facilities in the framework of research projects (and where money saved stays in the institution);
- Apply these measures consistently across the system so as to facilitate mobility (see below) and drastically reduce the rate of endogamy.

In addition, changes in human resources management may also contribute to the goal of promoting the opening up of universities and PROs to the external world:

- Assess and improve the incentive policy for the mobility of researchers during their career by promoting mobility within Spain or Europe, and between university and companies or universities and research organisations, adapting promotion criteria (e.g. concerning publications) and pension rules<sup>13</sup>;

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<sup>13</sup> Note: the LCTI (2011) improves mobility between private and public organisations by allowing an extended leave for a maximum of 5 years and by reducing partially the incompatibility for working in private firms. It allows researchers to work part-time in private firms created by the organizations in which they are working and

- Assess and improve instruments allowing experts from the private sector to take positions of associated professor (also on a part-time basis) within universities and PROs. This could be supported by strengthening the research tax credit for companies involved in the process. Another option would be to decrease the social security contributions by universities to cover the salaries of associate professors from the private sector.

### **Create focus and mass in public research**

One of the six priority lines of the Strategy responds to the identified need to create more critical mass in the public research system: *“specialisation and aggregation in the generation of knowledge and talent to lead to the scientific and technological specialisation of the stakeholders in the System, including institutions, centres, companies, groups and human resources. In addition, the aggregation of capacities, together with the scientific and technical specialisation of the implementing stakeholders, allows the strengths and potential for excellence of each of the stakeholders in the System to be identified and leveraged and the critical mass required for international leadership to be attained”*. Programmes have already sought to promote excellence and critical masses in the public research system, such as the Severo Ochoa programme.

The Panel recommends continuing the reform of the university system based on synergy between the State and the Regions, building a few academic centres with international visibility with a vocation to become excellent research nodes with high attractiveness. Provided that conditions for doing research are improved, Spain can exploit its large attraction potential: Barcelona has started a strategy to develop this potential further and other locations can follow. Experiences of voluntary synergies between universities, promoted by the above-mentioned programme Severo Ochoa, do exist in Spain, which could provide a blueprint for future advances (Box 3). Centres of Excellence must be based on specialisation, excellence and internationalisation. The goal is that companies (domestic and foreign) and society in general identify these centres of excellence as an opportunity to invest in Spain in co-creation between academia and the productive sector. The smart specialisation strategies adopted by the Regions could constitute a basis for the creation of focused nodes of public research actors, working in research and technology fields where regions display excellence. This will involve joint programming between the State and the Regions (see Chapter 4).

Reducing the gap between PROs and universities, should be one of the main objectives, in order first to improve the synergies and benefit from research complementarity and enhance mobility in the career between researchers and university teachers; secondly to reach critical mass in laboratories to optimise resources and research infrastructure and equipment and thirdly to reduce the gap between research frontiers and the content of teaching. This will involve a reinforcement of the partnership between the CSIC and the major research universities in order to optimise resources, achieve critical size and favour interdisciplinarity. Incentive instruments

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by eliminating restrictions on the maximum share ownership of a private company (10%) and the restrictions on being a board member in private companies. It modifies the previous Law of Sustainable Economy (Law 2/2011) to allow researchers to profit from their patent earnings.

The new strategy (2013-2020) aims to promote “Industrial PhD programmes” involving universities and firms, with the view of a better match between education and training supply and employment needs and of encouraging intersectoral job mobility.

could be designed for that purpose: State competitive programmes can introduce these notions of synergies and critical masses in selection criteria for funding joint projects by PROs and universities

### **Box 3. Voluntary synergies between universities in Northern Spain, including a cross-border dimension**

The Campus of Excellence Iberus is a strategic alliance between four Spanish universities (University of Zaragoza, Public University of Navarra, University of Rioja and University of Lleida), from four different Spanish regions (Aragón, Navarra, Rioja and Cataluña), with the aim of sharing resources and bringing together research and training capacities, built on a thematic specialisation strategy. With more than 50.000 graduate and undergraduate students, 3.000 doctoral students, 6.000 teaching and research staff, 476 research groups, Campus Iberus represents a significant critical mass in terms of research and education at Spanish and European level. This strategic aggregation intends to overcome the well-known fragmentation of higher education and territorial limitations, uniting four universities and overcoming the geographical and administrative limitations of four autonomous regions.

One important objective of Campus Iberus is the creation of a cross-border campus with the French universities in Toulouse and Pau constituting a new project called EBRoS (European Bioregion of Science) Western Pyrenees, which will give Campus Iberus a real international dimension. This cross-border cooperation aims at:

- improving the quality of higher education through an increase in the critical mass of lecturers-researchers and the optimisation of resources in equipment and laboratories
- the formation of competitive and internationally recognised education, research and innovation clusters
- the visibility, coherence and competitiveness on a European and on an international level of the education and research programmes offered
- increasing the cohesion and competitiveness of the regions of the Cross-border Campus EBRoS Western Pyrenees

More specifically, the following actions have been planned:

- establishment of Spanish-French Double degree/diploma programmes at degree, master and doctorate levels
- establishment of partnerships and joint programmes with national and regional research, innovation and entrepreneurship organisations
- knowledge transfer activities and cooperation with innovative industry sectors, especially at regional level (science parks, business clusters, competitiveness clusters, business schools, etc.)
- the sharing of resources among the partners of the Cross-border Campus EBRoS Western Pyrenees
- mobility programmes for students, lecturers, researchers and admin and support staff

Campus Iberus has chosen the fields of specialisation that according to capabilities and specific geographical situation, will allow it to claim for an international position, with four focused societal challenges:

- Sustainable energy
- Technology aiding the health of the citizen
- Food and nutrition
- Cultural heritage preservation

The Innovation and Entrepreneurship Centre is created to promote innovation in the regions where Campus Iberus is placed, with a special attention to the university entrepreneurship. It will build up the foundation and promote a favourable atmosphere, as well as the training and the funding necessary for the creation of new companies that can benefit from the knowledge generated in the universities of Campus Iberus.

#### **Reinforce system internationalisation**

The fourth priority in the National Strategy is: “*Support for the internationalisation and promotion of the international leadership of the Spanish Science, Technology and Innovation System*”. The Strategy refers in particular to the promotion of international mobility throughout the researcher career, which is indeed one aspect of the better human resources management point above. Spain participates in ESFRI and the Strategy promotes the active participation of the stakeholders in the construction and operation of large scientific infrastructure, including specific measures to support the “science industry”. In addition, several schemes help Spanish research actors to

prepare projects to be submitted to funding to international sources, such as the EU Framework Programme.

Criteria referring to internationalisation performance should be introduced in project and institutional funding mechanisms, and in researchers' careers, e.g., by integrating rewards to researchers engaged in EU projects.

### ***During the transition: allow for experiments under private law***

Achieving the key reforms needed for the core system, as elaborated above, is a long-term process which will take an extended period to reach full effect. There is thus a need to simultaneously support and build upon the positive developments of public research institutions operating under private law. This could involve the following:

- Explore the possibility of creating research positions in foundations on grant funding at market levels of salary, drawing on experience in some Autonomous Communities. Research laboratories can be built around staff working under these conditions, which are incentivised to deliver excellence and impact, and are rewarded accordingly through promotions and other incentives, IP sharing etc. If created at the level of a university (as is the case for some Spanish universities), such a separate legal entity might provide an alternative to set up a more competitive and reward based university researcher personnel policy in the advent of a more general reform of the research personnel policy for all Spanish universities. One could e.g. imagine a scenario where researchers are outsourced by such an autonomous legal entity to a university. Funding for those positions may be diversified coming from either public or private sources, or through joint chairs;
- Ensure mobility and flexibility built in by design and consider innovations such as joint labs with business;
- Introduce an 'exception for experiments' clause which allows the break out the legislative lock on the system.

Evaluation of these experiments should take into account the possibility that the high achievements of research organizations operating under private contractual law may have been enhanced by a creaming-off of leading talent from other parts of the system because of the superior environment that they offer researchers. Hence, total systemic benefit should be considered.

### ***Operationalise a Research Agency***

The scientific community awaits the implementation of a Research Agency, as foreseen in the law. The use of an Agency can help keep funding rules more flexible than those managed by the Ministry, particularly in terms of reportable credit from year to another and simplify the chain of expenditure. It can also reinforce accountability by introducing tighter control on funded projects and their outcomes. A Research Agency that has the classical function of a research funding organisation receiving grant proposals, as well as the newer strategic and networking functions that such organisations are taking up in many countries, is a necessary part of the Spanish research system. It is not sufficient, of course, to address the issues (which were outlined above)

but can contribute by being pro-active. That is a reason for allowing the Research Agency to be somewhat independent from the Ministries. The Agency should also be in a position to interact with Autonomous Communities.

Concerning the internal structuring of the Research Agency, various patterns are possible: an interesting possibility is given by the Research Council of Norway, after various revamping (and their evaluation) since the mid 1990s. The Peer Panel is in favour of a Spanish Research Agency with two main functions:

1. A grant and fellowships distribution function, also stimulating Centres of Excellence, and considering background issues of health of research community and research training, as well as infrastructure;
2. A strategic function, supporting knowledge exchange and the contribution of research to the economy and to societal challenges. It will need to interact and collaborate with other bodies and programmes, like CDTI with regard to innovation stimulation.

The Agency should be in charge of organizing and managing evaluation (ex ante and ex post).

The Law of 2011 (article 45) foresees two separate institutions, the Research Agency and CDTI. Suggestions have been made to integrate CDTI into the new Research Agency. This would create problems because of the difference in mandates, required work styles and networks. What is important for the Spanish research system is that the two organisations coordinate and occasionally collaborate. For example, close cooperation is needed between the two agencies with respect to funding of public-private partnerships, such as the Strategic Innovation Arenas discussed in Chapter 5. An example of such interagency cooperation can be seen in the case of Finnish SHOKs (Strategic Centres for Science and Innovation) which take the form of a not-for-profit limited company, the partners in which include key companies, universities and research institutes in a national strategic topic area and are supported by both the innovation agency, TEKES and the Academy of Finland<sup>14</sup>.

The institutional position and degree of cooperation between the Agency and the Ministry has to be carefully planned. The Agency should have a sufficient degree of autonomy vis-à-vis the Secretariat of State (concerning multi-annual budgeting, flexibility in the design of instruments, flexibility in the follow-up of projects etc.). On the other hand, close coordination and unity of purpose should be maintained.

Under these proposals the Ministry will cease to have an operational role in directing research funding but will have key responsibility for policy analysis, planning, coordination and monitoring particularly with CDTI, and with other Ministries and regional governments.

A number of elements will condition the success of this Agency in improving the Spanish public R&D system:

- First, the Agency has to have the ability to execute multi-annual financial planning: the Agency should have a medium to long-term financial perspective and should be able to use unspent funds in the following year;

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<sup>14</sup> <http://www.shok.fi/en/activities/background-and-objectives/>

- Second, its operations should be based on principles of transparency, accountability and fairness;
- Third, it has to execute peer review to the highest standard including maximal use of international reviewers. Its remit extends both to promotion of excellence and promotion of impact/translation (e.g. follow-on funding to ensure impact, industry fellowships, etc.): this is reflected in the choice of peer reviewers and the criteria of assessment. The Agency might experiment with combined assessment of scientific quality and societal relevance, as is being done in a number of countries in Europe;
- Fourth, instruments should be designed to maximise simplicity and flexibility as set out in the section on grant mechanisms;
- Fifth, the Agency should have the possibility to facilitate joint programming between the State and the Autonomous Communities, and also at international level ;
- Sixth, the Agency should contribute to break inertia and organisational practices by changing also roles and rules of personnel;
- Finally, the learning dimension is very important for the Agency to develop its strategic capacity. In its first years, the Agency will have to experiment and learn. Issues will be a rationalisation of financial instruments on a few specific objectives with significant funding, while maintaining a relative stability in programs and procedures. New initiatives can have different sources, including exploiting an opportunity. When feasible, they will be accompanied by a foresight exercise and a clear plan based on rationale and objectives. This will make it easier to evaluate such initiatives. Such ex-post evaluations will cover efficiency of implementation, impact and appropriateness. The latter will support eventual program renewal, and over time, the set of evaluations will allow the Agency to act more strategically.

## Summary of recommendations in Chapter 2

- 2.1 Increase public funding for R&D and initiate a growth path of these expenditures setting the target of 0.7% of GDP within three years in the context of a sustainable growth package and an extended stable 5-10 year investment framework.
- 2.2 Prioritise the allocation of additional budgetary appropriations to action lines aiming at reforming the public research system.
- 2.3 Establish universities and PROs' funding system which is more objective, transparent and performance-based: to incentivise research performance and relevance; support research excellence and meritocracy in public research funding mechanisms; and implement a wider system of institutional research evaluation which is used to allocate a proportion of resources.
- 2.4 Increase the share of competitive grant funding through the action of the Agency.
- 2.5 Promote public-private cooperation in research and internationalisation at the heart of the reform, through individual and institutional incentives.
- 2.6 Improve governance of PROS universities by introducing more flexibility in management of research departments, multiannual budget procedures and modern management practices.
- 2.7 Improve grant management systems in PROs through more integrated funding schemes, reduced administrative burden, more cost-benefit analyses for equipment purchase, etc.
- 2.8 Address the human resources bottleneck in the public research system by alleviating the freeze on recruitment for Ramon y Cajal fellows, implement a recruitment process to international standards, including appropriate incentive system and evaluation mechanisms; define a new profile of the civil servant researcher, foster and implement the Access Contract as a basis for a tenure track systems for young researchers and develop end-of-career arrangements; and assess and improve schemes promoting mobility within public sector and between the latter and the private sector.
- 2.9 Continue the reform of the university system based on synergy between the State and the Regions, and provide reinforced incentives to support new alliances, notably between the CSIC and the major research universities in order to optimise resources, achieve critical size, favour interdisciplinarity, with the aim to create a few excellent research centres with international visibility and high international attractiveness, also in applied research fields.
- 2.10 Support the positive developments of public research centres that have grown up and operate under the principles of private law.
- 2.11** Operationalise a Research Agency, with the remit to act strategically and within a multi-annual perspective, using international peer reviews. It would have two main functions: grant distribution and strategy, including interaction and collaboration with other bodies and programmes, notably CDTI. It will also over time ensure rationalisation of funding instruments towards fewer, more flexible and effective schemes.

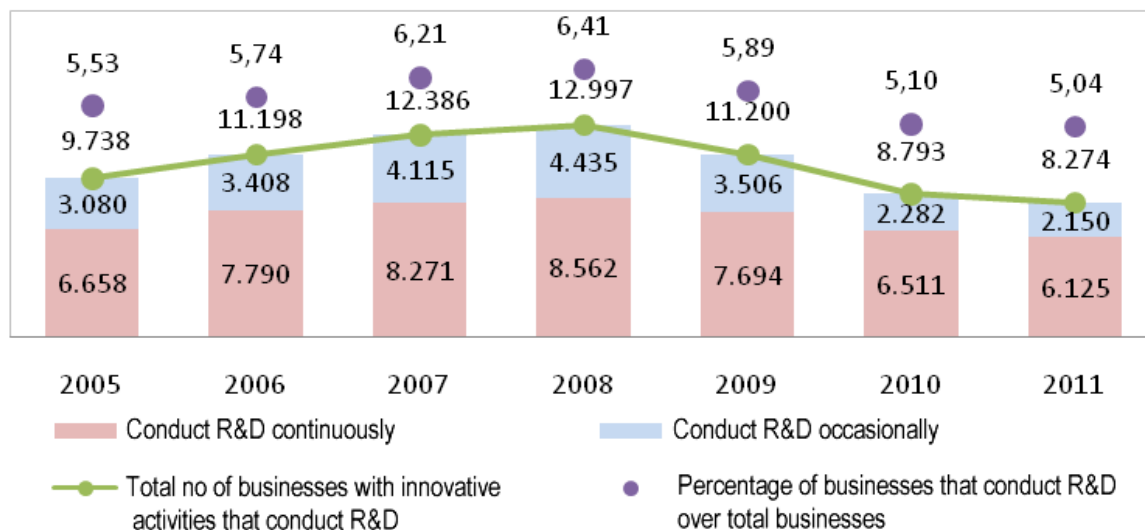
### 3. Research and Innovation in the private sector

#### 3.1. The challenges

##### *Underperformance in business R&D and innovation*

Since 2008, Spain has faced a dramatic reduction in the number of companies active in R&D, which is reflected in a sharp drop in figures measuring business expenditures on R&D and innovation (Figure 11). This trend applies mostly to SMEs, since R&D investment has continued to rise for the 13 largest private R&D investors (almost all larger firms<sup>15</sup>). Thus the contribution of SMEs to Spanish R&D has been dramatically reduced in the aftermath of the crisis. One characteristic of Spain compared to other similar countries is the high contribution of SMEs to the total business R&D investment, in particular in service sectors; a reflection of the lack of large R&D-intensive firms which are by far the largest contributors to R&D in other Member States (COTEC report 2013).

**Figure 11. Number and share of R&D-active companies in Spain (2005-2011)**



Source: INE. Prepared by FECYT.

Considering innovation more broadly, following the Oslo manual, there are around 18 000 firms in Spain actively involved in innovation in their business. With the economic crisis in Spain, the number of firms doing innovation has been reduced by half (from an estimated 36 000 in 2008) (COTEC report, 2013, European Commission 2014c).

<sup>15</sup> The 13 large firms investing in R&D in Spain are mostly active in the ICT services sector (Telefonica, Amadeus, Indra systems), in the construction and materials sector (Acciona, ACS, Obrascón Huarte Lain), in the pharma and biotech sector (Almirall, Grifols, Zeltia) and in the energy or industrial engineering sectors (Gamesa, Abengoa, Repsol). There is also one bank (Banco Santander) in this list. In 2012, the R&D investments by these firms ranged from € 1000 million of Telefonica to around € 100 million in the energy sector. All but one of these firms increased their R&D investments 3-12% over the three year period 2009-2012 (European Commission 2014c).

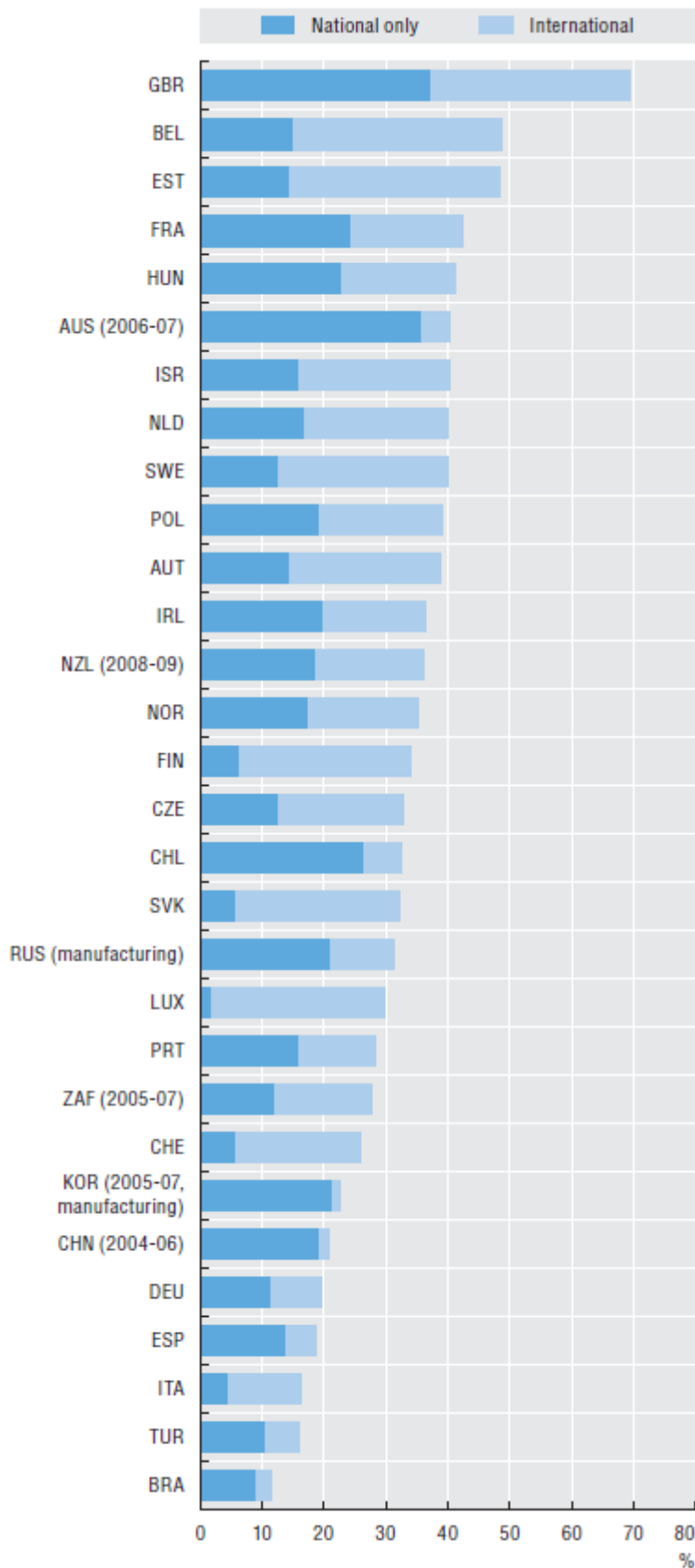


The crisis situation reinforces existing weaknesses in the private innovation system, besides the already mentioned scarcity of large R&D-intensive firms located in the country:

- A dominance of micro-level firms with few resources and limited inclination to undertake R&I or engage in innovation;
- A specialisation in low- and medium-tech activities with restricted presence of high-technology companies (cfr. Chapter 1);
- Weak innovation culture amongst SMEs: many enterprises still think about innovation only for new projects (not for new strategies or new process), and they do not think they can afford a continuous investment in innovation. A lack of absorptive capacity lies at the heart of this problem. SMEs participating in a survey of the Spanish Chamber of Commerce declare that only 2,5% of their annual turnover comes from innovation (Camaras Consejo Superior 2013);
- Strikingly weak inclination of Spanish SMEs to enter into cooperation, nationally and even more so internationally, for innovation (Figure 12);
- Limited cooperation between large and small firms (Camaras Consejo Superior 2013);
- Barriers to the creation and growth of New-Technology based companies, notably due to a shortage of risk capital to finance early development stages. The investments in risk capital including seed capital, start-up funds and funding for other stages of the business creation was in 2012 €1,470.2m and represented 0.009% of the Spanish GDP. This has decreased significantly since 2010 (€2,479.7m) by -20.4% in 2011 and by -25.5 in 2012 (ICONO-Eurostat, 2013). This is (per capita) considerably lower than in the EU;
- Weak public-private linkages for innovation as a result of the imbalance between academic incentives and industry science base and technological absorptive capabilities (Chapter 2).

At the same time, Spanish companies are improving on the front of internationalisation of their R&D activities: the share of business funding to Spanish companies, coming from competitive funding from FP7, increased from 6.9% in 2008 to 10.1% in 2011. For the period 2007-2013 Spanish SMEs received € 545.011.371 from FP7. This indicates the presence of some highly innovative firms, well embedded in international research networks.

Figure 12. National and international collaboration on innovation by firms, 2006-08  
(as a percentage of innovative firms)



Source: OECD (2011), *Science, Technology and Industry Scoreboard 2011*, OECD Publishing, Paris.

### ***A strategy oriented towards R&D promotion but insufficient attention to wider innovation***

One of the four goals of the Strategy is: *“The promotion of business leadership in RDTI. The objective is to increase the competitiveness of the production network by increasing RDI activities in all areas and, particularly, in those sectors which are strategic for growth and the creation of jobs in the Spanish economy and the Autonomous Regions”* and one of its instruments covers *“Measures, reforms and the design of instruments to capture private funding for scientific and technical research and innovation, and the attraction of investment in R&D from abroad and from foreign companies”*.

The situation in the private R&I system depicted above calls for a differentiated policy catering for the very different needs of the variety of companies involved in the system, located at all points of a spectrum between, at one end, internationalised and technology-intensive (large) companies, and, at the other end, small traditional companies with little R&I drive and resources. There is a need to further increase the number of companies engaging in R&I.

Spain, like many other EU Member States, develops policies geared towards research on the one hand, and innovation in a wider sense on the other hand, without much coordination between the two policy areas. The main vehicle for business R&D support in Spain is the portfolio of CDTI instruments. In parallel, there are instruments developed under industrial and economic policy – notably ENISA – which address innovation in a broader sense: areas of overlap exist, and this creates a grey zone between the two policy areas. In a country with a large number of companies innovating “at the margin”, it is likely that instruments favouring non-science-based innovation will be as relevant as instruments promoting R&D-based innovation. The Peer Panel did not have time and resources to devote to the analysis of other instruments under the industrial policy in general or to the work of the ENISA in particular.

### **3.2. The recommendations**

#### ***Engage in a catching-up process of public funding for R&D***

The need to increase public funding is an equally crucial imperative for business R&D and innovation as it is for public R&D (Chapter 2). The sharp drop, during recent years, in budgets managed by CDTI, the Spanish Agency in charge of delivering policy instruments for private R&D, means that its policy mix could not act as counter-cyclical device at times when companies needed it most. To prevent the occurrence of such situation in the future, maintaining stability in CDTI budget is necessary given the acute challenges faced by the private sector on its path towards more R&D and innovation activities.

The first main recommendation of the Panel is, as for public research, to engage in a catching-up process for public resources devoted to private R&D and innovation in Spain.

### ***Fine-tune the policy mix for R&I in firms***

The second main recommendation of the Panel is to improve the policy mix for R&I in firms. Before entering into the discussion of the national policy mix, two important recommendations are relevant here, which will be dealt with in the next Chapter:

- Solving the many challenges faced by the private sector in engaging in R&I activities requires concerted and efficient action from all policy levels and domains. A division of labour seems to have emerged where the State takes care of companies at the higher end of the spectrum, while Autonomous Communities deploy their action towards the lower end of the spectrum, including non-R&D based innovation. However, these distinctions are not clear-cut, a number of companies stand in between the ends of the spectrum, and several Autonomous Communities support cutting-edge research and innovation. Hence there is a need to create strong synergies and complementarities between national and regional actions to support private R&I;
- The question of ensuring better coordination, visibility and synergies between the various support instruments available to innovative firms is also dealt with in the next chapter, as much support, even though it is funded partly at national level, originates from the regional level (Science Parks, Technology Centres, clusters, etc.).

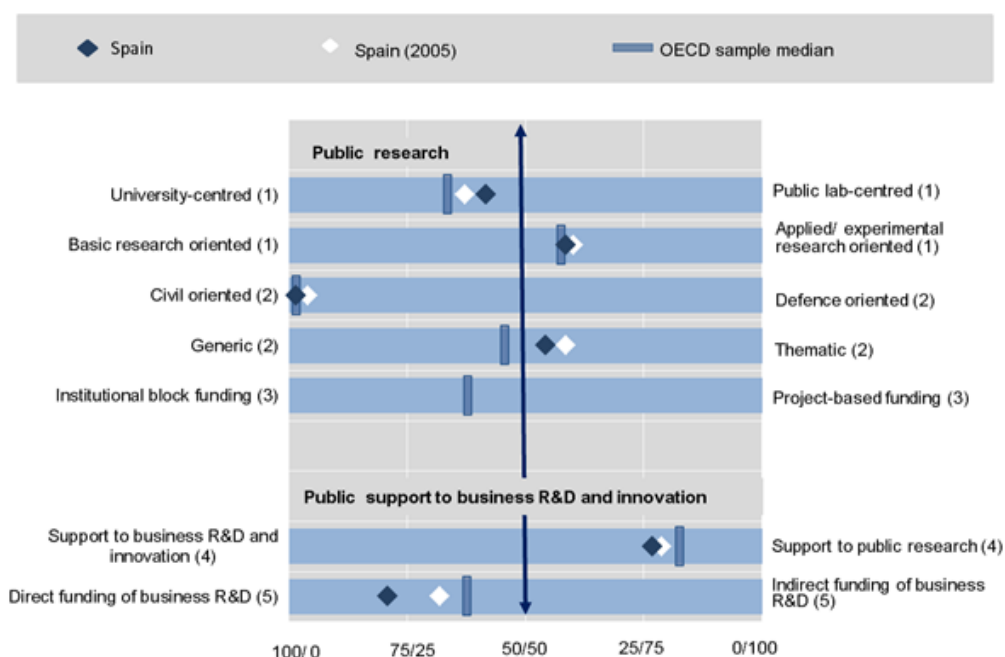
Within the State policy mix, the Panel sees four areas where new attention should be paid to tackle the challenges of the private R&I system:

1. Fine-tuning the policy mix for R&I in firms;
2. Encouraging the creation and growth of innovative new firms (including reinforcing the role of private venture capital in financing projects);
3. Leveraging the potential of public procurement for innovation;
4. Improving innovation culture.

The policy mix for R&I in firms consists mainly of direct (grants and loans) and indirect (tax incentives) public instruments. Tax incentives and direct funding are not substitutes, and research findings show that the probability of using tax incentives falls when firms face financial constraints, while the likelihood of using direct funding increases (Busom et al. 2013). Indeed, Spain is one of the OECD countries with the most generous R&D tax incentives regime. However when looking at funds distribution, it seems that its policy mix is more oriented towards direct funding than other countries (Figure 13). This contradiction can probably be explained by firms in Spain having difficulties accessing the tax incentives. We provide some ideas to improve this situation at the end of this section. Below we turn to direct instruments, which the State uses to support the specific objectives that it had set to its R&I Strategy.

The national agency that supports business innovation is CDTI, which delivers a series of programmes that generally enjoy a favourable view from stakeholders (Table 2). CDTI is responsible for all sub-programmes for promoting business leadership in R&D, except for the Technological Platforms and some actions that are directly managed by the State Secretariat. The reason for this difference are unclear to the Panel, and with the implementation of the Research Agency, it would seem more logical to have all programmes run either by the Agency or CDTI.

Figure 13. Key features of Spanish R&D Policy



Source: OECD (2011), Science, Technology and Industry Scoreboard 2011, OECD Publishing, Paris.

Table 2: Spanish R&I Funding instruments for the private sector -2013

Sub-programme	Description	Subventions	Loans
<b>Programme for promotion of talent and its employability</b>			
Torres Quevedo Contracts	to promote permanent employment of doctors in the private sector, especially in newly established high technology enterprises. (300 contracts, 3 years, co-financing of salary+ social security)	15.000.000	
EMPLEA Incorporation of managers and other R&I activities	To promote full time employment (1-3 years) of professionals in the management of R&I (incl. knowledge valorisation and transfer and promotion of participation in H2020). Beneficiaries e.g. enterprises, technological centers, business associations (nonprofit), technology platforms. Mainly credits, subvention is to cover costs for training.	1.500.000	100.000.000
<b>Programme for Scientific Research</b>			
EUROPA TECHNOLOGICAL CENTERS	to develop and implement a strategic program that allows technology centres to act as promoters for companies' (esp. SMEs) participation in H2020	3.000.000	
Infrastructure and equipment EQUIPA	Credit to enterprises and technology centres for the acquisition of scientific and technological equipment		70.000.000
<b>Programme for promoting business leadership</b>			
Business R&I Projects	Funding through credit of projects for industrial research and experimental development (137 projects)		67.000.000
CDTI Internationalises	Credit funding for raising SMEs international exploitation possibilities in R&I activities (10 projects)		2.000.000
International Inter-enterprises "CDTI EUROSTARS"	Funds aim to promote R&I projects led by R&I intensive SMEs. Only EUROSTAR projects with secured funding from other countries(27 projects)	7.400.000	
NEOTEC	Credit funding for R&I active young small independent enterprises with less than four years of constitution. The companies need to demonstrate that they can cover up to 30% of their business plan expenses. (22 projects)		5.000.000,0

Essential Enabling Technologies R&D Projects	Credit funding to support the essential enabling technologies: photonics, microelectronics, nano-electronics, nanotechnology, advanced materials, biotechnology, and ICT.(34 projects)		17.000.000
Direct line for Innovation. CDTI projects for Innovation and Technological Modernisation	Credit funding of projects that allow the incorporation and adaptation of new technologies at a sectorial level and which represents a competitive advantage for the company. (500 projects)		400.000.000
Promoting Collaborative RTD: FEDER Interconecta	Funding of business consortia (coordinator being a medium or big enterprise) from Andalucía, Extremadura or Galicia. Funding for R&I projects for development of technologies of the future (105 projects)	132.000.000	
Projects for public-private collaboration for business development (CIEN)	Funding for big business industrial research projects. Consortia w 3-6 enterprises (>= 2 SMEs) Research Centers have to participate with at least 15% of the budget of the project. The minimum funding for a project is 7 000 000€. The enterprise needs to include 500 000€ from its own resources. Mainly credit funding (a minor part granted on the basis of results). Repayment term of 12 years		200.000.000
Technological Platforms	Aid for the creation and consolidation of the Spanish network of Technology Platforms with the objective of funding their outreach actions, exchange of information and best practices, promotion of the cooperation between entities for the development of projects.	1.500.000	
<b>Programme for promotion of R&amp;I towards societal challenges</b>			
Challenges-collaboration R&I projects	Funding applied for development projects in collaboration between research centers and enterprises with the objective to promote the research oriented towards tackling societal challenges through the development of new products and services. The consortia need to have 60% minimum of business participation. The funding can be subventions or credit or a combination of the two.	63.000.000	840.000.000
Challenges-research R&I projects	As above, but without credit financing	266.761.000	
Challenges Enterprise R&I projects	Credit funding for enterprises collaborating in R&I projects. Responds to technological demands to tackle societal challenges (658 projects)		341.000.000
Revitalisation actions for technological enterprises	Support for researchers to create a technology based company. The funding is for the legal and administrative expenses (vary between 10.000 and 20.000 €)	500.000	
AEESD1: R&I PROJECTS	The aids are assigned to companies, private research entities when they participate in projects of ICT clusters of EUREKA and to the business groupings or associations. Priorities are: Future industries, safety and security, development of smart cities applications and e-administration; SME competitiveness, digital content and services, as well as environmental management applications. The funding combines subsidy and credit.	(?)	469.100.000
AEESD2: R&I BROADBAND	For Telecom operators. The aid aims to fund projects that amplify the coverage of the next broadband generation. The funding combines subsidy and credit	(?)	55.000.000
AEESD3. DIGITAL TRAINING	The funding gives the priority to actions of training of personnel in companies, especially SMEs. The training is focused in reaching excellence on the Digital Agenda technologies	1.500.000	
AEESD4. CONVENIO ENISA	Support for SMEs' business projects in the ICT area as identified in the Digital Agenda for Spain. Loans between 25 000€ and 300 000€.		30.000.000

Source: Ministerio de Economía y Competitividad (2013)

As mentioned above, a number of instruments which are also relevant for the promotion of business development and innovation in firms, and are managed by the Ministry for Industry, Energy and Tourism including ENISA (projects for the improvement of competitiveness of SMEs), ICT-related projects in companies, through the Strategic Action in Digital Society and Economy, etc.), are not discussed here while their synergies, overlaps or duplications with the “mainstream” R&I policy discussed here also deserves further attention. This means that increasing coordination should take place between the Ministry of Economy and Competitiveness and the Ministry of Industry, Tourism and Energy.

The observation of the above Table, along with the messages collected in the hearings conducted during the meetings of the Peer Panel in Madrid, generate the following observations and recommendations:

- In general, public funding for business R&D is mainly channelled through CDTI loans, and very few grants. Sometimes these loans have been awarded with interest rates that were very close to private market financial rates, and also requesting bank guarantees for the award. These conditions made those loans unattractive and very difficult to access for the majority of SMEs that are experiencing economic troubles. Loans are also less adapted for newly started innovative firms. The prerequisite of additional bank guarantees, which can be a big barrier in the current context, might be abolished if loans were awarded after a more in-depth assessment of the economic and financial situation of applicants (turnover, debts level, etc.) and the acceptance that tolerating a certain (low) rate of financial failures is preferable to spending larger sums in unnecessarily bureaucratic procedures;
- A specific problem occurs in the schemes addressing the absorptive capacities of SMEs through the provision of qualified “innovation or research managers” partly funded by the State. These have proven their success in several countries with a large retention rate after the subsidised period (example of the UK Knowledge Transfer Partnerships scheme in Box 4, or the French CIFRE scheme). In Spain they are funded by loans rather than by subsidies when used for qualifications levels below a doctorate, which are more relevant to most SMEs (EMPLEA). This limits their attractiveness and it is suggested that direct subsidies could be used for this purpose in order to address several main bottlenecks of the Spanish and innovation system: weak SMEs’ orientation towards innovation, meagre employment perspective for graduates and weak linkages between companies and PROs/universities;
- The landscape of instruments seems difficult to capture in full by small firms, and in addition there tends to be instability in the policy mix with many instruments being transformed, suppressed or renamed from one period to another. This calls for less fragmentation and more stability of instruments over time;
- Several programmes do exist to support private-public collaboration in research. These include Technology parks, Knowledge Transfer Offices, Innovative Companies Associations and Clusters Programme, Technology platforms, programmes for cooperative research. These should be continued and made more effective, using lessons notably from international examples of incentive instruments to develop partnerships between SMEs and public laboratories (cf. the LabCom Programme of the French Research Agency ANR). The elimination of the ‘joint and several liability’ requisite for participants in cooperative projects, and its replacement by a Guarantee Fund, would

facilitate the participation of SMEs. Implementing innovation vouchers, which have proven to be effective instruments for ensuring an user-driven orientation to instruments such as technology centres is another option to be investigated in the Spanish context (several regions use such a scheme but a national initiative would also be relevant and help foster cross-regional synergies);

#### **Box 4: Knowledge transfer partnerships in the UK**

KTP is a programme led by the UK Technology Strategy Board where three-way partnerships are formed between a business (the company partner), one or more recently graduated people (associates) and a senior academic acting as a supervisor (knowledge base partner). The aim of KTPs is to increase interactions between the knowledge base (University, Research Organisation and Further Education Colleges) and companies through the mediation of the associate who during the period of staying in the company will work on a project developed in collaboration with and co-supervised by the partners for a period of 12 or more months and attend to further training.

This measure provides a grant to cover part of the cost of employing a recently graduated person to transfer and embed knowledge into a business from the UK knowledge base via a strategic project.

Each Partnership employs one or more high caliber associates for a project lasting one to three years, transferring the knowledge the company is seeking into the business. Each associate works in the company on a project which is core to the strategic development of the business. Associates are jointly supervised by a senior member of the business and an academic or technical staff from the partnering knowledge base organisation. Through contact with businesses, the knowledge base partner is also provided with a relevant and improved understanding of the challenges companies encounter, and their business requirements and operations.

Source: ERAWATCH

- Few instruments are targeting new innovative firms<sup>16</sup>. These are indeed part of the policy mix, but these programmes are often too small, e.g. 22 NEOTEC projects have been funded in 2013, which is a very low figure for a country of the size of Spain. We turn back to this important issue in the next section;
- The policy mix does not pay enough attention to non-technological innovation. Schemes should be integrated in the policy mix to support this form of innovation. The question of coordination and synergies to be established with the work of ENISA is crucial here;
- Increased direct support could focus especially on SMEs without previous experience on innovation activities, in order to reverse the falling trend of the number of innovative firms, to achieve a higher technology level among business projects, to enable them a larger access to national and European programmes that finance R&D and Innovation, and to facilitate interaction with external knowledge suppliers (universities, technology centres, etc.), Scaling up the instruments to put R&I personnel into such companies is an important element here;
- Demand-side policies are not represented in this policy mix. A discussion on public procurement as an incentive for business innovation is provided in a section below;
- As in many countries, Spanish beneficiaries of CDTI support are asking for a simplification of the application procedures. Reducing administrative burden is also needed to stimulate

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<sup>16</sup> It is however possible to get a small amount (EUR 10 to 20.000), from MINECO, for the legal and administrative expenses for creating a new technology-based company. There are also a set of financial instruments awarding smaller amounts for new entrepreneurial firms in general (often in replacement of unemployment benefits).



innovation. The main obstacles declared by enterprises regarding public instruments are the following: long reimbursement periods, too complicated application and evaluation of (research) proposals and administrative burdens. Future interventions should decrease administrative burdens and reduce the periods to get the reimbursement of the innovation expenditure;

- Last but not least, it is necessary for CDTI to develop its foresight and strategic monitoring capacities. CDTI is seen as a very reliable and professional agency in its delivery of funding, but it has only recently engaged in evaluation and is weakly involved in policy design. A better understanding of the additionality of CDTI interventions, based on evaluations, will help shape and improve its future portfolio and avoid crowding out. The leverage effects of funds administered by CDTI should become part of the performance indicators for the organisation. We return to this crucial issue of monitoring and evaluation in Chapter 5.

Supporting SME's internationalisation is also part of the policy mix for R&I: Spanish innovative companies are more internationalised than the total of Spanish companies, and show a lower propensity to reduce employment (Camaras Consejo Superior 2013). A stronger networking and structured contacts with Spanish graduates working in enterprises in countries outside Spain would help in particular SMEs to connect to foreign firms for collaboration on innovation and sales.

#### *Tax incentives*

Improving effectiveness of tax incentives for R&D is the last point in this section dealing with the fine-tuning of Spanish policy mix for private R&I.

The Spanish system of research and innovation tax deductions is not widely used, especially by SMEs, because they think it is very complicated and, consequently, expensive. In theory, the system is very generous and comprehensive for enterprises, and it has been further improved at the end of 2013, but in practice, it is accessible only to medium-big companies or for the small group of technology-based enterprises.

Recent amendments in the regulation of tax incentives to R&D and innovation activities will help to stimulate private R&D and innovation investment (i.e. tax credit for firms that could not previously benefit from this tax incentive due to lack of profits; increase of tax incentive rate for innovation activities, and for incomes derived of own technology transferred to third parties). The Annual Budget 2013 Law 17/2012 allows the Government to establish additional social security benefits for those companies hiring researchers devoted to R&D and technological innovation. Tax deduction for hiring researchers has finally been adopted in 2014, but the lack of clear information on this and delays in implementation cause frustration among private firms.

The Spanish R&D tax credit system should be further reviewed in order to address a number of difficulties:

- Alleviate barriers experienced by SMEs (cost and time of certification, credits not available as cash payments which makes firms vulnerable to takeovers driven by credits);
- Ensure trust in fiscal incentives and no possibility to reverse certification except in cases of fraud;

- The R&D tax credit could be adapted in order to stimulate private funding to universities by large groups, e.g. in the framework of new Technology Institutes.

More generally, the following questions need to be answered in this revision process:

1. What is the type of costs that needs to be alleviated, R&D investments or salaries? The example of Belgium and the Netherlands can help shed light on systems that have focused on alleviating R&D salary costs, which has the advantage of being more predictable for companies and removing ambiguities about what is eligible expenditure;
2. Who should manage the certification? There are arguments for giving this responsibility to agencies managing R&D grants and loans, because they are closer to the beneficiaries than finance ministries and they are better placed to assess the complementarity between these tax incentives and grants/loans;
3. What type of control to implement? One of the great advantages of tax incentives over direct support is (normally) that procedures are much lighter for the former. But this has limits and the degree of control is a sensitive issue as the above difficulties reported for the Spanish system show.

### ***Encourage the creation and growth of innovative new firms***

The Strategy puts special focus on better conditions to support spin-offs, startups, etc. by promoting entrepreneurial culture in universities and public research organisations, Industrial and intellectual property rights, Technological surveillance and competitive intelligence as part of the innovation process. An important step was the Entrepreneurship and internationalisation law of 2013. The Strategy also refers to “*numerous instruments and initiatives that guarantee funding using efficient Venture Capital instruments that cover the different phases of business development, from seed and start-up funds to subsequent rounds*”. The National Plan includes: (a) support for creation of Technology-Based Companies, and (b) drive for Venture Capital initiatives to cover the different phases of development, from seed capital and start-up to subsequent rounds and to permit the support, scaled and without discontinuity, at all levels of business projects.

Measures that are being implemented address the financing needs of businesses at various stages of development, although in the short term they cannot be expected to fully address the structural lack of equity financing from private sources (COM 2013). Funds under the ESIF (European Structural Investment Fund, previously ERDF - European Regional Development Fund) have been recently reprogrammed (approximately €320 million) to improve access of SMEs to credit. There is room for further ESIF reprogramming into new national or regional financial instruments that may cover loans, guarantees, seed and working capital for SMEs. There is a business angels policy and a new programme for risk funding “Isabel la Católica”. It is important that the effectiveness of these recent policies to improve access to seed and start-up venture capital are continuously monitored and evaluated. In particular, increasing the level of risk in the instruments targeting early stage capital may help support the creation of high growth innovative firms.

There are indications of improved early stage seed capital in the Spanish system, while there are still very limited amounts of growth capital available. Similarly, national support for the growth of (innovative) SMES is quite limited. Also, support for the growth of SMEs is also co-funded by CDTI

and the regional level (Technology and Science Parks, Technology Centres, clusters, etc., see Chapter 4) but the lack of data blur the view on the relative role of State and Regions in funding these intermediaries. Besides structures acting as an interface between research and business, it is important to also acknowledge other kinds of business support, for example focussing on company growth, market development, management and internationalisation.

In Sweden, a National Incubator Programme has been designed with the ambition of creating more high-growth innovative firms (Box 5). In other countries, for example Denmark, accelerator programmes have been designed with the ambition of improving high growth. Searching for growth capital is part of what a professional incubator management team can do (growth capital is most often international). Thus, it is not the money itself that is the most important - it is the competence.

### **Box 5. Business Incubation for Growth: The Swedish National Incubator Programme**

Sweden's first national incubator programme was initiated in 2003. It was named the National Incubator Programme (NIP), and run by VINNOVA, the Swedish Governmental Agency for Innovation Systems. Based on experiences in NIP a second national incubator programme –IBIP – was launched in 2008. This was replaced by the third programme BIG (Business Incubation for Growth) in the autumn of 2011. Today the BIG programme is run by the national agency ALMI.

The purpose of the incubator programme is to give emerging growth companies in Swedish incubators access to the support they need to develop their businesses. The goal is to ensure that companies are able to increase sales, internationalisation and employment and improve their survival potential through the incubators. Most of the incubators are linked to a university, and mainly financed by regional and local initiatives.

The BIG programme offers three different kinds of funding for incubators: BASECAMP-funding for skill development and learning among incubator managers, performance-based SUMMIT-funding, as well as Explorer-funding for joint projects with several cooperating BIG incubators.

In 2012, the programme financed BASECAMP activities in 45 Swedish incubators. In addition 24 out of these also received performance-based SUMMIT-funding. This year, Almi contributed SEK 59 million to the management and development of these incubators, and an additional SEK 20 million in seed financing to different independent ventures in the incubators. In total over 2.000 new ventures have been created in these incubators, the majority are university spin-offs.

Within BIG it is not only the financing that is important. Out of the 45 Swedish Incubators in BIG there are only 24 with performance-based funding. The others only get a very small amount (BASECAMP) which is mainly used for competence building in the incubator themselves. In Sweden this programme has been important for improving technology transfer and the creation of new innovative firms.

Source:[www.almi.se/Nationell-inkubation-for-ledande-inkubatorer](http://www.almi.se/Nationell-inkubation-for-ledande-inkubatorer)

A recent Spanish example of public-private collaboration for the creation of high-growth innovative is the Accelerators of Telefonica presented in Box 6. The State contributed financially to Telefonica's Venture Capital Funds (in fact as much as €50 million). Telefonica's Accelerator initiative has in turn emulated other Spanish actors to establish similar schemes. In the middle of the crisis, 13 additional Spanish companies have now contributed to the creation of Accelerators and/or Funds. Today Telefonica collaborates with some 20 Spanish Accelerators, most of them private but a few public as well (often linked to universities). It is recommended that such initiatives of linking national and regional public actors with private (large as well as new or small) businesses are further encouraged, and scaled when they have proven their effectiveness, as well as carefully monitored and evaluated.

It is proposed that Spain links (parts of) its seed financing to incubators/accelerators, which can become important instruments for supporting the development of new innovative firms. This builds upon what Spain has already started (Telefonica) and adds competence to the capital. It is also something the State can achieve in collaboration with the Autonomous Communities (creating synergies and learning possibilities).

### **Box 6: Telefonica's Accelerators**

Being part of the Digital landscape/sector, Open Innovation and start-ups are important for Telefonica. Thus, in 2010, Telefonica initiated two Venture Capital Funds (AMERIGO, one in Spain and one in Latin America) and raised some € 300 Million in capital. Parts of the financing came from MINECO, while the Spanish Fund can be seen as an example of a public-private collaboration. The funds focus on investments in new technology ventures, where Spain is considered to have many good ideas, but less money. The VC Funds are managed by external professionals and open for investments from other companies.

One year later, in 2011, Telefonica's Accelerators were initiated (Start-up Accelerators, sometimes also called Incubators). These are physical offices for the incubation of new ventures. The first Accelerator was located in Telefonica's Madrid head quarter (with very hands on help from the CEO). Today Telefonica has 18 Accelerators (6 in Europe, out of which 2 in Spain: Madrid and Barcelona) in different locations where the company is active. The initiative is called WAYRA.

Since 2010 25.000 open innovation projects/ventures have been initiated, and by now this has led to the creation of 300 new ventures (worldwide). The ventures usually spend 6-9 months in the Accelerator before they are ready to leave. Telefonica takes equity shares in the ventures, but the financial motive is not the most important. Instead it is the scanning of new innovative ideas and talent that motivates the firm.

### ***Leverage the potential of public procurement for innovation***

It is a well-known fact that public procurement represents a huge pool of public funds, which can in part be mobilised to foster innovation. In Spain, there is no data available on share of this source in total GDP, but this is usually quite large in many EU countries. Public procurement for innovation, including, but not restricted to pre-commercial procurement, and extended to the Autonomous Communities, should be fostered in Spain. New European directives offer increased opportunity for innovation procurement.

The current Plan (2013-2016) includes public procurement of innovative goods and services within the Strategic Action of Economy and Digital Society (Programme business leadership, Subprogramme business R&D and innovation. Progress has also been made via specific contractual arrangements between the State and regional authorities in areas of mutual interest such as health, thus paving the way towards future areas of cooperation between State and Autonomous Communities (see Chapter 4). In addition, the Council of Ministries agreed in 2011 on setting a 3% target of new investments of the general public administration to be devoted to innovative public procurement and a guide to disseminate the procedures. Five tenders are listed in the CDTI web but it is not clear if the 3% objective has been met. The programmes to foster innovation through public procurement are still not evaluated (ERAWATCH 2013).

The Plan also mentions that the capacity of the Administration to act as a driver of business innovation by managing their demand for products and services by means of innovative public purchase initiatives needs to be developed. It is still unclear to which extent this has been implemented. There is a growing toolbox of instruments addressing different deficiencies in

innovation procurement (see Box 7). While Spain has been a leader in this area, as with other countries there is very large untapped potential. A key challenge is the need for coordination across government both at high level and at the level of the commissioning and purchasing decisions. In France, innovation procurement exists in the law for public procurement for several years with moderate success. It has been observed that the risk aversion of procurers is the main barrier to develop such kind of policy (particularly in municipalities or at regional level). This country's experience also demonstrates that raising awareness of procurers is important.

The results of the INNODEMANDA programme should be assessed against existing knowledge as summarised in Box 7. Indicators need to be developed, also at regional level, to evaluate the performance of procurers in the integration of innovation in their activity.

### Box 7: Instruments for innovation procurement

Policy Category	Deficiencies addressed	Instrument types	Examples
<b>Framework conditions</b>	<ul style="list-style-type: none"> <li>i) Procurement regulations driven by competition logic at expense of innovation logic.</li> <li>ii) Requirements for public tenders unfavourable to SMEs</li> </ul>	<ul style="list-style-type: none"> <li>i) Introduction of innovation-friendly regulations</li> <li>ii) simplification &amp; easier access for tender procedures</li> </ul>	2005 change in EU Directives including functional specifications, negotiated procedure etc. 2011 proposal in EU to introduce innovation partnerships Paperless procedures, electronic portals, targets for SME share
<b>Organisation &amp; capabilities</b>	<ul style="list-style-type: none"> <li>i) Lack of awareness of innovation potential or innovation strategy in organisation</li> <li>ii) Procurers lack skills in innovation-friendly procedures</li> </ul>	<ul style="list-style-type: none"> <li>i) High level strategies to embed innovation procurement</li> <li>ii) Training schemes, guidelines, good practice networks</li> <li>iii) Subsidy for additional costs of innovation procurement</li> </ul>	UK ministries Innovation Procurement Plans 2009-10 Netherlands PIANOo support network, EC Lead Market Initiative networks of contracting authorities Finnish agency TEKES meeting 75% of costs in planning stage
<b>Identification, specification &amp; signalling of needs</b>	<ul style="list-style-type: none"> <li>i) Lack of communication between end users, commissioning &amp; procurement function</li> <li>ii) Lack of knowledge &amp; organised discourse about wider possibilities of supplier's innovation potential</li> </ul>	<ul style="list-style-type: none"> <li>i) Pre-commercial procurement of R&amp;D to develop &amp; demonstrate solutions</li> <li>ii) Innovation platforms to bring suppliers &amp; users together; Foresight &amp; market study processes; Use of standards &amp; certification of innovations</li> </ul>	<ul style="list-style-type: none"> <li>i) SBIR (USA, NL &amp; Australia), SBRI (UK), PCP EC &amp; Flanders</li> <li>ii) Innovation Partnerships &amp; Lead Market Initiative (EC), Innovation Platforms (UK, Flanders); Equipment catalogues (China to 2011)</li> </ul>
<b>Incentivising innovative solutions</b>	<ul style="list-style-type: none"> <li>i) Risk of lack of take up of suppliers innovations</li> <li>ii) Risk aversion by procurers</li> </ul>	<ul style="list-style-type: none"> <li>i) Calls for tender requiring innovation; Guaranteed purchase or certification of innovation; Guaranteed price/tariff or price premium for innovation</li> <li>ii) Insurance guarantees</li> </ul>	<ul style="list-style-type: none"> <li>i) German law enabling innovation demands in tenders; UK Forward Commitment Procurement; China innovation catalogues (to 2011); Renewable energy premium tariffs (DE and DK)</li> <li>ii) Immunity &amp; certification scheme (Korea)</li> </ul>

Source: Georghiou et al 2013

### ***Support innovation culture***

The importance of citizens or consumers for fostering innovation cannot be overemphasised. The scientific, technological and innovative culture of a society is a variable that has a decisive effect on its capacity to adapt to technological changes, absorb technologies and new uses of these or to be active participants in open innovation processes.

This is notably important to support “living labs” and the co-creation of innovations; but also to develop trust, acceptability and market deployment of new technologies addressing societal challenges. City-level initiatives do exist in Spain (e.g. Barcelona won the EU “Innovation City” award) and can be expanded upon to support an innovation culture everywhere in Spain.

Inducement prizes and awareness raising campaigns are possible instruments to this aim. This challenge has been highlighted for a long time by COTEC and the Chambers of Commerce. The Spanish Foundation of Science and Technology (FECYT) is working on promotion of Scientific Culture and Innovation Culture (the Annual Plan of Activities 2013 notably awards FECYT EUR 3.25 Million for a competitive call to this aim).

### Summary of recommendations in Chapter 3

- 3.1. Use a raised funding level as a counter-cyclical measure to restore and stimulate increased business R&D spending in Spain, with the additional resources targeted on key direct measures reformed as below.
- 3.2. Innovation support actors including technological centres, science and technology parks, incubators and accelerators need to be integrated into more strategic approaches so that they can act as the core for cluster formation. Such an approach needs to be driven by a rigorous interpretation and application of smart specialisation strategies operated in a complementary manner between national agencies and agents of the Autonomous Communities.
- 3.3. Fine-tune the policy mix for R&I in firms: develop synergies with instruments from the industrial policy sphere, notably the work carried out by ENISA, alleviate conditions for awarding loans and make loans from public sector and specially from CDTI attractive by ensuring their interest rate lie substantially below those of commercial loans; provide subsidy-based support for hiring innovation managers in SMEs; ensure less fragmentation and more stability of instruments over time; further develop different types of support to public-private research collaboration as well as private sector collaboration, taking advantage of synergies in linking large and small innovative firms; eliminate the ‘joint and several liability’ requisite for participants in cooperative projects; target also non-technological innovation and SMEs which are “first-timer” in the innovation area; incorporate innovation voucher schemes to confer more demand-orientation to technology and innovation support centres; simplify and accelerate procedures; review the Spanish R&D tax credit system in order to address a number of difficulties; and develop strategic capacities of CDTI in order to secure additionality of public funding and discourage rent seeking behaviour of firms
- 3.4. Encourage the creation and growth of innovative new firms: reinforcing the role of private venture capital in financing projects, providing venture capital for later growth phases of innovative SMEs, monitoring the effects of recent seed and venture capital schemes, and providing other support measures such as public-private models of incubators
- 3.5. Leverage the potential of public procurement for innovation, at State and regional levels
- 3.6. Further support a culture of innovation

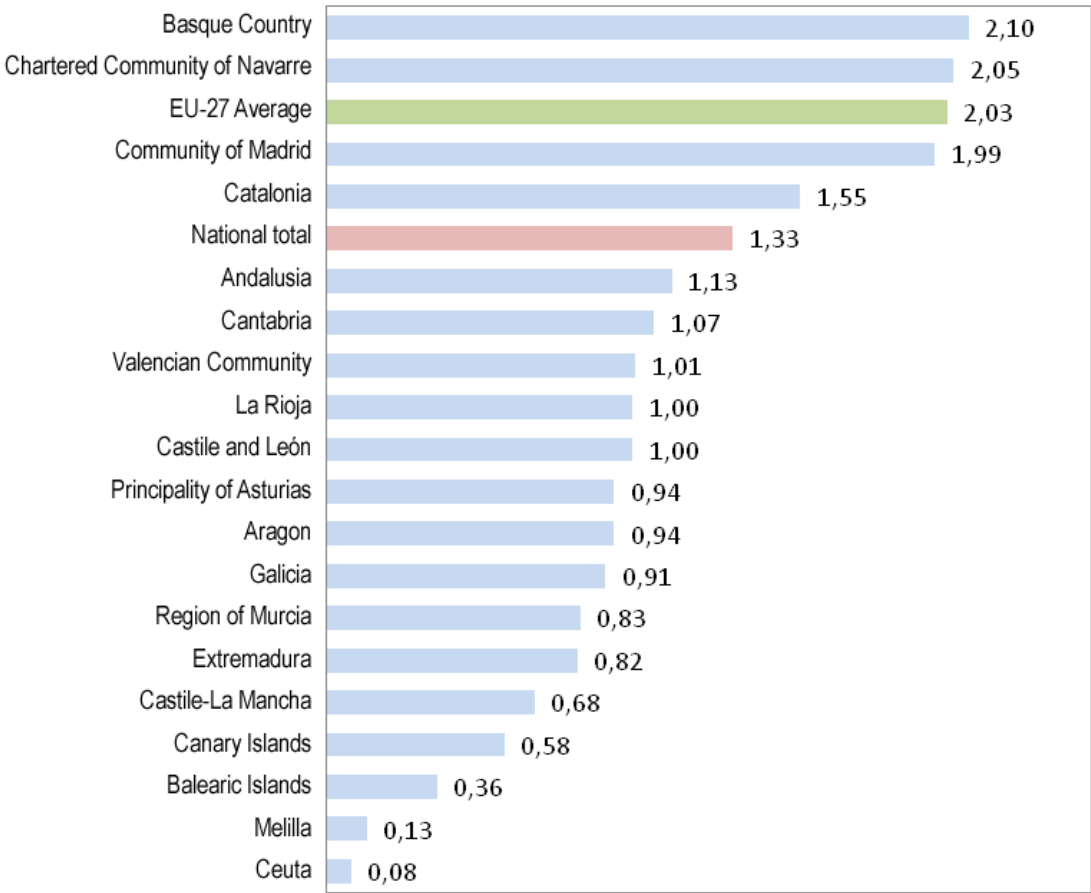
## 4. National-regional synergies in Research and Innovation

### 4.1. The challenges

#### Diversity in regional R&I potential and performance

Nearly all Spanish Autonomous Communities are classified, like the country as a whole, amongst the “moderate innovators” category of the European Innovation Union Scoreboard. Only two Autonomous Communities fall in the upper category of “innovation followers”, Pais Vasco and Navarra. Those two regions are also the only two Spanish regions that display a R&D intensity above EU average (Figure 14). R&D activities are highly concentrated: in absolute terms, four regions only account for 70% of all R&D expenditures: Madrid (25.6%), Catalonia (22.3%), Andalusia (11.1%) and Pais Vasco (10.7%) (2012 data, Erawatch report). Taking into account regions’ GDP size, leading regions are Pais Vasco, Navarra, Madrid and Catalonia with a share of GERD on GDP in 2011 of 2.1%; 2.05%, 1.99% and 1.55% respectively. This disparity creates an important challenge for national policy, to ensure that it fits the need of all parts of the diversified territory.

**Figure 14. R&D intensity of Spanish regions (GERD/GDP) - 2011**



Source: INE. Prepared by FEYCT.

From a scientific perspective, Catalonia is the most connected Spanish region, and Madrid, Andalusia and the Community of Valencia are the only other Spanish regions to be classified amongst the 50 EU regions with high scientific output (Figure 15). The same regions (Catalonia

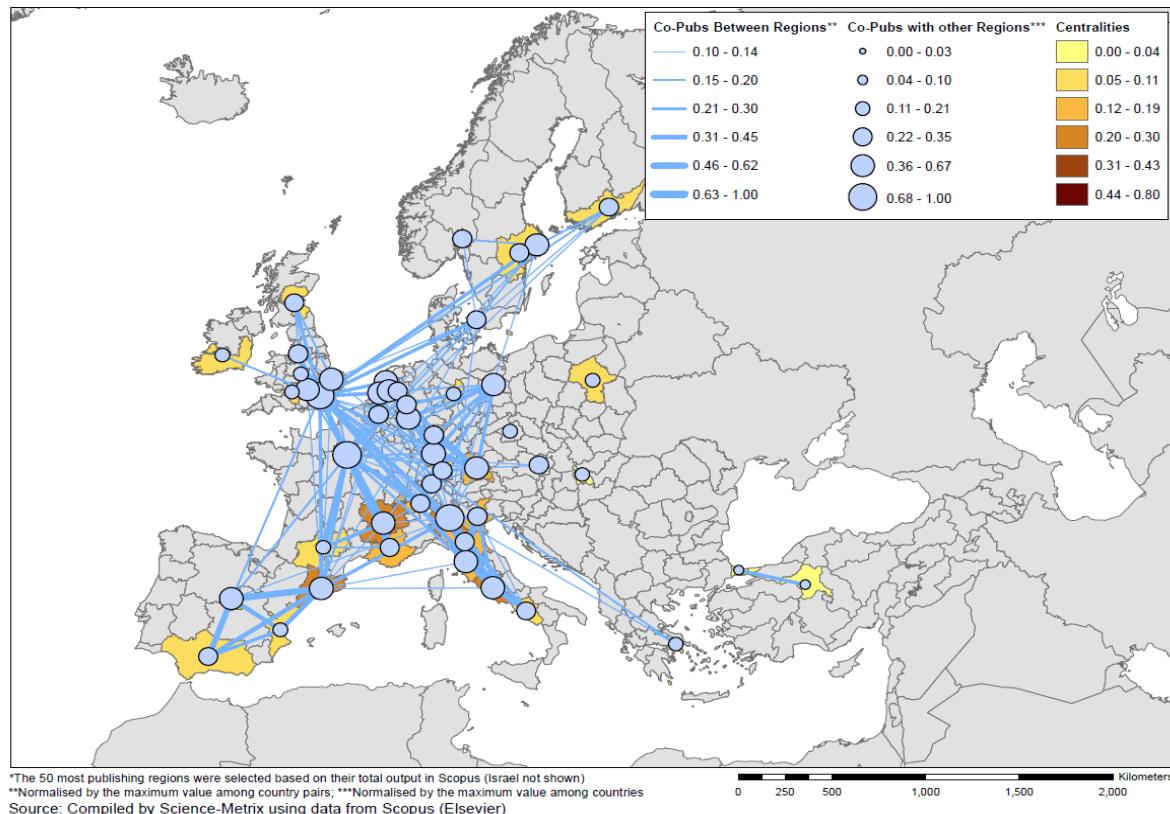


and Madrid in particular) stand out in terms of the capacity of their universities to attract EC funding from FP7. The ten Spanish universities which are the highest beneficiaries from FP7 come from three Autonomous Communities: Madrid, Catalonia and to a less extent Valencia<sup>17</sup>.

**Figure 15. Scientific connectivity of EU regions**

**Collaboration network of the 50 most publishing NUTS2 regions\***

Total FP7 Thematic Priorities, 2011



Source: European Commission 2014b

***A fragmented business support services landscape and insufficient evidence of effectiveness***

Spanish Autonomous Communities are responsible for innovation and business support and develop a wide range of tools and incentives to promote business-driven innovation, technology transfer and knowledge circulation, also with some support of European Structural Funds. This encompasses a wide diversity of bodies and programmes scattered over the whole territory:

- Science and Technology Parks;
- Technology Centres;
- Business support and regional development agencies;
- A variety of (small-scale) funding programmes;
- Cluster policies of varied scope;
- Etc.

<sup>17</sup> These are : Universidad Politecnica de Madrid, Universidad Pompeu Fabra in Barcelona, Universidad de Barcelona, Universidad Politecnica de Catalunya, Universidad Autonoma de Barcelona, Universidad Politecnica de Valencia, Universidad Autonoma de Madrid, Universidad Complutense de Madrid, Universidad del País Vasco, and Universidad de Valencia. There is a large concentration of the funding in the five first universities. (European Commission 2014).

This diversity creates a fragmented landscape that is not easy for innovative firms to navigate through, especially for the smallest ones. The complementarity with national level schemes, programmes and organisations is not always clear either for beneficiaries.

The lack of evidence about the effectiveness of those organisations and programmes in supporting business RDTI in Spain is a problem. Both Technology Centres and Science and Technology Parks depend to a large degree upon public funds, often in a combination between national and regional origin (and with the addition of ESIF). However little is known about their contribution to knowledge-based development and the match between the services they deliver and the needs of SMEs, in particular.

The case of Science and Technology Parks has been put under the spotlight in recent times, due to the important difficulties faced by these organisations to reimburse the loans received by the State. The contribution of Science Parks to locally-based regional development cannot be taken for granted. As argued in (Nauwelaers et al. 2014), they can act as a fertile ground for developing innovation-oriented initiatives, only if a number of conditions are met, notably: (1) internal connectivity is high and if there is a favourable ecosystem facilitating the creation of new, unexpected combinations leading to innovation; (2) the ecosystem is well embedded in the wider regional ecosystem, where other skills and resources can be accessed; (3) the share of private funding is sizeable and the Park is not too dependent on public funds. It is unlikely that this sector can be brought into a productive role under their current debt burden and there would seem to be no real prospect of the debt being paid off in the foreseeable future. A thorough evaluation of impact of the funding allocated to Science and Technology Parks is needed, in view of ensuring an evolution towards more effective contribution.

Technology Centres follow a large diversity of models, in line with the diversity in regional contexts and regional strategies: some like Tecnalia in the Basque country are key actors at the edge of research, involved in European R&D partnerships and playing a key role in their regional smart specialisation strategies, while at the other end of the spectrum, others are merely acting as service centres to local companies. Hence a general diagnosis cannot be made, but detailed evaluations are needed to assess their performance. For these two instruments, cases of “cathedrals in the desert” have been reported, which deserve attention and correction. Problems of lack of critical masses should also be addressed by mergers and strategic alliances between centres. As mentioned in the previous chapter, introducing innovation voucher schemes at national level is a good option to concentrate funding on the more efficient centres.

### ***Large potential but limited use of EU Cohesion funds to support innovation in Spanish regions***

Due to its size and the intensity of development problems, Spain is, with more than 5 billion €, is one of the EU Member States that has dedicated the largest absolute amounts of ERDF funds to R&I in the period 2007-2013 (the third after Poland and Italy in absolute numbers). During the 2007-2013 period for Cohesion policy, Spain has received from this source an average annual R&D budget of €710m, which is about 9.6% of overall Spanish public expenditure on R&D (calculated with the data of the year 2009) (Source: MINECO). This EU-level source represents a source of R&D funding for the country that should not be neglected. Furthermore, with the advent of more

strategic policies in the regions, following the smart specialisation strategy line, such a source could have an important leverage effect beyond its actual quantitative share in total funding.

This being said, the relative figures show that the share of Structural Funds allocated to R&I during the period 2007-2013 - a proxy for the importance given by Autonomous Communities to this component of their growth strategy – is remarkably low in Spain: with a share of 20%, the country comes in 15<sup>th</sup> position on this indicator, below all other EU-15 Member States except Greece. This share only increases slightly in the current period, to a little more than 22% (Table 3). Only Asturias, Catalonia and Extremadura have increased their budget for RDTI in absolute numbers during this period. The share of RDTI in total ERDF funding has decreased considerably (compared to the previous period) in Aragon, Cantabria, Baleares and Madrid. There is hence a large unused potential from this public funding source to reinforce R&I in the whole of Spain.

**Table 3. Allocations of EU Structural Funds to R&I in Spain**

Period	Allocation ERDF to R&I	Share of R&I in total ERDF
2007-2013	5.168.747.805 €	20 %
2014-2020	4.349.158.788 €	22.4 %

Source: European Commission, DG RTD

**Weak coordination mechanisms between national and regional strategies**

R&D budgets from the Autonomous Communities account for approximately 60% of total GBAORD in Spain (with 50% of this spending allocated to General University Funds). This makes coordination between national and regional investments in R&I a necessary condition of success for policies at both levels. The Panel recognises advances made in coordination around the Strategy: the Strategy has been jointly elaborated for the first time, by the State and Autonomous Communities but nonetheless this is not sufficient to unlock the potential synergies in the Spanish system.

Spanish Autonomous Communities have contributed to the National Strategy, which is a “RDI political agenda which includes coordination between the actions of the General State Administration, the Autonomous Regions and the European Union”. We note the following references to the role of Autonomous Communities in the overall Spanish Research and Innovation System in the Strategy:

- The first basic principle of the Strategy is “Coordination of the Policies for RDI of the Public Administrations with the European Union, and with the other sectorial policies, in order to generate the necessary synergies and complementarities”. It would be beneficial to elaborate this with clearer statements on the contributions of regional authorities, within the limits of their constitutional rights;
- The fifth priority in the Strategy refers to the benefits to be expected from smart specialisation strategies from a regional perspective and this is welcome intention. The articulation with the National Strategy will need to be clarified at the stage of implementation of the strategies in the regions: “the creation of a highly competitive regional framework based on smart regional specialisation to provide the backbone in the different Autonomous Regions to the social and economic development that requires

*convergence based on the capacities of the existing production network, the scientific potential of the stakeholders and the boost to innovation as a driver of change and progress”;*

- The elaboration on the theme “Boosting business R&I” does not incorporate a mention of the role of Autonomous Communities, while the following appears under the “Societal Challenges” theme: “*given that in some areas competences are transferred to the Regions, a very concerted and coordinated action with the Regions is also required*”;
- The description of the 8 societal challenges on which the Strategy wants to put priority does not mention particular areas of strengths in regions. Articulation would be a useful next step.

The National Strategy was elaborated during 2012 and approved in February 2013, before the adoption of Smart Specialisation Strategies in the Autonomous Regions. During the interviews the Panel members noticed that the Spanish government has been working together with the European Commission to adopt the Spanish Strategy as the national strategy for smart specialization. After approval by the Commission of all Smart Specialisation Strategies the Spanish Strategy should be updated as a mechanism to build regional-national synergies.

#### ***Synergies or duplication in smart specialisation strategies?***

Spanish Autonomous Communities are amongst the EU regions which are most active in designing and adopting smart specialisation strategies, in response to the new conditionality imposed by the European Commission to access cohesion funds. Many Autonomous Communities focus on similar broad priorities: sustainable agriculture and natural resources (14 regions); intelligent and sustainable transport (13 regions); sustainable energy (9) and digital society (9). This provides opportunities for synergies but also creates risks of duplication. In some regions, the exercise might have consisted of a replication of Spanish priorities, with little strategic work carried out to identify genuine regional strengths. This can be linked to the lack of capacities in some administrations of those regions which are not amongst the frontrunners in innovation. Generally, regional R&D strategies do not include - with some exceptions - measures for the cooperation with other Spanish regions.

Smart specialisation strategies, if they are conducted carefully, can help create a better picture of regional strengths, in order to support the objective of creating more focus and more critical mass in the research system. This new type of regional innovation policy recognises the diversity in regional potential and pushes regions to find their comparative advantages not only in frontier technological development but also (and mainly, in the Spanish case) in smart and creative applications of existing knowledge and technologies. This gives a chance to all regions, provided that they mobilise their resources and connect to resources outside their own territory.

## 4.2. The recommendations

The Strategy “*supports the complementarity of the scientific, technical and innovation capacities and the production capacities existing in the Regions, so that the system will acquire an overall vision on a national level*” and “*supports alignment with the instruments and strategic objectives defined in the framework of the new «smart specialisation strategies» -RIS3*”.

Given the institutional context, R&I policies in Spain need stronger coordination to achieve greater economic impact and benefit from both economies of scope (specialisation) and scale (aggregation).

In order to achieve this goal, the following four recommendations are proposed:

1. Reinforce effectiveness of, and synergies between, innovation support organisations spread over regions;
2. Reinforce mechanisms for the sharing of research infrastructure;
3. Engage in national-regional and cross-regional coordination and programming;
4. More strategic use of ESIF funding and enhancement of regional planning capacities.

### ***Reinforce effectiveness of, and synergies between innovation support organisations spread over regions***

In order to address the fragmentation of business support there is a need to evolve towards a more integrated and more effective network of organisations involved in supporting business.

The Strategy acknowledges the need for an “*efficient network of structures, such as Technology Platforms, Alliances for Science and Innovation, Technology Centres, Science and Technology Parks, University Foundations and other public organisations, transfer units and others which act as an interface between researchers and the production network*”. This is certainly a valid objective, but it is important to also connect companies (and in particular SMEs) to other types of support, targeting internationalisation, management, etc., in short support for non-R&D-driven innovation. Ensuring that the different structures are well aware of the services provided by other organisations and fine-tune their own mission according to the complementarity between their expertise and that of the other structures, is a first step to that objective. This implies that the “networking” and “referral” missions are integrated into the mandates and funding criteria of these organisations. Here it is important that the missions are defined in a user-oriented perspective based on actual feedback by companies, rather than based on views of structures managers only.

These networks should not be confined to administrative boundaries: neighbouring regions should be encouraged to offer each other innovation services by forming alliances that could compete for business or consolidate their activities to achieve supra-regional economies of scale and scope.

It is obvious that better networking and integration between business support services is important and necessary, but insufficient: they can only serve companies’ needs if the various components of the networks function well.

Technology centres, most of the existing ones being established at regional level, have been established to address the problems faced by micro-SMEs which lack absorptive capacity to integrate new R&D results. They are expected to play a key role in the renewal of the Spanish industrial and services fabric. A way to break the vicious circle (no R&D absorption -> only cost based competitive offerings -> no money for investment in R&D absorptive capacity -> no R&D absorption) is indeed to establish intermediary organisations that perform research for a group of firms (also called collective research centres in other countries, see Box 8, example from Belgium). These can help transfer technology and knowledge into micro-firms, and foster wider knowledge circulation, which is a key bottleneck in the Spanish research and innovation system. Science and Technology Parks are expected to play such a stimulation role for firms that are linked to the science base. Demand-oriented funding schemes like innovation vouchers will help clarify the landscape of technology centres and identify the way these respond to SMEs needs.

### **Box 8. Belgian Centres of Collective Research**

Belgium has a long standing tradition in centres for collective research (dating from shortly after the Second World War) that perform research for a group in a technology domain. An interesting point in the set up in these centres is the membership fee paid by the participating companies: this creates a strong incentive for the centres to address issues relevant for the companies. One lesson from the experience with these centres for policy makers, is to clearly set the target in terms of addressing low tech companies versus focussing on breakthrough technology development that benefit more high tech innovative companies.

The actual role played by a range of agents that are part of the system and broadly cover the knowledge circulation missions - technology platforms, technology centres, OTRIs, science parks - is not well understood so far. There are four points on the agenda to meet the expectations set in those structures, which receive an important part of public funding for R&I (notably at regional level) (OECD 2011):

1. ensure a user-driven orientation, based on beneficiaries and partners' feedback;
2. ensure more networking within regions between structures with similar and complementary goals;
3. establish compulsory strategic monitoring and evaluation systems geared towards improving the performance;
4. develop more cross-regional use of these agents and encourage the creation of more professional and larger units, reducing fragmentation (see Box 9).

### **Box 9. Technological Transfer Acceleration Companies (SATT) in France**

The SATT programme aims to create around ten technology transfer acceleration companies. These companies will be mostly owned by a consortium of HEI and research centres. Their mission is to focus on the valorisation of public research through innovative strategy in respect to patents, industrial partnerships, creation of SMEs, and researchers' mobility. The SATT programme represents 90% of the funding coming from the "National Valorisation Fund". The other 10% of the Fund will be used for specific valorisation projects from SATT selected through competitive calls. 900m€ have been allocated to the SATT in 2010.

SATT is part of the French 'Investments for the Future' programme. This programme was enacted in March 2010 with a state budget of €35 b (to be complemented with private investments). It funds projects with high potential for the economy and focuses on higher education and training, research, innovation and sustainable development. It thus also serves to finance investment in strategic sectors. Similar to other measures of the programme, SATT is an instrument for public administration to support innovation and research through large funds. SATT is part of a strategy that aims to provide French HEIs and research organisations with the means to be key players in the global research and innovation landscape.

Source: ERAWATCH

In the emerging division of labour between State and Autonomous Communities action toward R&I, Autonomous Communities seem in general better placed to deal with modernisation strategies while the State can take care of science- and technology-based and radical innovation (with of course a fuzzy border between those two broad types of innovation). As an example, the AEI State cluster programme seems to be funding many small clusters. If the State turns to Strategic Innovation Arenas (which needs to be bold, see next Chapter) then the Autonomous Communities could focus on smaller networks and prioritise incremental and less science-based innovation.

### ***Share research infrastructure***

Previous rounds of ERDF co-financing have resulted in a high quality of research infrastructure being accumulated in public R&D organisations and universities in Spain with co-funding both from national and Autonomous Community levels. Equipment ranges from large facilities (e.g. synchrotron) through to mid-scale and small items. This capital renewal provides a good base for investment in resource spending to take advantage of the equipment and the equipment should remain at a competitive level for some time. However, evidence was also provided that duplication exists, especially between regions.

It is recommended that a system is put in place for systematic sharing of equipment to ensure maximum use of assets, and to ensure that future capital investment is made with maximum efficiency. Sharing requires an accessible database of available items and pre-existing arrangements covering charging arrangements, training, health and safety, liability etc. Such arrangements may also be extended to industrial users, creating a further axis of cooperation (see Box 10 on North of England arrangements).

#### **Box 10. Equipment sharing in research intensive universities in the North of England**

UK research funding bodies experienced major cuts in capital funding in 2011. One response was the imposition of a requirement for any new equipment to be accompanied by proof that existing assets were fully utilised. The N8 group of research intensive universities in the North of England was the first to respond by developing a commonly searchable inventory of all equipment items costing over £25,000. ( <http://www.n8equipment.org.uk/> )

The initiative continued by developing protocols for sharing equipment where spare capacity existed, consisting of an equipment sharing toolkit ( <http://www.n8research.org.uk/asset-collaboration/n8-est/>). This provides guidance on Health & Safety and Training, Pricing and Charging, taxation and Contracts and Legal matters. The group also used the protocols in support of winning funding for a shared High Performance Computing Facility which has in turn acted as a major attractor for collaborative projects with firms. Other regions have now followed suit. Successful arguments for a new capital funding initiative by the government were supported by these demonstrations of efficiency gains (see also Georghiou, 2012)

### ***Engage in national-regional and cross-regional coordination and programming***

To foster collaboration in R&I policies, the State could facilitate and set up a coordination mechanism that not only involves political decision makers and/or high level officials but also includes more operational levels and tasks (such as e.g. a portal with all calls for proposals, an information exchange mechanism as to avoid overlapping initiatives, ...). In the latter case, coordination should be organised frequently and regularly. Currently, informal consultation between Autonomous Communities exists but no permanent platform exists.

To address fragmentation and reduce the risk of overlap across 17 regions lacking critical mass for specialisation, common programmes (taking EU ERA-nets and Joint Programming as models) could be incentivised around RIS3 and ESIF.

Joint programming and co-financing instruments could be developed, where the State and Autonomous Communities jointly allocate funds coming from their respective programmes, in a variable geometry setting. This would facilitate a significantly higher number of cooperative R&D and Innovation projects of multiregional scope, beyond those multiregional projects which are currently funded by national calls for proposals. In fact, it would allow each participating region to ensure funding for the benefit of their respective regional R&D and Innovation stakeholders under projects that would be carried out in cooperation with stakeholders from other regions, without having to apply for conventional national calls for proposals where applicants compete with stakeholders from the 17 Spanish regions. Examples of coordination should be studied and extended if successful: e.g. Madrid and Navarra have combined CDTI funds with ERDF funds from their respective Operational Programmes for co-financing business R&D and innovation projects coming from these two regions. The Strategy has recognised this potential from joint programming and it is important to implement this.

Drawing lessons from joint programming experience at EU level, it appears that a key success factor is to agree a general framework so that time and resources are not wasted on transaction costs such as terms and conditions each time a new opportunity emerges. Matching funds rewarding cross-regional cooperation could be provided by the State, e.g. in the framework of Strategic Innovation Arenas of national interest (cfr. Chapter 5). The principle of variable geometry should also be applied in order to ensure flexibility and suitability to the variety of regional needs.

The RIS3 exercises carried out in all Spanish Autonomous Communities provide a good opportunity to engage in such joint programming. The R&D and Innovation axis of the draft Multiregional Operational Programme (drafted at State level) envisages the possibility of being jointly implemented with regions by means of “joint programming activities”. This shows a clear will from the State side for achieving a certain degree of coordination with the regional Autonomous Communities. Yet, such openness to coordination coming from the State side needs to be matched by a favourable reply and a political consensus from each and every one of the 17 Autonomous Communities, or at least from a significant number of Spanish regions. This has to be achieved along two dimensions: a thematic perspective –i.e. those specific sectors or technology domains which are considered as suitable and priorities for an exercise of joint programming and co-financing-, and an instrumental perspective –i.e. specific joint support measures and calls for proposals. The State is coordinating, through the National Plan, joint programming initiatives including also multiregional initiatives. This openness is not (yet) present in the current RIS3 drafted by the Autonomous Communities.

When Autonomous Communities will have adopted their RIS3 and translated them into renewed policies, time will be ripe for a revision of the National Strategy, to improve alignment of the various strategies.



RIS3 also provides an opportunity for networking and alliances with external regions active in the same value chain. The example of the Vanguard initiative (Box 11), to which Asturias, Catalunya and Euskadi are committed, shows interesting perspectives for developing inter-regional innovation-oriented policies.

#### **Box 11. Vanguard initiative of EU regions**

The 'Vanguard Initiative for New Growth through Smart Specialisation' seeks to better position and embed the smart specialisation agenda within relevant EU policy frameworks. The multi-level political leadership highlights common goals, while promoting a bottom-up entrepreneurial drive for value-creation. The initiative works through the following activities:

- Matching strategic roadmaps between regional, national and European policy levels in support of European priority areas, such as those that are identified in the Industrial Policy Communication of October 2012. Vanguard Initiative regions are committed to developing joint roadmaps for building critical mass and complementary specialisations in these emerging industries.
- Aligning strategic investments, arising from these roadmaps, in order to open new industrial pathways via flagship projects such as demonstrators and pilots identified in the European priority areas. Vanguard Initiative regions are committed to combining their resources with European investments in these focus areas.
- Upgrading regional partnerships and clusters with global potential, which are identified in smart specialisation strategies, to European world-class clusters that can compete globally. Vanguard Initiative regions are committed to internationalising their cluster initiatives in cross-border and interregional networked European clusters and partnerships.

Source: [www.s3vanguardinitiative.eu](http://www.s3vanguardinitiative.eu)

#### ***More strategic use of ESIF funding and enhancement of regional planning capacities***

To avoid funding facilities which are not effectively used – which is a well-known risk faced by regions with weak absorptive capacity that have been large recipient of Objective 1 ERDF funds in the past - there is a need to take a need-driven approach to innovation promotion. Establishing clear and measurable targets for the investments and fine-tuning the funding criteria to the achievements of such targets, is necessary to improve effectiveness in the use of ESIF in the current programming period.

Another key aspect is the acceptance of private co-financing for R&D and Innovation projects funded by Structural Funds. Private co-financing of operations is foreseen in the Structural Funds regulation. It could be implemented while fully respecting the intensity of aid thresholds set up by the Community Framework on State Aid to R&D and Innovation activities.

Evolving towards better strategic planning and more effective implementation of actions funded by ESIF (beyond a “funds consumption” approach) requires regional administrations that are equipped with the necessary skills and tools. Exchanges of good practices and diffusion of methods, indicators, etc. could be facilitated either by a central organisation or by bottom-up networks of Autonomous Communities.

## Summary of recommendations for Chapter 4

- 4.1 Reinforce effectiveness and synergies between the variety of innovation support organisations (Technology Centres, Science and Technology Parks, clusters, etc. ) spread over regions:
- Include “networking” and “referral” missions in the mandates and funding criteria of these organisations;
  - Ensure more networking within regions between structures with similar and complementary goals;
  - Establish compulsory strategic monitoring and evaluation systems geared towards improving the performance;
  - Develop more cross-regional use to achieve supra-regional economies of scale and scope;
  - Ensure a user-driven orientation, based on beneficiaries and partners’ feedback, and with the help of voucher schemes.
- 4.2 Put in place a system for sharing of research infrastructure and for systematic sharing of equipment to ensure that future capital investment is made with maximum efficiency, involving also industrial users.
- 4.3 Engage in national-regional and cross-regional coordination and programming; set up a coordination mechanism using RIS3 and ESIF within a variable geometry setting; support the development inter-regional innovation-oriented policies.
- 4.4 Review the National Strategy in light of the regional smart specialisation strategies.
- 4.5 Evolve towards more strategic use of ESIF funding and reinforce strategic capacities at regional level through new tools and exchanges of experience.

## 5. Cross-cutting solutions to cross-cutting challenges

This section gathers two important recommendations provided by the Peer Panel to increase the effectiveness and the relevance of the Spanish research and innovation system. The first one – the establishment of Spanish Strategic Innovation Arenas – is seen as a way to enhance the critical mass and long term public-private synergies that are lacking today in the system. The second one – the reinforcement of a monitoring and evaluation system – is a necessary condition for ensuring policy impacts, in times where each euro spent on research and innovation counts.

### 5.1. Spanish Strategic Innovation Arenas

The weak innovativeness of the business sector, the lack of incentives in the public research sector to orient research and technological development towards the needs of the productive sector and societal challenges, the fragmentation of research activities carried out in public research sector, the mismatch between public research potential and economic potential, and the lack of incentives to search for synergies between regional and national actions in support of R&I, are key challenges for the Spanish R&I system. Today, Spanish R&D funding schemes are targeted at separate groups of beneficiaries rather than at specific areas with innovative potential, and tax incentives do not allow strategic focusing,

A way forward to tackle these challenges simultaneously is to establish nation-wide consortia geared towards innovation, gathering the best resources from both the public and the private sectors and taking the form of “Spanish Strategic Innovation Arenas”. The Strategy recognises the goal to orient research towards strategic areas, and this could help implement this intention. This section discusses the main characteristics and feasibility of this option for Spain, based on existing experiences in the country and on foreign initiatives.

This type of solution would help to implement the priority set in the Strategy, which: *“recognises the importance of stimulating far-reaching and ambitious business initiatives in RDI, the objective of which is business leadership in highly competitive global environments”*. The latter would be the overall goal of the proposed Spanish Strategic Innovation Arenas.

Spanish Strategic Innovation Arenas would display the following characteristics:

1. Their aim is the transformation of the productive and services sector in Spain, towards more value-added, more knowledge-based activities;
2. They gather actors from the private and public spheres, and act in a multi-disciplinary setting around a theme for which Spanish actors are at competitive edge, enjoy technological excellence, and respond to societal challenges;
3. The participation is open to all types of actors provided that they can demonstrate contribution to the overall goal and synergies in their contribution; there is no pre-allocation of budgets to specific types of actors and their mix can vary according to domains;
4. They have a national coverage and make full use of regional capacities; there is no pre-defined regional allocation of funds;
5. They are internationally-oriented and cooperate with foreign platforms in similar or complementary domains;

6. They are selected, with the above overall goal and key characteristics in mind, through competitive procedures, involving independent and foreign evaluators;
7. They combine support from regional and national authorities, and European Cohesion funds are directed towards these consortia. Regional support is expected to match the specialisation domains of smart specialisation strategies;
8. The definition of public support is done in partnership between the actors in the consortia and the public authorities. This support covers not only R&D and innovation funding but also soft support to businesses, training and education programmes, adaptation of regulations, etc. It can vary from one consortium to another, according to the specificity of the domain;
9. They work within a long-term perspective, they are not “projects” but platforms for innovation;
10. The consortia are evaluated regularly against their contribution to the main objective and funding is tuned to the results of the evaluation.

Table 4 provides several examples of this type of arenas, as they have been implemented in different ways in several EU countries (Germany, France, Sweden and in the Netherlands). A Spanish pilot exercise developed in the framework of the Smart Specialisation Strategy in Catalonia is described in Box 12.

### **Box 12. Catalan model for public-private consortia for research and innovation**

RIS3CAT communities are voluntary associations of companies and stakeholders in the Catalan R&I system that work in coincident sectors and cooperate to incorporate R&I into production activities in the leading sectors.

These communities are an essential and innovative element of RIS3CAT. As active stakeholders in the Catalan innovation ecosystem, they ensure the participation of companies and stakeholders from the system in defining, monitoring and evaluating the priorities for R&I programmes. Their multidisciplinary profile and bottom-up focus make them leading players in entrepreneurial discovery processes that lead to increasing specialisation, as they identify and generate projects related to specific topics in the leading sectors.

RIS3CAT communities are selected by open calls for proposals, implement agendas for the economic transformation of production activities through the incorporation of R&I. Within the sectors they represent, the members of the communities must generate critical mass and be representative and multidisciplinary, as well as featuring considerable private sector involvement.

RIS3CAT promotes new, emerging economic activities based on market opportunities, technological need or new knowledge generated through cooperation amongst stakeholders from different sectors. Once identified, opportunities must be included in an action plan that establishes business initiatives to successfully capitalise on economic potential through research and the creation of emerging companies.

The emerging activities selected (no more than four in each different time period), organised into clusters, receive technical and financial support over the course of two or three years, enabling them to develop work programmes and consolidate their business activity in the global market. Clusters are established by groups of research and innovation companies and stakeholders with capacity for international leadership that present an action plan for cooperation, innovation and investment and are engaged in emerging technological sectors or unexplored market niches. Action plans can be very different in type, but must always follow the principles established for RIS3CAT tools. They must define quantifiable objectives and impact indicators that enable the results of their actions to be evaluated.

RIS3CAT are funded by the Government of Catalonia, European funds and other public/private sources of finance.

Source: extract from RIS3 Catalonia

Spanish Strategic Innovation Arenas would use existing programmes in a more strategic way. The Spanish CIEN programme, the follower of the CENIT programme supporting public-private partnerships in R&D (see Chapter 3), could serve as a funding mechanism supporting the consortia. The existing cluster programme (AEI) could also be used to fund certain activities within the Arenas, provided that they demonstrate their contribution to their overall goals and reach a critical size. This would actually lead to a levelling-up of the program. Compared to the current functioning of the AEI, it is expected that this would decrease the number of projects funded (in 2014 161 clusters are funded) in order to fund larger initiatives, avoiding wasteful duplications across regions. The same could be said for Technology Platforms, of which the budget is only EUR 1,5 million for 2013, and which fund as much as 50 Platforms. Alternatively such programmes could be suppressed and the funding saved (even if limited) re-allocated to actions under the Strategic Innovation Arenas.

To define their strategy, Spanish Strategic Innovation Arenas could take inspiration from the successful examples of Germany and Flanders in implementing “agenda processes” to generate strategically-oriented innovation projects and research programmes (Boxes 13 and 14).

Some lessons emerging from foreign initiatives are:

- **Sweden:** on the importance of selection criteria oriented towards innovation. The first Strategic Innovation Areas that were selected were not primarily high-technology areas. Instead some traditional sectors (e.g mining and metal extraction) were selected. This is due to evaluation criteria being very strong on 1) building on existing strong research and innovation strength and competitiveness and 2) Strong emphasis on innovation. Interestingly the traditional sectors were very good at the second criteria (maybe because of the competition with the strong high-tech sectors). Today the Strategic Innovation Areas of course also cover high-tech environments, but this is not the major criterion;
- **France:** on the importance and role of the centralised labelling process and of national-regional coordination and mobilisation but based on a bottom up approach to favor creativity from local actors. The French experience suggests a process that is run as follows:
  1. Set up centralised labelling and funding schemes based on inter-ministerial evaluations;
  2. Empower and use existing public partners to accompany the clusters at all levels;
  3. Link labelling to smart specialisation strategies;
  4. Evaluate the necessary funding levels and mobilise inter-ministerial, regional and national funds on a significant scale;
  5. Organise regular calls for projects – at least 2 major calls per year, and smaller specific calls at more frequent intervals.

**Table 4. Models of strategic innovation arenas**

	<b>Spitzenclusters Germany</b>	<b>Competitiveness poles France</b>	<b>Strategic Innovation Agendas and Areas, Sweden</b>	<b>Top Consortia for Knowledge and Innovation, Netherlands</b>
<b>Objective</b>	Developing strategic collaborative partnerships involving public research actors as well as businesses, aiming at jointly developing innovative products and services leading to renewal of the productive fabric towards more competitive activities. Responding to societal challenges with innovative solutions is a main goal of these consortia			
	“Take Germany to the top of the league of technologically advanced nations”	“Build on synergies and innovative, collaborative projects, in order to give partner firms the chance to become first in their fields, both in France and abroad”	“Renewal of Swedish areas of strength Stimulation of future areas of strength through the development of new and the modification of existing value chains Strong cross-industry expertise, knowledge, technology and service development”	First goal is to guide research and innovation towards Dutch top sectors. Second goal is to stimulate economic development through cooperation between firms, R&D agencies and knowledge institutions in so-called innovation contracts (see below)
<b>Target</b>	Clusters of businesses (large and small), public research organisations and HEIs, forming a critical mass, active in specific domains and developing joint strategic agendas and common projects			
	Focus on a technology	Regional dimension combined with international or national excellence	National dimension Focus on “need owners”	Focus on innovative wider product value chains
<b>Selection mechanisms and type of public support</b>	Very selective Competition No top-down decision on sectors 50% matching funds by private sector	Competition with three “quality” levels (international, national, regional relevance) No top-down decision on sectors. Clusters have been selected from open calls. Labels are given for 4 years, and renewed after appraisal.	Competition. International peer evaluation There are two types of efforts – Agendas and Areas Agendas are formed in a first step before a consortium applies for a Strategic Innovation Area (SIO) Funding to organise and manage a SIO programme Funding for research, development and usage.	Guidance and initiatives are delegated to Top Teams for each sector, who stimulate the establishment of innovation contracts: agreements between the State and actors of the Top Sectors on collaborations and inputs allocation of money. Top Consortia for Knowledge and Innovation (one or more for each sector) implement the innovation contracts. Supplement awarded on top of grants from existing funding sources and institutions devote funds, for user inspired fundamental and applied research for the top sectors. MIT scheme: support for SMEs: feasibility studies, knowledge vouchers, hiring of knowledge workers and private-private
<b>Size - budget</b>	15 clusters for the whole country	71 poles divided into three groups	The first Agendas were financed in	19 TKIs

	Public funding: €600 million to 5 clusters each for 5 years	Regional subsidizing for the coordination of clusters.  Centralised funding on competitive calls from the programme + Specific lines of budget in funding agencies + contribution of Regions	2012 (around 100 agendas by now. Limited to SEK 400.000) Five SIOs were funded in 2013 and six in 2014. The public support for an individual SIO programme can be between SEK 10m and 50m per year. The SIOs are long-term, with visions far beyond 2020, but funding is initially only decided for the first years. Follow on investments are expected, but to be decided at a later stage.	No specific budget line
<b>Role in support system</b>	Complementary to other national programme focusing on “economic clusters” (Go clusters) and numerous regional cluster programmes	The aim is to bring more synergies in a too fragmented system, they act as catalyzer at regional level of different organisations, programmes, funding streams	A joint initiative between different national agencies to lay the foundations for international competitiveness and sustainable solutions to social challenges	Top Sector policy acts as a guiding framework for a wide range of R&I activities and policies, also for other policies, regulations, etc. Knowledge institutions are keen to show they can link up to the Top Sector Policy, which may herald a transformation of the system.
<b>Lessons for Spain</b>	Targets a small range of leading-edge actors: small overall effect on Spanish economy?	French Competitiveness Poles have been recognised a success to provide visibility at national and internal levels. The exercise allowed to identify regional strengths, critical masses, and reliable synergies.  Poles have been criticised for being too numerous and too much oriented towards R&D rather than market opportunities. Integration of SMEs at the core of the poles remains a challenge as most of the International poles are build around large groups. They play a positive role in stimulating inter-regional cooperation and in enabling State-Region joint programming	This is a relatively new programme, and no evaluations have yet been done. The Agenda process has mobilised many actors. To be awarded an agenda or a SIO it is necessary to interact with <i>all</i> relevant stakeholders in the area. This often means several universities as well as competitive and complementary firms (both large and small).	The approach is flexible because of delegation to the Top Teams. It can also be used for weak sectors that need to be strengthened. Important are the system-level effects when knowledge institutions start to orient themselves towards the top sectors.

### **Box 13. German Agenda Processes: an instrument to identify strategic research and innovation objectives**

Over the past three decades, agenda processes have proven their worth in generating strategically oriented innovation projects and research programmes in Germany (laser research programmes, security research programme, energy research programme, FONA research programme for sustainable development, etc.).

Structure and format of an agenda process:

- The process is limited in time (duration 6 to 12 months) and focusses on a closely defined topic.
- It is organised and led by an institution (e.g. a ministry).
- Before the process is launched, relevant technological and application-related issues are clearly defined.
- The issues are addressed by specific workshops or meetings of experts. The results are taken down and are continuously analysed. If new issues or relevant topics arise, they can easily be fed into the process.
- All relevant stakeholders who are needed to tackle the issues participate in the process. More participants can become involved during the process.
- Participating industrial companies commit themselves to investing five to six times the total amount of funding in order to bring the technology to the market if the process has been successful.

It is important to ensure that a larger number of real, mainly scientific experts are invited to the workshops while the number of representatives from associations and other interest groups should be limited. A large number of participants prevents individual interest groups thrusting themselves into the limelight and guarantees a more balanced picture. Workshops and expert meetings promote interdisciplinary and trans-disciplinary networking. This will be of great importance later on when efforts are made to implement the research results. The networks are also a stable basis for a number of other collaborations outside the concrete topic defined in the agenda process.

The results of the workshops are translated into research and funding policy priorities which either become part of specific funding programmes or research agendas. At the end of the process, the agendas and programmes are once again presented and discussed at a larger event which involves all participants in the agenda process. So-called lead projects (or initiatives) can be derived from the research programmes developed during the agenda process. Lead projects are major collaborative projects involving industry, research and science. Such a collaboration or consortium pursues a specific innovation project / objective (such as the development of marketable OLEDs, technologies for the production of innovative solar cells, etc.).

### **Box 14. Setting priorities in Flanders**

The Flemish Council for Science and Innovation (VRWI) has organised in 2013 for the second time (the first time was in 2006, with the advent of a new Flemish government) a foresight process involving the stakeholders (<http://www.vrwi.be/publicaties/toekomstverkenningen-vrwi-flanders-2025>). The foresight study has a time horizon up to 2025 and aims at establishing scientific, technological and innovation priorities to help address grand societal challenges such as energy, mobility, ageing population, health, environment and climate change.

In a preparatory phase, an inventory has been made of both national and international (1) societal trends and (2) trends with regard to Science, Technology and Innovation (STI). Subsequently, a matching exercise has been performed on the basis of a foresight workshop to link (1) and (2) resulting in a model with different transition areas. In parallel, a strengths/weaknesses analysis of the current situation in Flanders was performed with regard to scientific research, technological development, innovation, economic activity and societal developments.

Subsequently, a steering committee consisting of Captains of Industry and Captains of Society has set a number of priority transition areas for Flanders: (1) Digital Society 2025, (2) Food 2025, Health - Well-Being 2025, (3) Smart Resources Management 2025, (4) Urban Planning, Mobility Dynamics & Logistics 2025 and (5) New Energy Demand and Delivery 2025. For each of the selected transition areas a panel was set up with experts from knowledge centres, enterprises, civil society and government. These expert panels were supported by process managers in close collaboration with the VRWI staff. Each expert panel has set scientific, technological and innovation priorities and opportunities that address the societal challenges within the transition areas and discussed the factors of success to realise the transitions. The expert panels met three times. A questionnaire (Delphi survey) was also administered to a larger group of experts (including the expert panels).

The final report will be presented to the coming government. As with the previous report, it is expected to “percolate” into the policy note of the new minister(s?) in the policy domain of economy, science and innovation and constitute a basis for more specific initiatives. The 2006 report has led to the inclusion of certain topics in the “Flanders in Action” policy framework and the “Innovation Centre Flanders” policy note, leading a.o., to the creation of innovation steering committees for several domains and new policy measures for e.g. high growth companies (also called gazelles) and a new industrial policy.

Source: [http://www.ewi-vlaanderen.be/ewi/wat-doen-we/programmas-subsidies/industrieel-beleid/vanguard\\_initiative\\_on\\_smart\\_specialisation](http://www.ewi-vlaanderen.be/ewi/wat-doen-we/programmas-subsidies/industrieel-beleid/vanguard_initiative_on_smart_specialisation)).



## 5.2. System monitoring and evaluation

The Strategy's fourth principle reads as follows: *“Efficiency and accountability in all Public Administration actions linked to the promotion of RDI to foster a stable framework of relations among stakeholders in the medium and long term and to ensure that society is appraised of the results”* and the following mechanism is foreseen *“The setting up of an integrated information system and the improvement of the quality of indicators for monitoring the actions funded by the Public Administrations and their impact”*.

This demonstrates a welcome intention to establish a culture of policy monitoring and accountability, as well as an evaluation culture across the whole system.

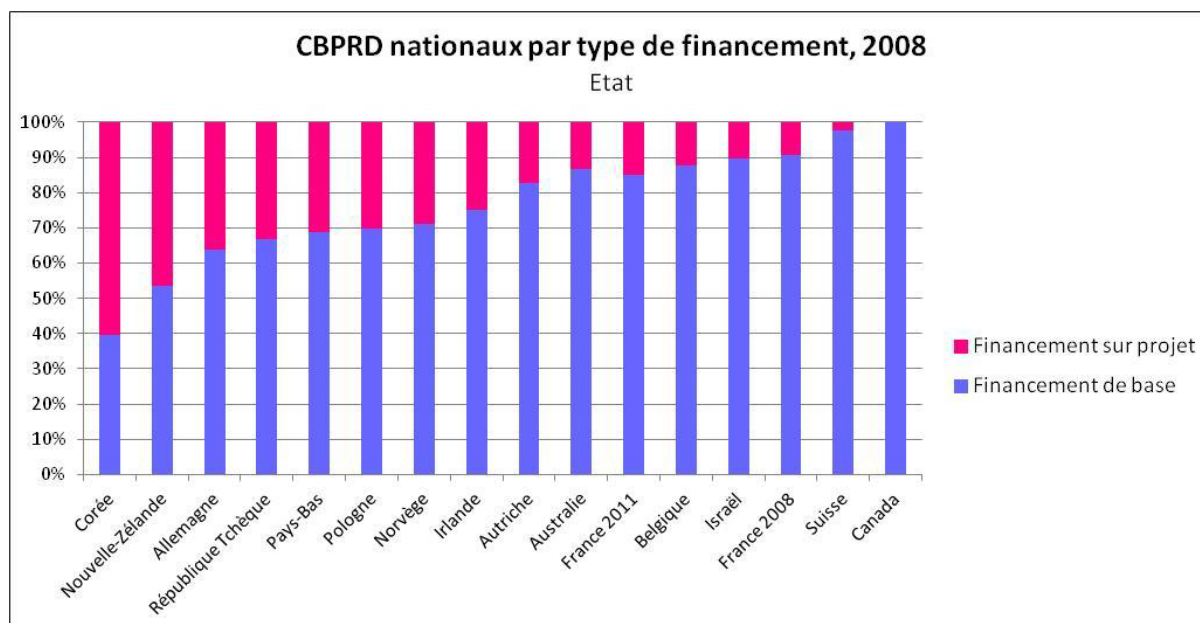
The Strategy provides a Scoreboard of indicators which includes a few traditional input indicators (GERD/GDP; BERD/GDP; private/public ratio of GERD; share of GERD from abroad) and a range of results indicators. Most of these indicators are similar to those collected in the Innovation Union Scoreboard, with however a stronger focus on PhDs, and an emphasis on indicators measuring scientific performance (publications, performance in ERC grants). Such a Scoreboard is necessary to get an overall picture of the system and its evolution, and to communicate to a wider audience and to decision-makers. It should however be completed with more indicators covering the business side and the role of Autonomous Communities.

During its work, the Panel faced limitations in data availability, notably on the regional level, as well as in terms of policy-relevant indicators on public funding for R&D. Evidence which was necessary for the Panel's work in its analysis of public funding channels was also lacking: other countries actively participate to analytical work conducted under the auspices of the OECD and prepare interesting indicators - which could also be introduced in Spain through ICONO - such as (Steen 2012):

- National public funding for R&D split between institutional and project funding (and within these categories, by sector of performance);
- National public funding of domestic R&D projects by R&D funding agency (national, intermediary, regional);
- National public funding of domestic R&D projects funding distinguishing between academically-oriented, innovation-oriented or policy-oriented project funding;
- Public funding of R&D, distinguishing between R&D contracts, public procurement, R&D grants, loans for R&D and government intramural R&D.

Such comparative data are being used in France for example to discuss the balance in public funding for PROs and HEIs (Figure 16 relates to PROs).

**Figure 16. International comparison of mode of funding for PROs (institutional versus project funding) - 2008**



Source: Futuris 2013

ICONO, the Spanish STI Observatory, is a very useful tool as it provides a large set of data accessible in a user-friendly mode, displaying time series of figures at national and regional level for most of the indicators. This platform could be improved by adding more information on foreign-controlled affiliates, and by using more benchmarking, for instance:

- international comparisons: the Observatory would benefit from adding an international perspective (with other EU MSs or at least EU average);
- regional comparisons: it is currently difficult to identify the strengths/weaknesses of each region. Spider charts could be used for this purpose (by using several variables as dimensions and plotting various regions and Spain on the same chart). This would help having a clear global view/ranking of the Spanish regions with respect to relevant dimensions. Summary/composite indexes for each region could be developed (taking example from the EU Summary Innovation Index, e.g.-) in order to summarise all the information.

In addition to such an overall Observatory, and in order to reinforce the sense of accountability, the governance of the system should be supported by two policy intelligence tools:

- 1 A policy-oriented monitoring system. This system would gather detailed and regular information on policies implemented (including ex post data on project results), linked in a coherent framework and structured according to the Strategy's goals. This monitoring would need to cover policies from Autonomous Communities, State as well as policies funded by ESIF. The latter will increase transparency and accountability while providing the basis for evidence based agreements and joint actions between the State and the Autonomous Communities. That would be one of the major tasks to be accomplished by a policy intelligence unit (see below);

- 2 A common evaluation system based on international evaluation standards at different levels (programmes, institutions, laboratories). This would probably involve the combination of different existing evaluation systems to be gathered at a national umbrella with independent governance (within the Ministry or independently). This could take the form of a think tank with operational capabilities (foresight, econometrics of the research system). The goal would be to analyze and demonstrate the impact of research and innovation policies on a long term basis, modelled along institutions such Nesta in the UK, EFI in Germany.

Regarding evaluations, Spain would benefit, as would most other EU Member States, from wider and stronger evaluation practices, covering programmes as well as organisations involved in R&I, receiving public funding. This covers evaluations of R&D projects submitted to public funding, where Spain has achieved good progress, but most importantly, impact evaluations, for which much remains to be done. The use of international best practice and of experts to be part of evaluation panels should also be reinforced.

The establishment of the Research Agency could be, as stated above, a good opportunity to reinforce evaluation practices in the system, and this should apply to all CDTI programmes too. Impact analyses of all instruments should be organised. Integrating new criteria in evaluations as spelled out in Chapter 2 (excellence, critical mass, internationalisation, relevance, etc.) would help shed new light on the contribution of each programme and structure to the Strategy's goals. This requirement extends also to regionally-funded schemes and institutions: today, too little information is available on effectiveness of the various initiatives within regions, and on their potential for cross-regional impacts (see Chapter 4).

Establishing a central monitoring and foresight unit in support to the Spanish Strategy is a critical success factor for the Strategy. Not only is such a unit needed to follow-up the progress of the overall Spanish R&D system, but also, at the start of the entire process, to coordinate and supervise the process of providing a precise definition of the indicators and in an unequivocal manner to define how to compute the indicators involving well identified or specified (sources of) data. This unit should also be responsible for validating the data and maintaining its quality. Some Spanish regions have expressed their wish that this process should be facilitated, coordinated and initiated by the central state. It is to be recommended that the central government foresees (financial) bonuses and sanctions as incentive measures to assure a qualitative input to the indicator data from the start. The unit should also capitalise on, and exploit knowledge and analytical capabilities by researchers in public research organisations, universities and consultancy firms, working on R&I policy issues. Some countries have established "policy support points" in universities providing funding for policy-oriented monitoring and evaluation work in competent research units, while ensuring their independency (Box 15).

### Box 15. Evidence base for R&I Policy: Flanders

In Flanders, every two years, an “Indicator Book” is published including lots of indicators on all policy domains, including R&D&I.

To support this work, the Government has established an independent policy research centre on indicators, the Centre for Research & Development Monitoring (Expertisecentrum Onderzoek en Ontwikkelingsmonitoring, ECOOM) an interuniversity consortium with participation of all Flemish universities (KU Leuven, UGent, VUB, UA and UHasselt). This centre coordinates the publication of the indicator book. Its mission is to develop a consistent system of R&D and Innovation (RD&I) indicators for the Flemish government. This indicator system has to assist the Flemish government in mapping and monitoring the RD&I efforts in the Flemish region. To this end, ECOOM collaborates intensively with all relevant actors in the Flemish RD&I system: universities, research institutes and industry. The government agencies EWI and IWT are close partners in this endeavor.

Source: [www.ecoom.be](http://www.ecoom.be)

### Summary of recommendations for Chapter 5

5.1 Establish Spanish Strategic Innovation Arenas, with the objective to obtain business leadership in highly competitive global environments in which Spain can build on its excellence. Co-creation of innovation is at the heart of those internationally-oriented partnerships, creating synergies between companies, research actors and intermediaries from various fields, disciplines and sectors. The Strategic Innovation Arenas will be a bottom-up vehicle to create synergies between regional assets, based on identified innovation opportunities. They will use regional, national and EU funds in a strategic way and under competitive procedures involving international experts. International experience should be used to design, implement and evaluate those initiatives that bear the potential to respond to several important deficits of the Spanish research and innovation system.

5.2 Make a big step forward in establishing an integrated monitoring and evaluation system in support of the Strategy. This would build on existing efforts and involves the creation of a well-staffed central monitoring and foresight unit in support to the Spanish Strategy, tasked with:

- An expansion of the Observatory ICONO, notably with regional data;
- A policy-oriented monitoring system, collecting regular information on policies implemented at various levels (including ex post data on project results and on impacts), preparing policy-relevant indicators on public funding for R&D, linked in a coherent framework and structured according to the Strategy’s goals;
- A common and integrated evaluation system based on international evaluation standards and focused on impact evaluations of all R&I programmes managed by the Ministry, the future Agency and CDTI programmes, and progressively also covering regionally-funded schemes and institutions in partnership with the Autonomous Communities
- A better exploitation of potential with experts and academics working on R&I policy in Spain.

## Conclusion

The Panel has been privileged to join the national debate in Spain and to hear, often strongly held, views from a substantial number of stakeholders. We have also been fortunate to receive excellent support in terms of the documentation made available to us by the Secretariat and by the rapid and comprehensive response to our numerous queries.

It is in the nature of a peer review of this type that what may be lacking in terms of the depth of knowledge of the system under review may be compensated for by the peers' ability to draw upon and share their own experiences of addressing similar problems. The European context provides a particularly fruitful environment for such exchanges (as the peers also have learning benefits).

The sum of our key messages and of our specific recommendations adds up to a vision of the future Spanish research and innovation system characterised by:

- A stable investment framework based on planned growth and a commitment to reform;
- Research careers which are open, flexible, mobile and reward excellence;
- Institutional reform to create a flexible, non-bureaucratic and accountable research system;
- Assessment being a normal part of the culture and driving resource allocation;
- Concentration and selectivity of public investments around market-driven coordination;
- A policy mix which brings SMEs into the innovation system and encourages the creation and growth of innovative new firms;
- A market and culture promoting and celebrating innovation;
- Autonomous agents taking responsibility for creating a stable and responsive environment;
- Maximising cooperation and coordination to take advantage of inter-regional and supra-regional synergies; and
- Effective monitoring and evaluation to support an evidence-based approach to policy-making.

Cutting across all of these is the need to build a higher degree of trust between actors at all levels of the system as the key to an efficient and effective research and innovation system.

Recommendations are distributed between actors and over time. The majority are within the remit of the Ministry of Economy and Competitiveness to implement. Others are primarily directed at other ministries or to the Autonomous Communities. Those of a more cultural and behavioural nature are the collective responsibility of anyone in a research leadership position. There are also recommendations that can be implemented now and others which will require legislative change or substantial preparation.

It is in the nature of a research and innovation ecosystem that change drives further change and our hope is that some initiatives which may be small in themselves will stimulate learning, experiment and further evolution towards the vision of an economy with competitiveness, growth, employment and societal development founded on the application of knowledge.

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## List of Interviewees

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2. B. Alcocer, Vice Deputy Director for Human Resources for Research (SGHR) at SEIDI
3. A. Alonso Pardo, Deputy Director for the Administration of the European Regional Development Fund at the Ministry of Treasury and Public Administrations (MINHAP)
4. J. Álvarez Benedí, Advisor for Science and Technology at the Regional Government (Castille and Leon)
5. A. Andreu, DG of the National Health Institute Carlos III (ISCIII)
6. E. Atienza, DG Technological Cooperation of Andalucia (Andalucia)
7. C. Ayllón, Director at Council of Chambers of Commerce
8. E. Balguerías, DG Spanish Institute of Oceanography (IEO)
9. E. Banda, Director for Science and Environment, La Caixa Bank Foundation
10. S. Barberá, Professor of Economics, U Autònoma de Barcelona and former Secretary General of Science and Technology Policy
11. J. Bertranpetit, Director of the Catalan Institute for Research and Advanced Studies (ICREA)
12. M. Blasco, Director of the Spanish National Cancer Research Centre (CNIO)
13. J. Boltá, Managing director at Funds4Research Association
14. J. Bravo, Deputy Director National Agency for Evaluation and Foresight (ANEP) at SEIDI
15. R. Bueno, Representative of the Manufuture Technology Platform
16. A. Caballero, "Ramón y Cajal" Researcher at Universidad de Murcia
17. C. Cabello, Deputy Director at FECYT
18. M. Calle, Head of R&I Department at I+D+i, the Business Association for Electronics, ITC and Digital Content (AMETIC)
19. C. Castillo, CEO Rooter
20. M. Celdrán, DG Graphenano
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27. D. del Val, President and Director General of Telefónica I+D
28. M.J. Deyá Bauzá, DG of Universities, Research and Technology Transfer (Illes Balears)
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47. B. López de Quintana, Deputy Director of Institutional Relations at SEIDI
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49. E. Lora-Tamayo, President of the State Agency National Research Council (CSIC)
50. J. Luis Huertas, CEO Mobbeel
51. L. Malumbres, Representative of Iberdrola and Scientific Director of the CENIT Ocean Leader Project
52. R. Marimón, Professor of Economics at the European Institute Florence (EUI)
53. F. Marín, Foro de Empresas Innovadoras (FEI), partner at Poile and Vice President of R&D Commission (CEOE)
54. J.L. Martínez Peña, Director of the European Spallation Source (ESS-Bilbao)
55. J. Martorell, Director of Research at the Catalanian Government (Catalonia)
56. R.M. Menéndez López, Professor at the National Institute of Carbon (INCAR)
57. J. Mulet, Director General, COTEC Foundation
58. E. Navarro, CEO Grupo Premo
59. A. Pasos, Executive Secretary of the R&D Commission at the Conference of Rectors (CRUE)
60. D. Peña Sánchez de Rivera, Rector of the Universidad Carlos III de Madrid and President Alliance 4 Universities
61. M. Pericàs, Director of the Catalan Institute of Chemistry Research (ICIQ)
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67. I. Riera, Member of Parliament
68. J. Rodés, President of the Advisory Council for Science, Technology and Innovation (CACTI)
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