# R&D+I in Spain: Is the growth engine damaged?

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**Spain´s innovation performance has been and remains below the EU average. A strong reform effort is needed to stay on the recovery path and improve future growth prospects.**

*Innovation is crucial for long-term growth but the current economic situation makes it difficult to maintain some pre-crisis R&D+I plans and strategies. In the case of Spain, innovation performance is not only below the EU average, but is not converging to it either. In particular, the main headline indicators on R&D+I, both in the public and the private sector, have been in free fall since 2008. This scenario results not only from financing shortfalls, but also from policy immobility and poses very likely downward risks to recovery in Spain. Short of a radical policy U-turn, the current trend reinforces the risk of the country experiencing a long and deep period of economic stagnation.*



## Introduction

Economic growth depends on productivity which, especially in advanced economies, in the long-term largely comes from the materialization of successful innovation and the existence of appropriate institutions (Aghion, 2006). Although this empirically proven connection between innovation and growth is widely accepted in business, policy circles and academia, the current economic juncture in some parts of the EU has led many agents, public and private alike, to stop or even dismantle part of their research, development and innovation (R&D+I) strategies.

On the public front, the pressure on governments to quickly reduce their public deficits has eroded their ability to maintain some of their pre-crisis plans in terms of basic R&D investment, research and university funding, staff, etc. On the private side, the weak activity outlook, with high unemployment levels and low propensities to consume, has forced many companies to freeze their R&D+I expenditures and reallocate resources to other activities, not so vital in the long-term, but that require immediate funding. In addition, given that public and private expenditure are complementary in certain R&D+I projects (co-investments, deployment of EU funds, etc.), the depression has been exacerbated in some sectors.

This gloomy evolution of the innovation effort could be, of course, very troubling as it may seriously jeopardize the prospects of future growth and reduce potential output levels. This paper analyzes to what extent these adverse developments are taking place in Spain. The paper also examines some of the most prominent policy recommendations that national and international observers have made to the Spanish R&D+I system and whether or not the Spanish government has accommodated them.

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## The performance of Spanish R&D+I in the EU context

The system of R&D+I is a complex one, with multiple critical inputs, outputs and facilitator factors. For this reason, it is very difficult to make a comprehensive assessment that captures the innovative performance of a country or region and that, therefore, can be used as a sensible metric to make cross-country and intertemporal comparisons.

The European Commission has long been advocating for a composite index of innovation based on the Innovation Union Scoreboard (IUS, first known as the European Innovation Scoreboard or EIS) for measuring innovation performance in EU countries. The IUS measures country performance by aggregating 25 individual indicators that are grouped in 8 dimensions of innovation which, in turn, come from 3 main types of indicators: enablers, firm activities and outputs (see European Commission, 2014). Although the IUS aggregate performance score suffers, as all composite indexes, from a number of methodological limitations (see Spanish government 2009 for a discussion of some of them), it has become the EU standard for measuring innovation in a very wide sense.

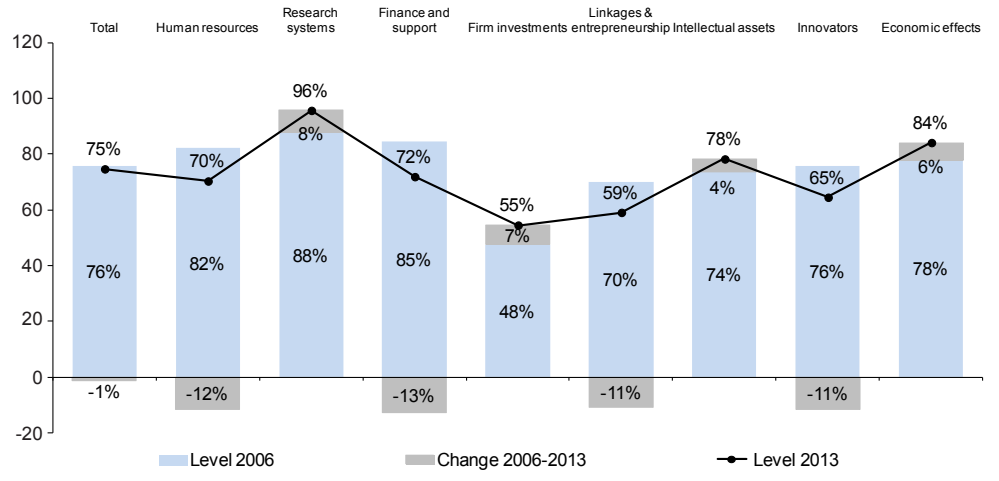
Exhibit 1 represents the IUS scores of Spain, in relative terms to the EU average score, for the aggregate index and for the eight main dimensions of innovation, in 2006 and in 2013 (the latest available data).

In aggregate terms, Spain's overall innovation performance has been and remains below the EU average, at an approximate level of 75% of the mean score. This stagnation of Spain´s innovation performance with respect to its EU peers is the result of significant backward leaps in four dimensions of innovation: human resources, finance and support, linkages and entrepreneurship and innovation output. Table 1 reports the values of the variables included in these four dimensions for Spain and the EU average, for 2006 and the latest available data.

The fact that the IUS works with large data sets that need to be homogeneous for all countries means that the latest available data for several

Exhibit 1

**Spain's innovation performance (IUS) in relative terms to the EU average**




*Sources: IUS, European Commission.*

Table 1

**Spain and EU-average scores (IUS) on selected innovation indicators**

| | Spain | | EU | |
|---|---|---|---|---|
| | 2006 | 2012 | 2006 | 2012 |
| Human Resources | | | | - |
| New doctorate graduates (ISCED 6) per 1,000 population aged 25-34 | 0.9 | 1.7 | 1.2 | 1.5 |
| Percentage population aged 30-34 having completed tertiary education | 38.1 | 35.8 | 40.1 | 30.0 |
| Percentage youth aged 20-24 having attained at least upper secondary level education | 61.6 | 80.2 | 62.8 | 77.9 |
| Finance and support | | | | - |
| Public R&D expenditures as % of GDP | 0.53 | 0.61 | 0.65 | 0.75 |
| Venture capital (early stage, expansion and replacement) as % of GDP | 0.104 (2008) | 0.037 | 0.114 (2008) | 0.077 |
| Linkages and entrepreneurship | | | | |
| SMEs innovating in-house as % of SMEs | 24.6 | N.A. | 31.4 | N.A. |
| Innovative SMEs collaborating with others as % of SMEs | 5.0 | 5.8 (2010) | 8.6 | 11.7 (2010) |
| Public-private co-publications per million population | 22.1 | 28.7 (2011) | 44.4 | 52.8 (2011) |
| Innovation output | | | | |
| SMEs introducing product or process innovations as % of SMEs | 29.5 | 28.7 (2010) | 33.3 | 38.4 (2010) |
| SMEs introducing marketing or organisational innovations as % of SMEs | N.A. | 27.7 (2010) | 40.5 | 40.3 (2010) |
| Employment in fast-growing firms of innovative sectors | N.A. | 15.5 (2011) | N.A. | 16.2 (2011) |

*Note: Dates refer to 2006 and 2012 unless otherwise indicated.*
*Source: IUS (2014).*

indicators are from 2011 or even 2010. Therefore, although the IUS is very useful to obtain information about the international context of the Spanish R&D+I system, it is necessary to rely on other data sources to obtain more updated information.

Exhibit 2 depicts the evolution of R&D expenditure as a percentage of GDP, also known as R&D intensity, which is the single most important indicator of technological innovation, for Spain and three well-known categories of EU countries: "innovation leaders," "innovation followers" and "moderate innovators" (see the notes of Exhibit 2 for the list of countries). These categories of countries correspond to descending ranges of the IUS innovation performance aggregate index with Spain being included in the lowest performance group, as a moderate innovator, since the first releases of the IUS/EIS database. Exhibit 2 shows that Spain initiated around 2002 a trend of moving away from the lowest group and catching up to the innovation followers. However, this trend was truncated in 2010 and since then the R&D intensity in Spain has been on the decline. It is

noteworthy that the average R&D intensities are growing in all three country groups, including the weakest "moderate innovators", despite the fact that some of those countries are undertaking –like Spain– fiscal consolidation efforts (Veugelers 2014a and 2014b).

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The downward trajectory of the R&D intensity is confirmed also in other complementary innovation measures, both in the public and private sectors. Consider first the public budget. Exhibit 3 displays the government expenditure in R&D as a percentage of total general government expenditure for Spain and the three country categories mentioned above. Two features characterize the evolution of the importance of R&D in the Spanish public budget: first, its volatility; second, the fact that it is declining after 2007, in sharp contrast with the pattern for the three country groups, which keep increasing the share of R&D in the public budget.

The Spanish R&D+I case is not only worrisome because of its lower R&D intensity and the shrinking public budgets, but also because of the poor contribution of the private sector to total expenditure.

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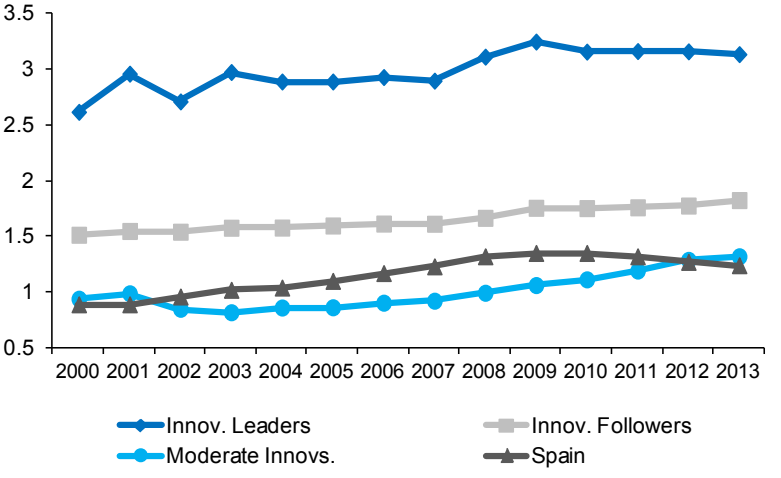
Exhibit 2

**Total intramural R&D expenditure (GERD) as a % of GDP**

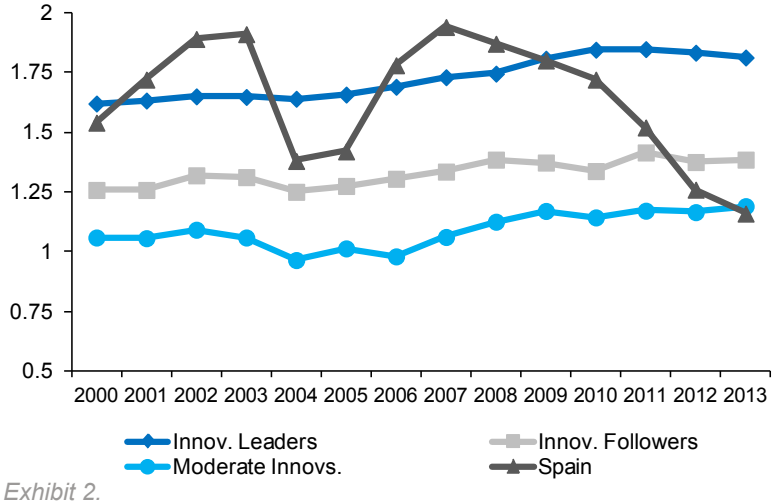



*Notes: Innovation Leaders: Sweden, Denmark, Germany, Finland; Innovation Followers: Luxembourg, Netherlands, Belgium, United Kingdom, Ireland, Austria, France, Slovenia, Estonia, Cyprus; Moderate innovators: Italy, Czech Republic, Spain, Portugal, Greece, Hungary, Slovakia, Malta, Croatia, Lithuania, Poland.*

*Source: Eurostat.*

Exhibit 3

**Total government expenditure in R&D (GBAORD) as a % of total general government expenditure**

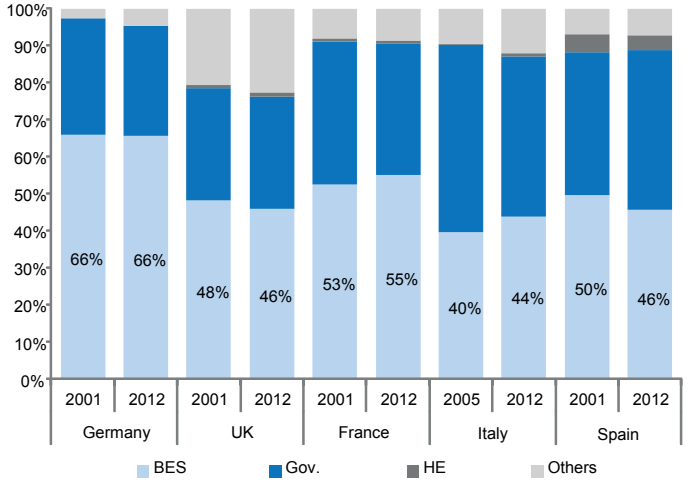



*Note: See notes for Exhibit 2.*

*Source: Eurostat.*

Exhibit 4

**Total intramural R&D expenditure (GERD) by source of funds**




*Notes: BES: Business enterprise sector; Gov. Government; HE: Higher Education; Other: Private non-profit institutions and abroad.*

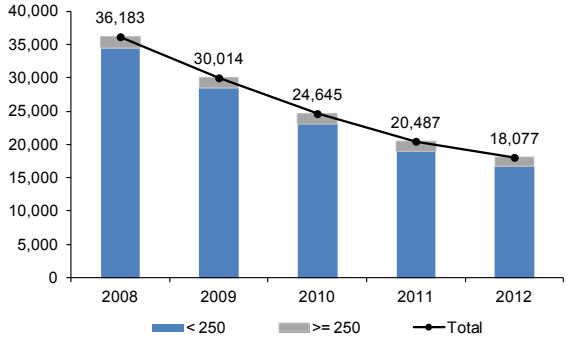
*Source: Eurostat.*

Exhibit 4 represents the shares of public, private and other funding in the total R&D spending for Spain and the other four largest EU economies. The situation in Spain is unique because it is the only country in the group where this private contribution has decreased significantly between 2001 and 2012. The reasons for this negative singularity are manifold but some of the most prominent are

Exhibit 5

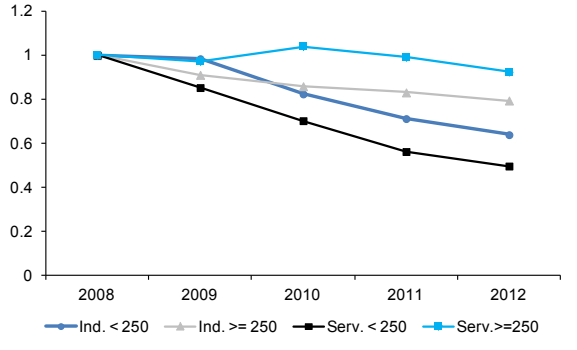
**Firms that perform technological innovation activities in Spain**

**5.a - Number of firms that perform technological innovation activities by firm size**




*Notes: <250: firms with less than 250 workers; >= 250: firms with 250 or more workers.*

**5.b - Number of firms that perform technological innovation activities by firm size and main sector of activity, index 2000 = 100%**



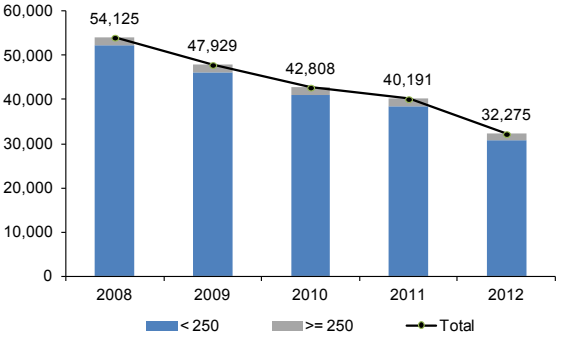

*Notes: Ind.<250: firms with less than 250 workers mainly operating in the manufacturing sector; Ind. >= 250: firms with 250 or more workers mainly operating in the manufacturing sector; Serv.<250: firms with less than 250 workers mainly operating in the service sector; Serv. >= 250: firms with 250 or more workers operating mainly in the service sector.*

*Source: INE.*

Exhibit 6

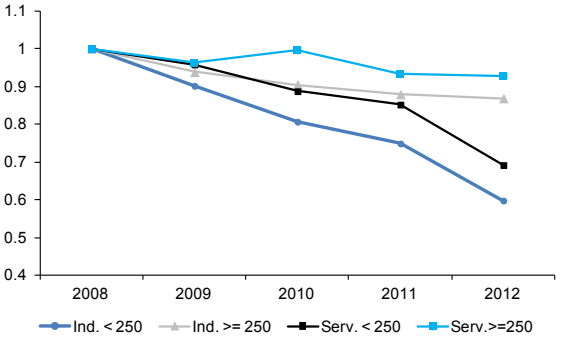
**Firms that perform non-technological innovation activities in Spain**

**6.a - Number of firms that perform non-technological innovation activities by firm size**




*Notes: <250: firms with less than 250 workers; >= 250: firms with 250 or more workers.*

**6.b - Number of firms that perform non-technological innovation activities by firm size and main sector of activity, index 2000 = 100%**




*Notes: Ind.<250: firms with less than 250 workers mainly operating in the manufacturing sector; Ind. >= 250: firms with 250 or more workers mainly operating in the manufacturing sector; Serv.<250: firms with less than 250 workers mainly operating in the service sector; Serv. >= 250: firms with 250 or more workers operating mainly in the service sector.*

*Source: INE.*

the following two: i) in Spain's industry structure, the R&D intensive sectors (typically, high-investment manufacturing industries) are underrepresented; and, ii) there exist some problems of private absorption capacity of R&D funds in the regions of Spain.

Finally, to better characterize how the past years have affected the private side of the R&D+I system, Exhibits 5 and 6 present the number of Spanish companies that, respectively, perform technological and non-technological (mainly marketing and organizational) innovation activities. The message that emerges from both exhibits is consonant and confirms the troubling diagnosis of the Spanish system: the number of innovative firms has been in free fall from 2008. In particular, within the business community that performs technological innovation, in 2012, there were roughly half the number of firms than five years before, with the larger losses corresponding to small companies (with less than 250 employees) that operate mainly in the service sector. With respect to the non-technological innovators, the contraction in the number of active firms is also important but smaller (40% reduction) and in this case it is mainly driven by the exit from the innovation system of small companies in the manufacturing sector.

## R&D+I policies: Main recommendations and pending challenges

Two prominent and independent observers have recently issued policy recommendations for the Spanish R&D+I system: the Cotec Foundation and a panel of experts from the European Research Area Committee (ERAC). Cotec releases every year an assessment of innovation in Spain (Cotec, 2014) and it recently produced a list of ten recommendations to improve it (Cotec, 2013). The peer review conducted by the ERAC, at the request of the Spanish Ministry of Economy and Competitiveness (ERAC, 2014), contains a detailed diagnosis of the Spanish R&D+I system, together with certain policy suggestions.

Table 2 summarizes and classifies the policy recommendations of these two institutions in four broad categories, each referring to a distinct element of the R&D+I system: the public sector, the private sector, national-regional synergies and innovation environment.

It is clear that there are many fronts that require a bold policy reaction from the Spanish government. In particular, one could single out one major challenge in each of the four categories mentioned above.

- *Public system*. Probably the single key pending element in the reform of the public system of R&D+I is, as the ERAC report points out, the creation of the Spanish Research Agency. The new Law on Science (passed in 2011) mandated this, but since then there have been no further developments. Most advanced countries have an independent research agency that assigns research funds to researchers and institutions mainly on excellence criteria and that allows for a more flexible, yet fully controlled, management of the research budget. The creation of this agency in Spain is vital as it would likely act as a catalyst to improve the efficiency in the allocation of resources throughout the whole public R&D+I system, including universities.

- *Private system*. Given the free fall in the number of Spanish companies that perform technological and non-technological innovation (Exhibit 5 and Exhibit 6 above) it is critical to stop this trend and encourage the creation and growth of innovative new firms, as the ERAC expert panel notes. Since the problems that companies face are manifold (insufficient financing; poorly developed business plans; lack of expertise of the founders and CEOs) the response to this challenge needs also to be multidimensional. Firstly, it is necessary to modify the laws to further ease credit in the initial stages of firm creation, including seed capital and mezzanine finance. This should be accompanied by establishing new incentives to banks and financial institutions so that they evaluate properly innovative projects. Secondly, it would be of great help to offer (partially subsidized) specialized training to those who need to improve their business plan or upgrade their business abilities. Currently there is no single public agency in Spain with this specific mandate.

Table 2

**Recommendations to the Spanish R&D+I system from selected institutions**

| | ERAC | Cotec |
|---|---|---|
| Public system | – Increase public funding for research<br>– Set in motion a reform of the public research system<br>– Improve funding and evaluation mechanisms as well as governance of the system<br>– Better human resources management in the public sector<br>– Create focus and mass in public research<br>– Reinforce system internationalisation<br>– During the transition: allow for experiments under private law<br>– Operationalise a Research Agency | – Universities' and public R&I system participation in solving day-to-day and proximity problems<br>– Make the best use of the public administration as customer and innovation tractor |
| Private system | – Engage in a catching-up process of public funding for private R&I<br>– Fine-tune the policy mix for R&I in firms<br>– Encourage the creation and growth of innovative new firms<br>– Leverage the potential of public procurement for innovation<br>– Support innovation culture | – Raise firms' awareness that their sustainability depends on their ability to create value<br>– Increase the participation of private capital in innovation<br>– SMEs shall be ready for the global market<br>– Make the best use of large companies as innovation tractors<br>– Make sure SMEs find an ample portfolio of innovation services |
| National-regional synergies | – Reinforce effectiveness of, and synergies between, innovation support organizations spread over regions<br>– Share research infrastructure<br>– Engage in national-regional and cross-regional coordination and programming<br>– More strategic use of ESIF funding and enhancement of regional planning capacities | |
| Institutional setup | | – Improve the education system<br>– Improve the general public perception of the entrepreneurs that take on risks for the sake of innovation<br>– Avoid laws and rules that pose obstacles to innovation<br>– Attract foreign talent and investment |

*Sources: Adapted from ERAC (2014) and Cotec (2013).*

- *National-regional synergies*. This issue, raised by ERAC's recommendations, is critical to solve some important problems that certain regions of Spain have in order to absorb public (mostly EU) R&D funds. The combination of two facts, that some research funds are earmarked to certain regions on the grounds of facilitating convergence, and that in some cases the public money comes only if accompanied by private funds, finally results in that the Spanish regions with the lowest R&D intensity are the ones with the higher risk of losing (i.e. not being able to absorb) public money. This is of course an unintended effect and there are remedies

to it that, in general, call for trans-regional cooperation with the objective of gaining critical mass, launching private medium– and large-scale R&D projects and thus maximizing the absorption capacity.

- *Institutional set-up*. The Cotec expert panel has included this particular category because in advanced economies the business and institutional environment is one of the most important factors for innovation to flourish (Aghion, 2006). In the Spanish case, it seems particularly appropriate to conduct an extensive brush-up and reform of several laws and decrees that may impede firm growth (e.g. by imposing new administrative obligations as firm size increases) or that represent a disproportionate penalization to non-fraudulent insolvencies. Along this line of improving the framework for R&D+I, political representatives should finally be able to reach a stable consensus about an education law that fixes the main long-term problem of the country – the high school and college drop-outs.

The caliber of the Spanish government's response to these policy challenges is, unfortunately, very small. The Spanish government has, in the past, issued grand R&D+I plans and strategies that, on paper, set out an integrated approach to foster innovation but that lack real political will to change the status-quo. The last two documents in the sequence, the Spanish Strategy for Science, Technology and Innovation 2013-2020 and the State Plan for Scientific and Technological Research and Innovation 2013-2016, exemplify this particular way of managing R&D+I in Spain. They are compendiums of the existing lines of action but their activity projections are based on shorter budgets and do not bring about major reforms of the system.

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## Conclusions

The current state of the Spanish research, development and innovation (R&D+I) system is worrisome. On the one hand, the main headline indicators, public and private, are in free fall – the public ones as the result of the fiscal consolidation process and the private ones mainly due to the persistent crisis. Given that in some R&D+I projects, public and private investments are direct complements to each other, there appears to be operating a negative dynamic that may engender a sort of "R&D+I poverty trap" from which it will be more difficult to escape as time goes by. It needs to be acknowledged that, in retrospect, excessive volatility in public R&D expenditure in the past probably did not favor the system.

On the other hand, on the policy and regulatory front, the Government's real strategy appears to be resisting without introducing structural reforms that maximize the efficiency of the expenditure in a time of extremely scarce resources. However, most of these reforms (like education reform or excellence-based R&D allocation with minimum administrative intrusion), as controversial as they might be, have been adopted by advanced economies that rely on knowledge to grow.

The combination of these two factors leaves Spain not converging to the EU average R&D+I performance but rather deviating from it. More tellingly, even the set of EU countries that historically have been less intensive in innovation and knowledge creation (known as "innovation followers") are making better progress than Spain. An immediate and radical change on both fronts –budget and reforms– is needed if Spain is to preserve the knowledge creation capacity that has been so costly to build in the past 20 years.

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