



## EUROPEAN SEMESTER THEMATIC FICHE

# RESEARCH AND INNOVATION

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### 1. Introduction

Research and innovation (R&I) are at the heart of the Europe 2020 strategy, given their essential role in triggering smart and sustainable growth and job creation and in addressing societal challenges. By producing new knowledge, research is at the heart of developing new, innovative and greener products, processes and services, which enable higher productivity, industrial competitiveness and resource efficiency.

R&I systems are complex ecosystems which need various elements to perform optimally. Given the diversity of national R&I systems across the EU, it is important to identify the main bottlenecks in each of these. The R&I policy analyses in the Commission's Country Reports<sup>1</sup> are therefore based on a two-step approach:

1. Identifying, for each Member State, based on a set of R&I performance indicators, what its main R&I policy challenges are: that is, finding the main bottlenecks impeding the full contribution of R&I to smart, sustainable and inclusive growth, and;
2. Assessing the adequacy of the policy response to the identified challenges.

The present fiche reflects this two-steps approach by providing an overview across the EU of i) the main R&I policy challenges at national level and ii) the main policy levers to address them, as identified in the 2016 Country Reports.

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<sup>1</sup> [http://ec.europa.eu/europe2020/making-it-happen/country-specific-recommendations/index\\_en.htm](http://ec.europa.eu/europe2020/making-it-happen/country-specific-recommendations/index_en.htm)

## 2. Identification of the main research and innovation policy challenges in the Member States

The main R&I policy challenges identified in the 2016 Country Reports can be grouped in three broad categories:

### 2.1 *Quality of the public R&I system*

The public R&I system (composed of higher education institutions and other public organisations performing research and innovation such as public research centres and institutes) plays a key role in generating the knowledge and talented human resources needed by innovative firms. Analysing its quality across Member States helps identifying those Member States where this is a bottleneck to be addressed.

There are a number of relevant objective indicators to assess the quality of the public R&I system. Among those, some use "bibliometrics" to measure the impact of scientific publications on the generation of new science. Others focus on how many of the prestigious 'European Research Council' grants are awarded to researchers in a country, as these are considered to reward scientific excellence. Finally, the number of top performing universities in a country according to international rankings provides relevant information about scientific performance.

All those indicators point to a clear and persistent 'East-West' science divide in Europe, with overall lower quality of public R&I systems in all Central and Eastern European countries (as well as Cyprus and Malta) compared to the other Member States. This is complemented by a 'North-South' differential, as Greece, Portugal, Spain and France are performing just below the EU average, and holding an intermediate position between Central and Eastern European countries and Northern Europe.

Chart 1 presents:

- On the vertical axis, a bibliometric indicator of scientific excellence: the percentage of highly-cited scientific publications among all national scientific publications<sup>2</sup>, and
- on the horizontal axis, an input indicator: the public R&D intensity, i.e. the level of expenditure on Research and Development performed in the public research system as a % of GDP.

Chart 1 shows various typical situations:

- Based on both the indicators used, Latvia, Bulgaria, Croatia and Romania are the Member States with the weakest science base: the low quality of the public R&I system in these Member States is a key issue to be addressed, in particular through capacity-building. For these countries, increasing investment will need to go hand in hand with far-reaching reforms to increase efficiency and quality.
- The Netherlands and Denmark, followed by the United Kingdom, Belgium and Sweden, are the Member States with the strongest science base. Their key

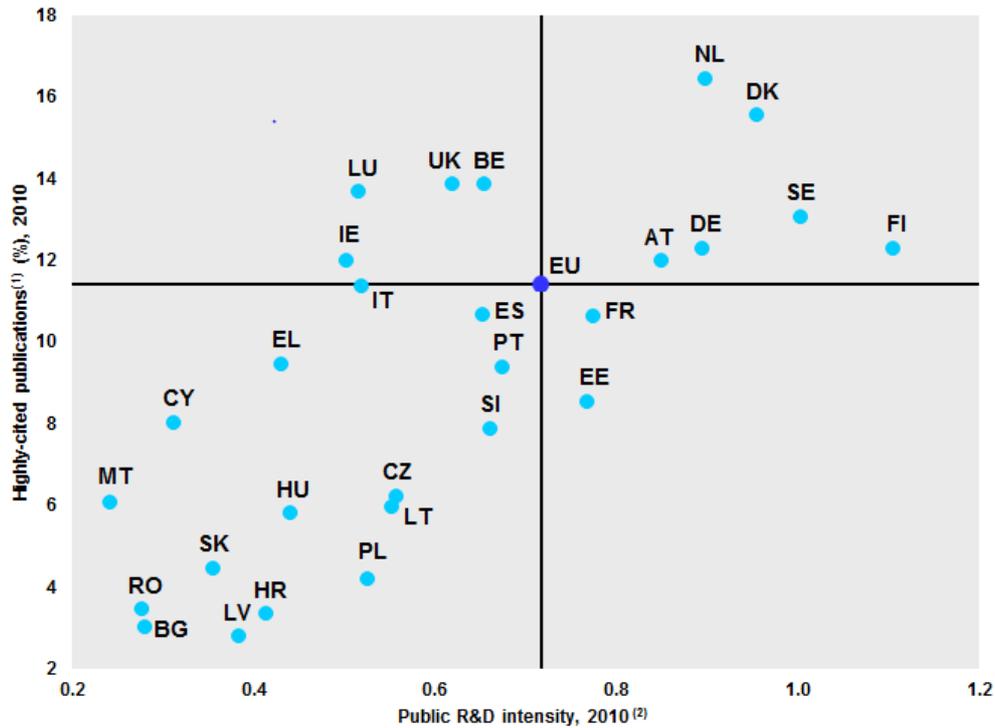
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<sup>2</sup> As it is necessary to analyse the citations in a window of several years after the publication date, the most recent data concern publications made in 2010.

challenge is to translate this world class science base into an increased level of innovation in the economy.

- Some Member States like France and Finland do not show a level of scientific performance in line with their level of public R&D expenditure, highlighting an issue with the efficiency of investment.

**Chart 1: Highly-cited publications versus public R&D intensity**



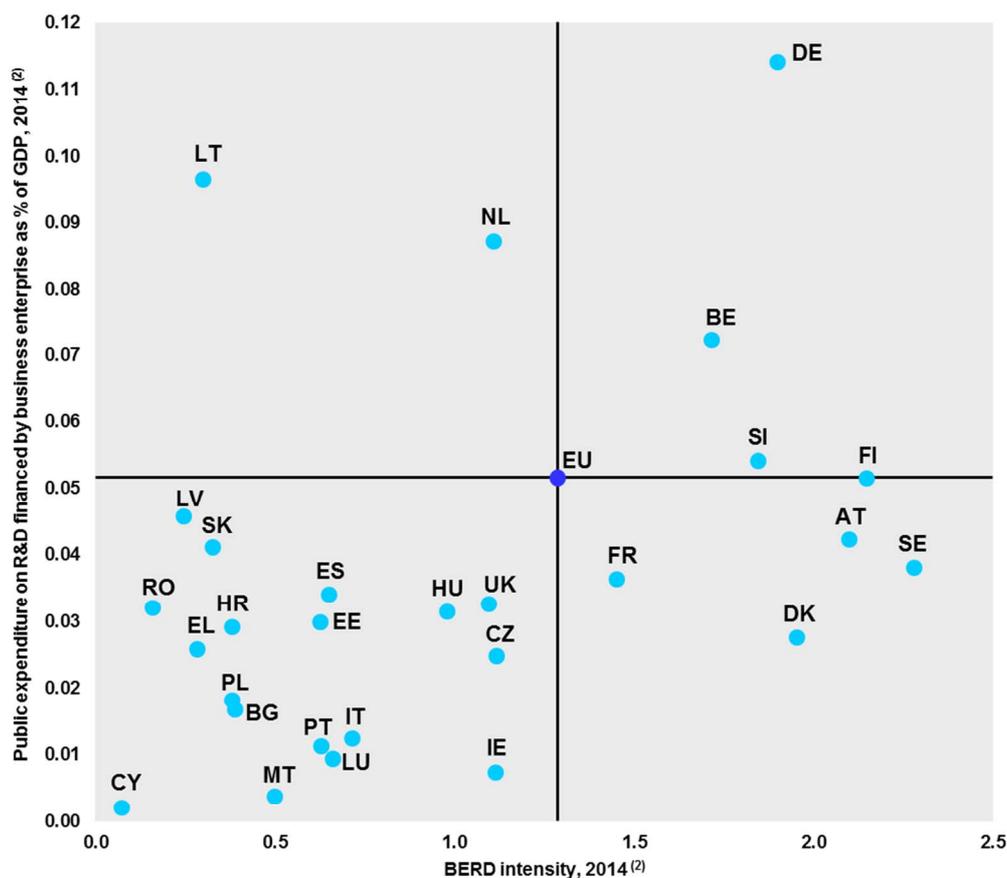
Note: (1) scientific publications within the 10% most cited publications worldwide as % of total scientific publications of the country, fractional counting method. (2) government expenditure on R&D plus higher education expenditure on R&D, EL: 2011. Source: European Commission, DG Research and Innovation – Unit for Analysis and Monitoring of National Research Policies. Data: Eurostat, Science Metrix/Scopus (Elsevier).

## 2.2 Leveraging business R&I through public-private cooperation

While Some Member States urgently need to increase the overall quality of the public science base, others need to better harness the strengths of their science base to create economic wealth and jobs. This requires in particular fostering science-business links and cooperation between the public R&I system and the business sector.

Chart 2 below displays on its vertical axis one of the most significant indicators of the level of public-private cooperation in R&I: the volume of research which is performed in the public R&I system and which is funded by business (as % of GDP). These indicators are particularly relevant ones as 'contract research' or direct investments by firms in concrete projects carried out by public research organisations provide clear indications of strong public-private engagement in R&I.

**Chart 2: Public expenditure on R&D financed by business enterprises versus BERD intensity as % of GDP**



Source: European Commission, DG Research and Innovation – Unit for Analysis and Monitoring of National Research Policies. Data: Eurostat. Notes: Public expenditure on R&D is the sum of the Eurostat indicators "Higher education intramural expenditure on R&D" (R&D performed in the Higher education sector) and "Government intramural expenditure on R&D" (R&D performed in the public organisations not linked to higher education). Public expenditure on R&D financed by business enterprise does not include financing from abroad. AT, BE, BG; DE, FR, IT, CY, PL, PT, SE, EU: 2013.

Chart 2 also takes into account the level of business R&D intensity (on the horizontal axis): if a country does not have much business R&D, the possibility of public-private cooperation is obviously very limited.

Countries with a low performance level on the indicator of public-private cooperation are most often also those with an overall low-quality science base. However, some Member States with an average or even excellent science base do not have a level of public-private cooperation as high as could be expected. This includes Portugal, Italy, Luxembourg, Ireland (Member States with an average quality science base), as well as, e.g., Denmark and Sweden (despite their scientific excellence).

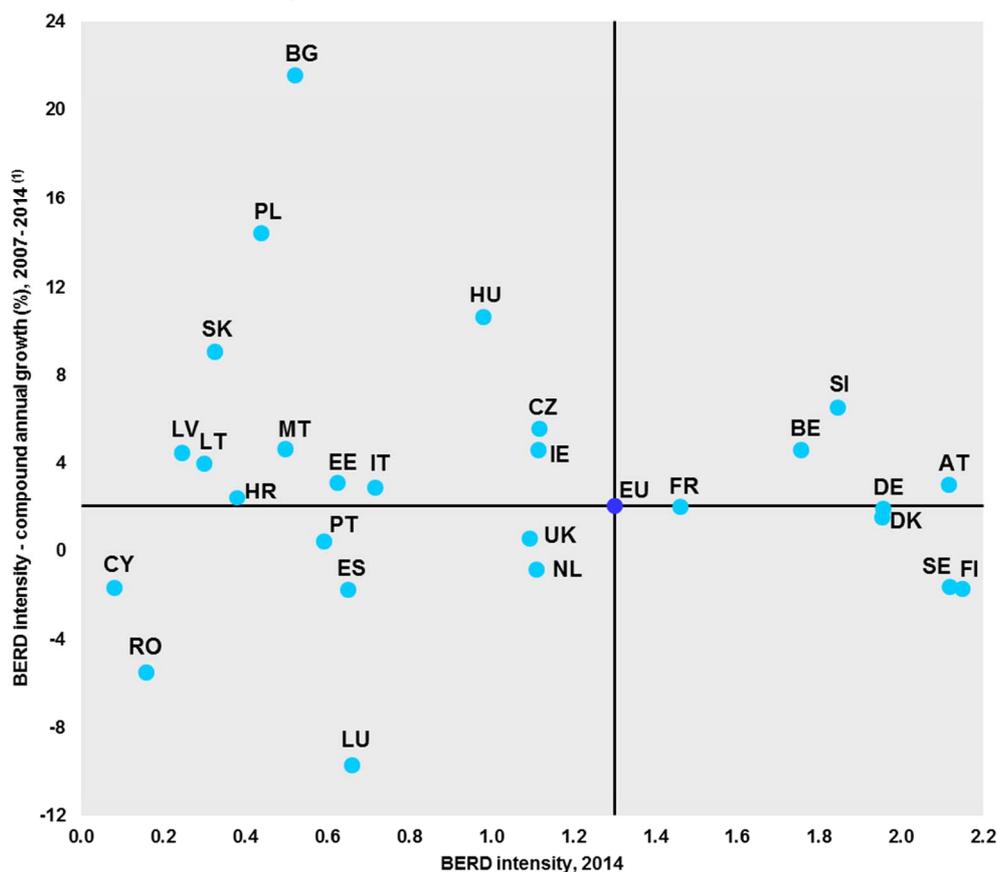
### 2.3 An investment-friendly environment

It is only through business investment in R&I that the expected economic impact of R&I can fully be realised. Yet the EU lags significantly behind other leading regions in this respect. It is crucial to step up reforms at the national level to ensure an investment-friendly

environment: stimulating Europe's companies to innovate, more quickly implementing measures with a full impact on the innovation ecosystem, and eliminating regulatory barriers.

Chart 3 below displays trends in business R&D intensity (growth on vertical axis vs. absolute level on horizontal axis). While some Member States experienced strong growth of business R&D intensity as their economies "catch up", others suffered negative trends over 2007-2014. This includes Romania, Luxembourg, Cyprus, Spain, the Netherlands, Sweden and Finland.

**Chart 3: BERD intensity**



Source: European Commission, DG Research and Innovation – Unit for Analysis and Monitoring of National Research Policies. Data: Eurostat. Notes: IE: 2012. NL, RO, SI: Breaks in series were taken into account when calculating compound annual growth. IE: 2007-2012; ES, SI: 2008-2013; EL: 2011-2013.

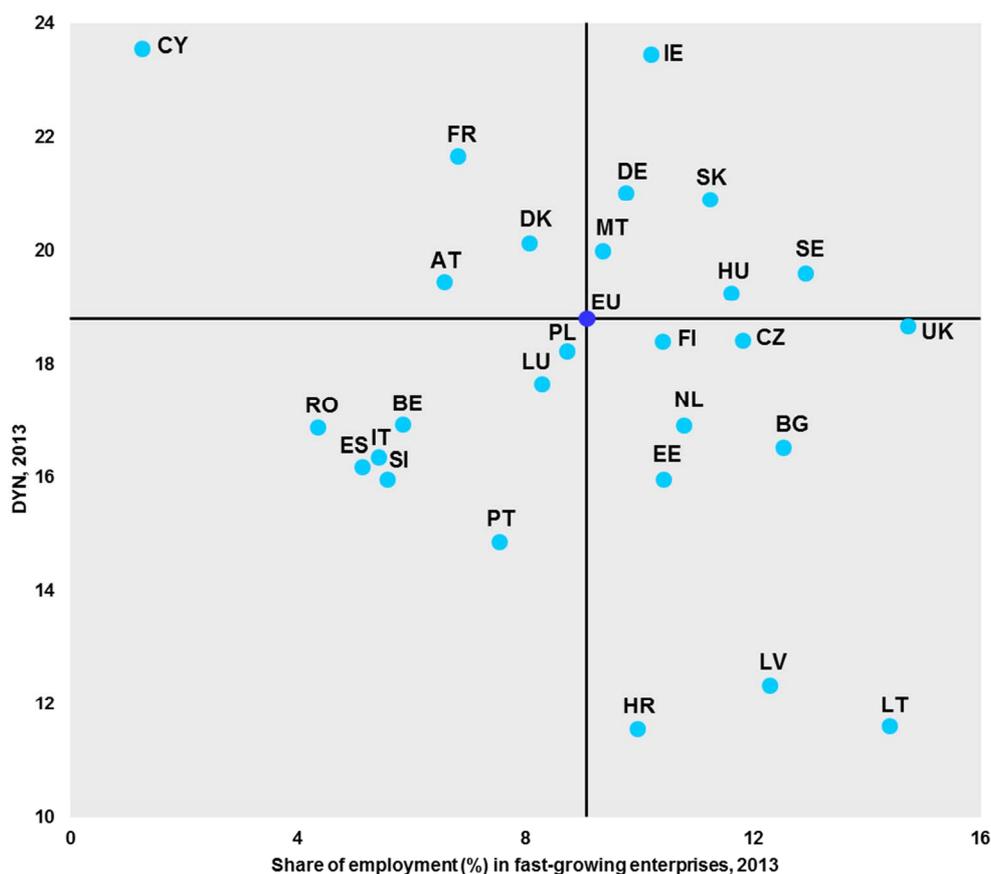
The deficit in business R&D intensity of the EU vs the US reflects the lesser ability of the EU to develop competitive science-based business. In particular, there are much fewer "yollies" (young leading innovators, which are "firms that have grown in a relatively short term into world leaders on the basis of their R&D efforts, while still remaining independent"<sup>3</sup>) in the EU than in the US. It is key issue that, when new firms are founded in the EU, they grow more slowly than in the US or emerging countries; fewer of them join the ranks of the world's largest. This has wide-ranging consequences, as there is clear evidence that economic growth depends critically upon fast-growing firms, which also generate a disproportionately

3 Veugelers R. and Cincera M. (2010), "Europe's missing yollies", Bruegel policy brief

large share of jobs. A specific important policy challenge is thus the need to help fast-growing SMEs in innovative sectors, the dynamism of which depends on enabling such enterprises to emerge and develop so as to speed up structural change and transform the EU into a more knowledge-oriented and innovation-driven economy.

Chart 4 below displays the number of employees in fast-growing firms (in any sectors) as a share of the total number of employees (horizontal axis) versus an indicator (DYN<sup>4</sup>) reflecting the extent to which these fast-growing firms belong to innovative and knowledge-intensive sectors (vertical axis: a high DYN reflects a situation where fast-growing firms mostly belong to sectors which are highly innovative and knowledge-intensive).

**Chart 4: DYN (employment dynamism of innovative fast-growing enterprises) versus share of employment in fast-growth enterprises, 2013**



Source: European Commission, DG Research and Innovation – Unit for the Analysis and Monitoring of National Research Policies. Data: Eurostat, JRC. Note: EL: Greece is not included on the graph because data are not available for both indicators

<sup>4</sup> DYN is one of the four components of the Innovation Output Indicator, [http://ec.europa.eu/research/innovation-union/index\\_en.cfm?pg=output](http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=output)

In the Member States with low scores on both indicators (Member States in the left lower quadrant, notably Romania, Spain, Italy, Slovenia and Belgium), there are few fast-growing firms in innovative sectors. Among these countries, the situation of Belgium is interesting to note as it contrasts with Belgium's good performance on all other indicators previously examined: this weakness impedes the full translation of the strengths of its R&I system into economic performance. Although well-designed policies enabled business R&D intensity to increase in Belgium, R&D remains too concentrated in a limited set of large multinationals.

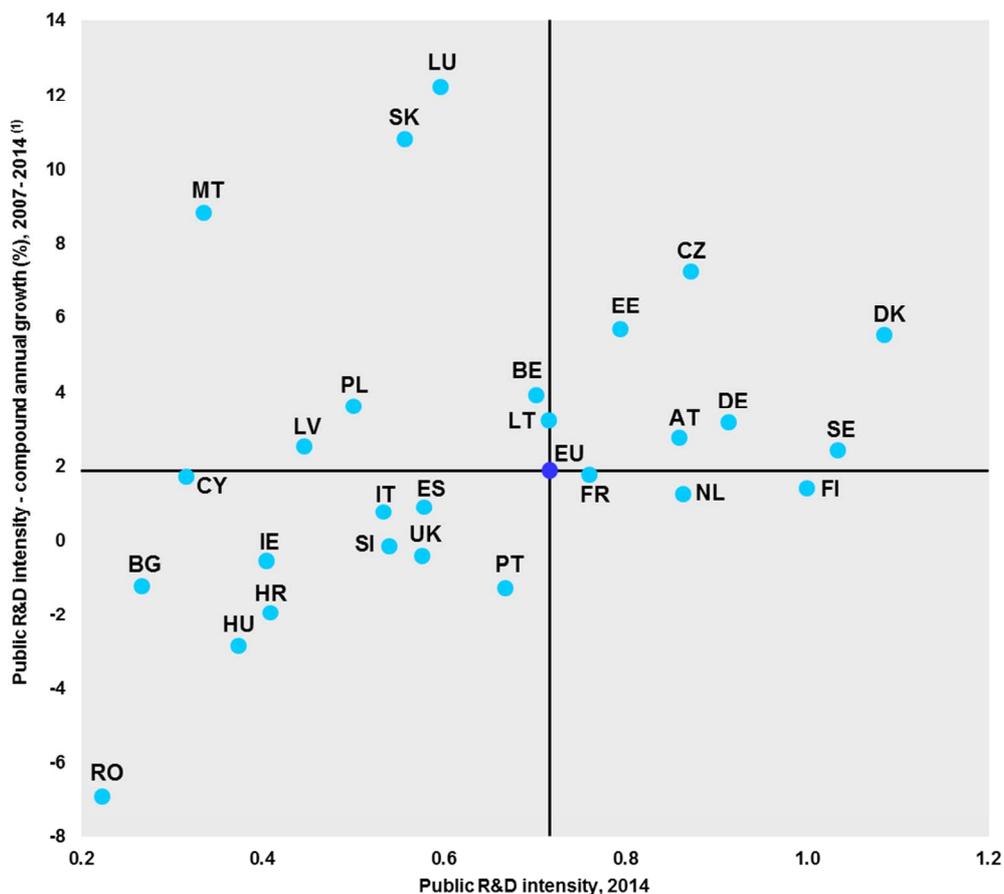
### 3. Identification of the policy levers to address the challenges and state of play

#### 3.1 Quality of the public R&I system

The level of financial resources made available for the public R&D sector is a key determinant of the quality of its output as measured e.g. by highly-cited scientific publications (see chart 1): the Member States that have invested above average in their public research base tend to be also those having a well performing system in terms of scientific excellence.

Chart 5 shows recent trends in public R&D intensity (growth on the vertical axis vs. absolute level on the horizontal axis).

**Chart 5: Public R&D intensity**



Source: European Commission, DG Research and Innovation – Unit for Analysis and Monitoring of National Research Policies. Data: Eurostat. Notes: PT: 2008-2014; EL: Greece is not included on the graph because valid data are available only for 2011-2014.

Various typical situations can be noted:

- In some Member States, such as Denmark and Germany, the level of funding of the public research system continued to increase throughout the crisis, from an already high level of public R&D intensity.
- Several Central and Eastern European countries (in particular Slovakia, Estonia and the Czech Republic) also display strong growth rates in public R&D intensity since 2007 (this is in particular thanks to significant mobilisation of European Structural Funds).
- Some Member States which already had a public R&D intensity well below the EU average (as well as a low quality of the public R&I system as shown on Chart 1), such as Bulgaria, Romania, Croatia and Hungary, have experienced budget cuts in their public R&D in recent years instead of building R&I capacities through more investments: these cuts risk delaying considerably the transformation of these countries into knowledge-based economies.
- Negative trends in Member States with a high quality public R&I system, such as the United Kingdom, are worrying as they risk undermining those countries' strengths.

While an adequate level of public funding is an important pre-condition for a high quality science base, merely increasing investment will not get the job done. Ambitious reforms of national R&I systems are often needed to increase the capacity to obtain the most value from these investments.

Policy levers to increase the efficiency of public R&I spending include the use of international panels to allocate project-based funding and the use of performance criteria in distributing institutional funding. While many Member States have recently implemented reforms using these levers (e.g. Finland, Italy), progress in relation to one or more of them is still required notably in Bulgaria, the Czech Republic, France, Slovenia, Slovakia and Spain. Moreover, in some Member States such as Croatia and Romania, excessive fragmentation at the level of research-performing institutions is an obstacle to increasing the efficiency of the public research system: wide-ranging institutional reforms are required to achieve critical mass.

### **3.2 Leveraging business R&I through public-private cooperation**

In some Member States benefiting from a good quality public R&I system, science-business cooperation may remain limited due to a mismatch between the public research capacities and the needs of the economy. A key lever to boost science-business cooperation is the design and implementation of 'smart specialisation' strategies which focus resources on areas where a potential for related business developments exists. In many Member States, while such a strategy has been designed, it remains to be seen how effectively it will be implemented.

Moreover, the public support system needs to be designed so that public research capacities are mobilised to address the needs of industry and the economy. This requires in particular:

- incentives for public research, notably at institutional level (e.g. through adequate criteria for institutional funding which favours engagement with businesses) and at

researcher level (e.g. through recognising experience working with the business sector when developing public sector careers);

- targeted funding schemes for public-private projects, proofs-of-concept, research agendas defined with industry, PhDs studentships in industry.

For instance, in Denmark, a recent evaluation report recommends adjusting the criteria for allocating institutional funding, setting goals for knowledge exchange in triennial university-government contracts, improving recognition and promotion of researchers engaging in knowledge exchange, involving more students in knowledge transfer activities, and increasing proof of concept funding.

### **3.3 *An investment-friendly environment***

Besides the factors related to the quality, relevance and mobilisation of the science base, there are broad range of policy levers that can be used to foster business R&D and innovation. The availability, accessibility and efficiency of direct public support for R&I and other incentives aimed at stimulating business R&D often needs to be improved. Administrative burdens linked to public support can be important obstacles, especially for SMEs. In some Member States, the R&D tax credits schemes need to improved, as some of these schemes might be skewed towards big companies and need to be fine-tuned to better take into account the needs of SMEs and young companies.

Another issue to be addressed is the availability of a workforce with adequate skills: in particular, skills shortages can arise due to mismatches between academic curricula and labour market needs. Access to finance is also an essential aspect and is covered in a separate thematic fiche. In general, fostering an environment favourable to business R&D investment and innovation requires coherently mobilising a range of policies: departing from a 'silo' approach and developing a 'whole government' approach to the policy mix. In many Member States, the key issue is to ensure strengthened and more effective governance.

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