

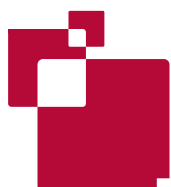
UNDERCUTTING THE FUTURE? EUROPEAN RESEARCH SPENDING IN TIMES OF FISCAL CONSOLIDATION

REINHILDE VEUGELERS

Highlights

- Innovation-lagging and fiscally weak countries in the European Union cut their public research and innovation (R&I) budgets during the crisis, while innovation-leading and fiscally stronger countries forged ahead with public R&I spending. There is therefore an increasing research and innovation divide in Europe.
- The European Union, with its growing R&I resources managed by the European Commission can only partly redress this increasing divide. But the Commission has not used its powers to their full extent to allow member states in weak fiscal positions to maintain public R&I support. Furthermore, the application of fiscal rules has not taken R&I into consideration.
- Understanding the degree to which public R&I budgets in the EU have been used 'smartly' during the crisis and whether the European Commission has made 'smart' recommendations on public R&I as part of the European Semester, requires an assessment of the long-term impact on growth. Unfortunately, there have been few such assessment exercises.
- The European Commission should play a greater role in supporting member states in their consideration of public R&I for smart fiscal consolidation.

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UNDERCUTTING THE FUTURE? EUROPEAN RESEARCH SPENDING IN TIMES OF CONSOLIDATION

REINHILDE VEUGELERS, JUNE 2014

1 SMART PUBLIC R&I CONSOLIDATION

The European Union's dangerous cocktail of high debt in some countries and subdued growth calls for smart fiscal consolidation. Cost-cutting programmes should minimise the potentially negative short-term effect on economic activity, while establishing a foundation for long-term growth, with growth-enhancing expenditure safeguarded from cuts, or even increased.

The areas most often highlighted as needing protection in the context of shrinking overall budgets include infrastructure, education and research and development. In its rhetoric at least, the EU has promoted the favouring amidst consolidation of government research and innovation (R&I) investment. As noted by Barbiero and Darvas (2014), the European Commission states in its 2013 Annual Growth Survey that *“investments in education, research, innovation and energy should be prioritised and strengthened where possible, while ensuring the efficiency of such expenditure.”*

This Policy Contribution asks how this encouragement to safeguard public R&I spending in a time of fiscal consolidation has been translated into practice¹. We first look at how EU public R&I budgets and policies have been affected by crisis measures and find an increasing intra-EU split, with the stronger countries forging ahead and the weaker countries further cutting their R&I support. We also examine to what extent the European Commission has remained true to its pronouncements on public R&I support in smart fiscal consolidation, in terms of both the management of the EU budget and the Commission's monitoring of member state R&I budgets and policies in the European Semester. Finally, we address whether public R&I budgets have been used smartly. What do the trends in public R&I spending mean for long-term growth? Have the Commission's country-specific recommendations on publicly-funded

research and development been smart? To answer this, we look at the scarce evidence on evaluation of the growth-enhancing effects of public R&I expenditure². We conclude with some suggestions for what can be done to make the public R&I budgets of EU countries smarter.

2 TRENDS IN PUBLIC R&I SPENDING IN THE EU IN CRISIS TIMES

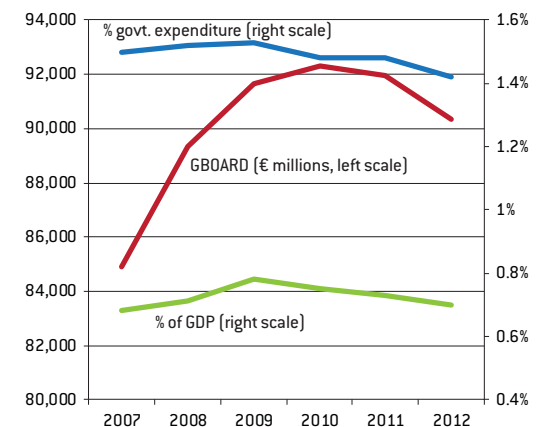
To examine how public expenditure on R&I fared in Europe during the crisis (ie since 2007), we use GBAORD (government budget appropriations or outlays for research and development) and GERD (gross expenditure on R&D) data³.

2.1 Trends in public R&I budgets in EU countries during the crisis

We first assess whether EU countries cut or expanded their public R&I budgets to a greater or lesser extent than other public expenditure (Figure 1).

For the EU as a whole, public outlays on R&I initially increased as part of the stimulus packages launched in many member states at the onset of

Figure 1: Trends in government expenditure on R&I, EU total (2007-12)



Source: Bruegel on the basis of EUROSTAT.

1. Although education is an area of smart consolidation closely related to R&I, a comprehensive treatment of tertiary education expenditure is beyond the scope of this Policy Contribution.

2. The impact and hence justification for public funding of science and innovation goes beyond its economic effects on GDP growth; it also encompasses societal challenges such as health and a clean environment. This Policy Contribution is restricted to a more narrow question, namely the justification for public R&I budgets as areas of smart fiscal consolidation, which is why our analysis concentrates on the growth-enhancing impact of public R&I.

3. Source: Eurostat and OECD. GERD can be split by source of financing. The government-financed part of GERD is what we are interested in. Both series have their strengths and weaknesses. GBAORD covers budgeted items, while GERD covers actual expenditures. GBAORD allows direct comparison with the other budgeted items. GBAORD data is more recently available compared to GERD.

the crisis. Compared to overall public expenditure, the share of R&I-related expenditure went up between 2007 and 2009 but started to decline thereafter, when stimulus spending stopped. R&I as a share of total public spending currently stands at 1.4 percent (2012), which is a small decline from the pre-crisis level (1.5 percent in 2007). As a share of GDP, R&I spend has resumed its pre-crisis level of about 0.7 percent.

There is therefore no strong evidence that EU countries, on average, sacrificed their R&I budgets more than other government expenditure during the crisis. However, this favourable treatment of R&I seems to have been part of a one-off stimulus. More recently, R&I spend has been declined. It should also be noted, ignoring the crisis impact, that the share of R&I in public budgets is not high in general, particularly when considering the potentially high social rates of returns from public R&I investment (see Veugelers, 2014, for more on this). The relative importance of R&I in public budgets is substantially lower in the EU than in Japan, South Korea, Switzerland and the US.

Behind the average EU trend, about half of the EU countries have stabilised or increased the share of their public budget spent on R&I⁴. The other half has seen a drop in R&I as a share of total public spending⁵. In an attempt to further explore these differences, we distinguish groups of countries:

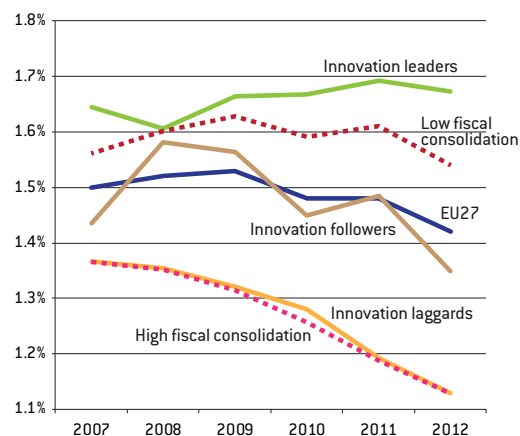
- Innovation leaders (Denmark, Finland, Germany, Sweden and the UK), innovation followers (Austria, France, Ireland, Luxembourg and the Netherlands) and the rest (innovation laggards);
 - This classification is based on the European Commission's Innovation Union Scoreboard indicator for innovative performance pre-crisis (2007); countries are classified according to whether they are well above, around or below the EU average score. Source: EU Innovation Union Competitiveness Report 2007.
- High fiscal consolidation countries (Bulgaria, Cyprus, the Czech Republic, Estonia, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia and Spain) versus the rest (low fiscal consolidation);
 - This classification is based on their budget-

ary consolidation position: countries with an above-median cumulative change in their structural primary balance since the year in which consolidation started (the year with the lowest negative structural primary balance in the period 2008-10). Source: EUROSTAT and AMECO. Also included in the high fiscal consolidation group are the Economic Adjustment Programme countries.

Figure 2 shows that innovation leaders increased public expenditure on R&I during the crisis, by more than their increase in other public expenditure. Innovation followers reduced their public R&I expenditure more than other categories of public expenditure. Innovation laggards, including Italy and Spain, substantially cut public R&I expenditure, even more so than other parts of their budgets, resulting in a considerable drop in the share of R&I in public expenditure, which was already below the EU average. The crisis seems therefore to have widened the gap between EU countries in public R&I expenditure. Most innovation laggards, perhaps not by coincidence, are also under greater fiscal consolidation pressure. Countries under high fiscal consolidation pressure have significantly cut their public R&I expenditure. This trend of a growing EU public R&I divide is also reported in the OECD STI Scoreboard (2013) and in ERIAB (2014).

Figure 3 on the next page shows there are significant differences even between countries within

Figure 2: Trend in government R&I expenditure, 2007-12 (GBORD as % of government expenditure)



Source: Bruegel calculations on the basis of EUROSTAT and AMECO.

4. Austria, Bulgaria, the Czech Republic, Denmark, Estonia, Germany, Greece, Luxembourg, Malta, Poland, Portugal, Slovakia and Sweden.

5. Belgium, Cyprus, Finland, France, Hungary, Ireland, Italy, Latvia, Lithuania, the Netherlands, Romania, Slovenia, Spain and the United Kingdom.

our groups. Among the leading innovators, Sweden, Germany and Denmark increased their public R&I budgets even more than other government spending. Germany spent 2 percent of its public budget on R&I in 2012. In Finland the increase has remained flat since 2011. As a consequence it is no longer the EU country spending the greatest share of its budget on R&I. The UK began to cut its public R&I budgets already in the early years of the crisis, and more deeply than its overall public expenditure.

Among the innovation followers, Austria has increased its public R&I budget substantially, by more than its overall public budget (1.6 percent in 2012). France has increased its public R&I budget on average, but not consistently. In the Netherlands, there was a decline in the R&I share of the public budget. Among the innovation laggards, Estonia was under high financial consolidation pressure but has nevertheless continued to expand its R&I budget so substantially that it is now the EU's highest public R&I spender, in relative terms: 2.1 percent in 2012.

Most countries under high fiscal consolidation pressure cut their public R&I budgets, but some did so more forcefully than others. Ireland cut its public R&I budget by somewhat more than its overall public budget (1 percent in 2012). Spain cut its public R&I budget substantially, by even more than its overall public budget, driving the R&I share of its overall budget down to 1.25 percent in 2012 from 1.95 percent in 2007. Italy has seen similar substantial cuts in public R&I spending,

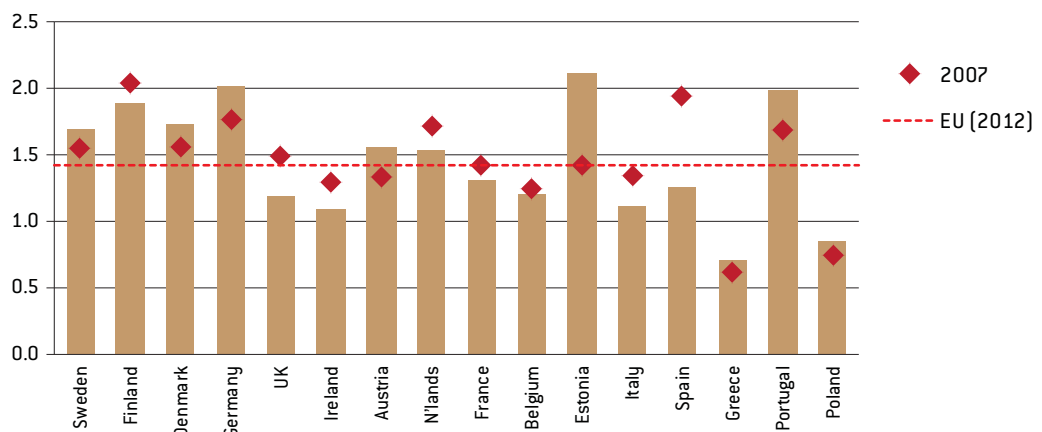
reducing the share of R&I in its public budget to an historic low (1.1 percent in 2012). Greece also had to cut its R&I budgets mostly in line with its overall budgetary cuts, but these cuts have deepened, reducing the share of R&I in Greece's overall budget from an already-low share (0.7 percent in 2012). By contrast, Portugal has expanded its public R&I budget and has only made cuts in recent years. R&I cuts in Portugal have been proportional to other budget cuts, meaning that the share of R&I in Portugal's public spending remains high (2 percent in 2012).

2.2 Trends in composition of public R&I spending during the crisis

Changes in the size of public R&I budgets matter, but we must also consider how the shrinking or expanding R&I budget is spent, and which spending categories win or lose. Crisis might put the emphasis on short-term targeted impacts and returns, rather than long-term impact. Crisis might also lead politicians to seek to leverage more private R&I investment, including a search for more public-private co-funding.

GBAORD data shows that about half of public R&I funding in the EU is 'general purpose' spending and the crisis has hardly changed this: from 48 percent in 2007 to 52 percent in 2012. The small increase is a result of innovation-following and lagging countries catching up with the higher shares that innovation-leading countries dedicate to non-targeted support (58 percent in 2012).

Figure 3: Trends in government expenditure on R&I (GBORD as % of govt. expenditure), 2012 relative to 2007



Source: Bruegel calculations on the basis of Eurostat. Note: Countries are reported in decreasing order of Innovation Union Score; Innovation Union Scoreboard 2007.

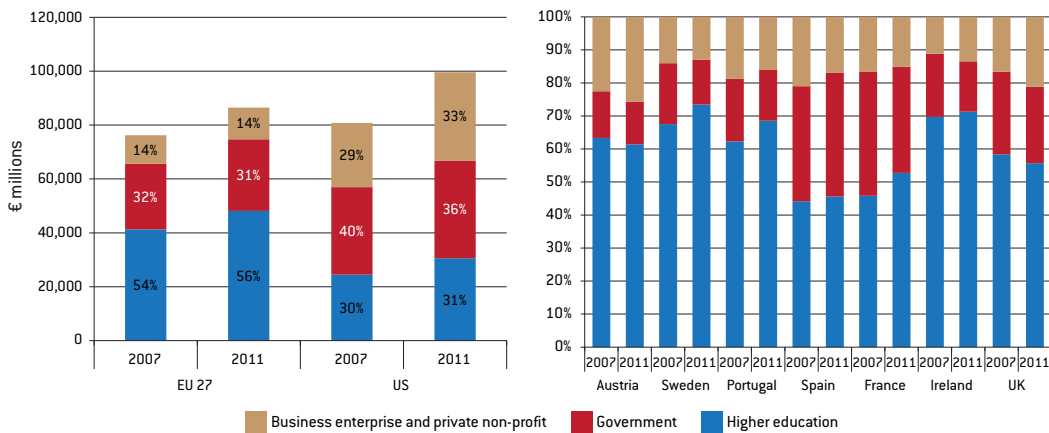
In terms of R&I support by sector, overall in the EU27, most funding goes to higher education institutes (56 percent) with public research organisations receiving 32 percent. Funding to the business sector represents only 13 percent (2011, Figure 4). These shares remained stable during the crisis. Consolidation or expansion of public R&I budgets therefore seems to have been sector-neutral. Compared to the EU27, the US spends more of its public R&I budget on the business sector. From 2007-11, the US significantly increased its public R&I expenditure. The largest increment went to the business sector.

In the EU, noteworthy shifts in recipient sectors have occurred in only a few countries (Figure 4, right panel). In the UK and Austria, the business sector has seen its share increase. In Spain, the business sector saw its share decline. In Sweden, France and Portugal, the higher education sector's

share has increased.

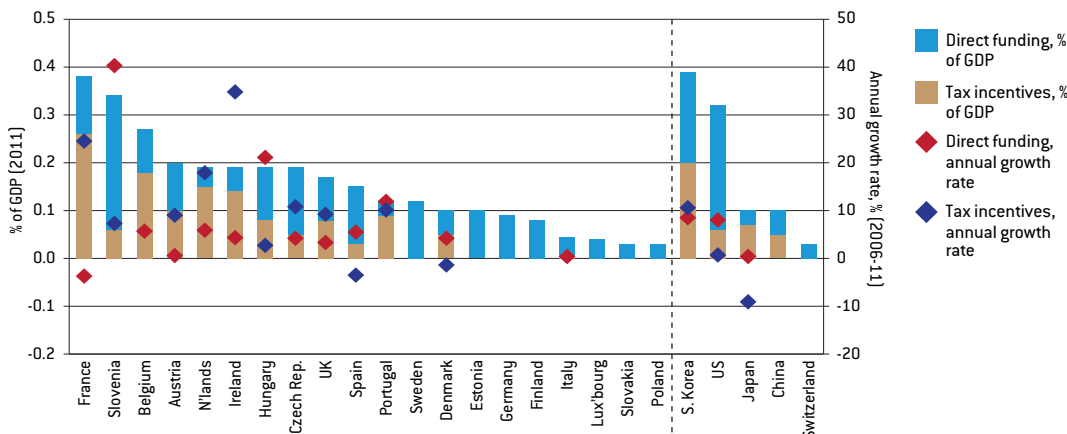
Public budgetary support for business R&I includes direct support through grants, but also indirect support, predominantly through tax incentives. This indirect support is not visible in the GERD or GBAORD data. Figure 5 shows that tax incentives have become the main channel of government support for business R&I in countries such as Belgium, France, Ireland, the Netherlands and Portugal. With the exception of Portugal, in all of these countries, use of tax credits increased much faster than grants during the crisis. In Austria, Denmark, Hungary and the UK, tax incentives and grants have about equal weight. Some countries, including Estonia, Finland, Germany and Italy, have no substantial R&I tax incentives. Germany has long debated the introduction of R&I tax incentives. The use of tax credits therefore seems to mark another divide in Europe: some countries

Figure 4: Government GERD by sector: EU27, US (left panel) and selected EU countries (right panel)



Source: Bruegel calculations on the basis of Eurostat.

Figure 5: Government support for business R&I: subsidies vs tax incentives



Source: Bruegel on the basis of OECD- STI [2013]. Notes: for Belgium, Ireland and Spain figures refer to 2010 instead of 2011. For Luxembourg figures refer to 2009.

are heavy and increasing users, while others continue to refrain from using the instrument.

The increasing shift towards tax credits during the crisis is unsurprising given that tax credits for R&I are an easier-to-use instrument in times of fiscal consolidation. They do not require allocation of public funds upfront, only foregone earnings. They may also have the advantage that they are more lightly monitored under EU state aid rules, because they are expected to be less competition-distorting because of their general applicability. However, there is no strong evidence that tax credits are a more effective instrument for boosting private R&I (see Veugelers, 2014).

3 EUROPEAN COMMISSION POLICY ON PUBLIC R&I IN A TIME OF FISCAL CONSOLIDATION

The commitment of the European Commission to research and innovation is manifest in the Europe 2020 strategy and the Innovation Union Flagship Initiatives. But how has the EU treated public R&I during the crisis, both through its own EU budget (Structural Funds and research funds), and its monitoring of member state R&I budgets and policies through the European Semester?

3.1 EU own R&I budget spending

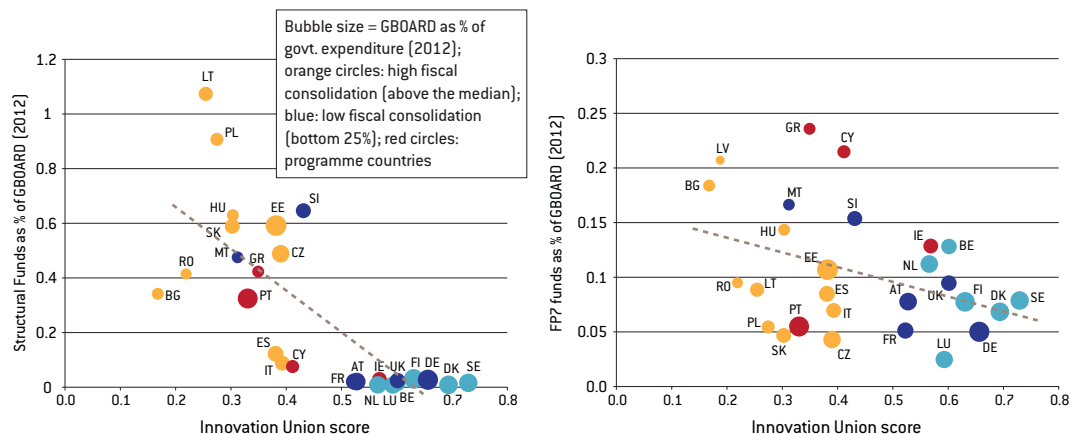
The major sources of EU R&I funding are the Structural Funds and the Framework Programme research funding – the Seventh Framework Programme for Research and Development (FP7) from 2007-13, and Horizon 2020 from 2014-20.

This funding complements member state own public investment in R&I.

From 2007-13, of the €347 billion (current prices) Structural Funds budget, about €86 billion, or a quarter, went to R&I. In some countries, Structural Funds for research and innovation are of the same magnitude as national R&I budgets, meaning that Structural Funds (almost) double the volume of government R&I funding included in GBAORD data for the country (see the table in the annex and Figure 6). This is the case for Estonia, Hungary, Lithuania, Poland and Slovakia. In Latvia, Structural Fund allocations even triple the public R&I budget. But also in Portugal, Structural Funds represent 31 percent of total public R&I. In Greece, Structural Funds support for public R&I represents 40 percent. However, the low implementation rate brings the actual share down to 21 percent⁶. In Spain, allocated Structural Funds make up 10 percent of total public R&I funding. But a low implementation rate reduces this share to 7 percent, the same share as in Italy.

Funding acquired through the competitive, excellence-geared Horizon 2020 programme (and its FP predecessors), also represents extra public R&I funds available in different countries from the EU budget, but this is not measured in the GBAORD data. Nevertheless, for some EU countries with small national R&I budgets, this funding can represent a substantial amount of money, even if the funds need to be acquired through competitive calls and on the basis of R&I excellence (see the table in the annex and Figure 6). During 2007-13,

Figure 6: EU research and innovation funds and Innovation Union scoring



6. Lacking resources for co-funding may imply that not all of the allocated budget can be implemented (see the table in the annex for the implementation rates of allocated Structural Funds).

Source: Bruegel on the basis of IUC 2007, Eurostat and AMECO. Note: EU funds are both the structural RTDI funds as well as the FP7 funds. Latvia is excluded as an extreme outlier in the left panel.

this was the case for Bulgaria, Cyprus, Estonia, Hungary, Latvia, Malta and Slovenia. Even for countries such as Belgium, Greece, Ireland, the Netherlands and the UK, the share can be substantial – greater than 10 percent.

The EU budget serves as mechanism to somewhat ease the growing public R&I divide in Europe. EU funds are relatively more significant for innovation-lagging countries with low national R&I budgets. Figure 6 illustrates clearly the negative relationship between EU funds as a share of national R&I spending and countries' innovation scores. This is particularly evident for the Structural Funds. But it also holds, albeit to a much lesser degree, for research funds allocated through excellence-based competitions.

EU funding in countries with declining R&I spends

is likely to become even more important. With Horizon 2020, EU funding for R&I will amount to €80 billion, an increase of 30 percent compared to its predecessor (2007-13). The share of R&I in the total EU budget is now about eight percent, much higher than the share of R&I spend in member state budgets (1.4 percent in 2012). In addition, a greater share of the Structural Funds is earmarked to be spent on Europe 2020 challenges during 2014-20: from 50 to 80 percent.

3.2 Country-specific recommendations for R&I in the European Semester

The European Commission monitors the progress of member states towards their own R&I targets in pursuit of the Europe 2020 goals. This monitoring happens annually through the European Semester (eg Hallerberg *et al*, 2012). An analysis of the

BOX 1: COUNTRY-SPECIFIC RECOMMENDATIONS FOR R&I IN THE 2013 EUROPEAN SEMESTER

- The programme countries (Cyprus, Greece, Ireland, Portugal) had their own template, only reporting on framework condition improvements. Reforms relevant for innovation were only mentioned for Greece.
- For the non-programme countries, only nine out of the 23 countries received a country-specific recommendation that involved their public R&I budget. These countries were the Czech Republic, Estonia, Germany, Hungary, Lithuania, Luxembourg, the Netherlands, Poland and Romania. The recommendation in each case was to prioritise and increase the public R&I budget, or reverse the decline.
 - Included is Germany, an innovation leading country without any fiscal consolidation pressure, and with increasing public R&I budgets. The recommendation for Germany was that it should set even more ambitious targets. Recommendations were also issued to Estonia, an innovation follower that has increased the R&I share in its public budget substantially, but is under fiscal consolidation pressure, and the Netherlands, which is not above average with respect to fiscal consolidation pressure, but has recently seen a decline in the share of R&I in its public budget.
 - Among the innovation laggards, only five countries received an R&I prioritisation recommendation. All are countries under fiscal consolidation pressure: Poland and Czech Republic, where the share of R&I in the public budget is increasing, and Hungary, Lithuania and Romania, which have declining public R&I budget shares. Innovation-lagging countries receiving no recommendation to prioritise R&I include Italy and Spain.
- On framework conditions relevant for R&I, out of the 23 non-programme countries, Belgium, Bulgaria, France, Italy, Malta and Romania received a country-specific recommendation. Again, this is a mixed bag of countries: innovation followers and laggards, some under fiscal consolidation pressure and some less so, with diverging public R&I budgets. Enhancing the connection between public research and the business sector was recommended for Estonia, France, Latvia, Luxembourg and Malta. Improving efficiency of public intervention and policy evaluation was recommended for the Czech Republic, Finland, Poland and Romania.

Source: Bruegel on the basis of Innovation Union Competitiveness Report 2013, Eurostat and Council Recommendations document – 2013 [and Economic Adjustment Programme for programme countries – latest available].

Commission's latest country-specific recommendations delivered as part of the European Semester system of economic policy coordination shows that recommendations related to R&I are patchy (Box 1). This is not new. Pisani-Ferry and Sapir (2006) reached a similar conclusion when they analysed the capacity of the Commission to monitor member state National Reform Programmes under the Lisbon Strategy, the Europe 2020 strategy's predecessor.

Overall, R&I-related country-specific recommendations in the European Semester seem rather ad hoc. The recommendations that are put forward are not supported by the systematic use of evaluation tools to assess the smartness of national R&I proposals in terms of their impact on long-term growth, or to identify the critical framework conditions that need to be improved to enhance efficiency of public R&I instruments.

3.3 The 'investment clause' use for public R&I budgets

A further means by which the Commission could promote R&I investment during crisis as part of smart fiscal consolidation is through the so-called 'investment clause'. This allows member states that are in deep recession, but that have budget deficits below the three percent of GDP threshold and that respect the public debt reduction rule, to temporarily deviate from the fiscal targets of the Stability and Growth Pact (SGP), to the extent of their national co-funding of EU-funded investments. The Commission proposed this in summer 2013 in response to the request of the European Council (2013) to explore *"the possibilities offered by the EU's existing fiscal framework to balance the productive public investment needs with fiscal discipline objectives ... in the preventive arm of the SGP."* The investment clause, which extends beyond R&I, has however so far not been activated, as reported by Barbiero and Darvas (2014).

All this evidence suggests that despite many communications advocating that R&I investment be part of smart fiscal consolidation in the member states, the European Commission has not itself established a firm track record in implementing such a preference. Nor has it set up a rigorous framework for promoting R&I in the European Semester framework.

4 ARE EU PUBLIC R&I BUDGETS BEING CONSOLIDATED SMARTLY?

The evidence so far has shown an increasing public R&I divide in the EU during the crisis, with the innovation-lagging and fiscally-weak countries cutting public R&I budgets, while the innovation-leading and fiscally stronger countries forge ahead with public R&I spending. The European Commission, with its growing resources for R&I, is able to only partly redress this increasing divide. The Commission has so far not used its powers to their full extent to allow member states in weak fiscal positions to deviate from the fiscal targets in order to maintain public R&I support.

The critical question that still needs to be addressed is whether these diverging trends are good or bad news. Are the cuts in the weaker countries evidence of smart use of public R&I investment, ie were they effective in supporting recovery and growth and in eliminating inefficiently spent public resources? Or have the public R&I cuts been too aggressive, jeopardising long-term growth? Is the Commission right to not allow members states in weak fiscal positions, which also happen to be weak innovators, to shelter their public R&D budgets from fiscal exigencies? Or should the Commission be more lenient and exercise the investment clause option?

Understanding the degree to which public R&I budgets in the EU have been used 'smartly' during the crisis and whether the EU has made 'smart' recommendations on public R&I in the European Semester requires an assessment of the long-term impact on growth.

When innovation-lagging countries are also less efficient in turning public R&I into growth, consolidating public R&D budgets in these countries is a more effective outcome until the efficiency and effectiveness of their public R&I spending is improved. To benefit from the growth effects from R&I, it could be a better strategy for innovation-lagging, weak fiscal-consolidating countries to improve their capacity to absorb R&I investments made elsewhere, rather than to fund with public resources their own R&I. Building such absorptive capacity may still require public R&I policies, but of a different kind. Effective leveraging of external

R&I spending into local growth could thus at least partly address the increasing growth divergence resulting from the R&I investment divergence. Cutting back on own public R&I in weaker countries might in this case not harm the growth potential of the innovation-lagging countries, as long as these countries replace this with an improved capacity to effectively leverage external R&I spending into local growth.

Assessment of the growth effects from public R&I requires the appropriate methodologies to evaluate the causal impact of public R&I on long-term growth. Conté *et al* (2009) report that almost all EU member states indicated that they had some evaluation schemes in place to assess their public R&I support. Most member states that conduct ex-post evaluations do this every few years, tracing headline indicators such as numbers of publications and patents. Only a few member states have made ex-ante and ex-post evaluation a fixed element of their R&I programmes and projects. The new guidelines for state aid recently proposed by the European Commission includes evaluation of state-aid schemes as a condition for approval for some schemes⁷.

Although the number of studies evaluating public R&I programmes have grown substantially, they are still grappling with the causal link between

public intervention and its impact on growth, and establishing proper counterfactuals to assess what the growth outcome would have been for the beneficiaries had they not received the support. Various methodological improvements to assess causality are increasingly being used⁸, but still require a cautious interpretation of the causal nature of the results. In addition, most evaluation studies only look at the immediate impact of public support on private research and development and innovation, checking whether it crowds out or generates additional private investment (the so-called 'additionality'). There are few assessment exercises that pin down the longer-term social returns and growth impact of R&I, which is the impact that matters for smart fiscal consolidation. Assessing social returns and the growth impact is a much more complex exercise requiring a longer-term perspective, an analysis of the diffusion effects from R&I across institutions, sectors and countries and an assessment of the framework conditions in place for innovation-based growth. This can only be done when integrating the micro-additionality exercises into endogenous growth macro-models⁹.

Box 2 discusses two assessment examples. Both suggest that public R&I spending in innovation-lagging countries is less effective.

BOX 2: EVALUATING THE EFFECTIVENESS OF PUBLIC R&I IN EU COUNTRIES

Conté *et al* (2009) estimated for a panel of EU countries the efficiency of various R&I inputs (public and private) for generating various R&I output measures (patents and publications), and then examined the factors explaining the efficiency measure. Among the factors they considered was the stock of public R&I, for which they find a positive effect, suggesting that countries with a bigger stock of public R&I have a more efficient innovation system. Their efficiency analysis unfortunately does not extend into the impact on GDP growth and does not include proper counterfactuals.

Roeger *et al* (2013) run simulations using QUEST III, a semi-endogeneous global Dynamic Stochastic General Equilibrium (DGSE) model, to analyse the effects of various structural reforms in southern European countries (Italy, Spain, Portugal and Greece), including the use of R&D tax credits. R&D tax policy was modelled as closing the gap between the country in question and the average level of the three best-performing euro-area countries. R&D tax additionality parameters were calibrated as an average from the literature and assumed the same for all countries. The use of R&D tax credits yielded positive, but small long-run effects on GDP (ranging from 0.1 percent for Spain to 1.4 percent for Greece). The structural reforms that yielded the most significant results in the long run were policies to reduce the share of low-skilled workers, generating an increase of 15 percent in GDP for Italy and Spain. For Greece, the greatest economic gains were realised from product-market reforms (39 percent of GDP). For Spain, product-market reforms would also result in a substantial increase in GDP (16 percent).

7. http://ec.europa.eu/competition/state_aid/modernisation/index_en.html#rdi

8. The up-to-date evaluation methodologies (partly) addressing the causality include randomised experiments, diff-in-diffs, regression discontinuity design, instrumental variables, matching, structural estimation]. The EU State Aid framework includes a methodological appendix describing the state-of-the-art techniques for evaluation schemes. Each have their limitations and are only valid under strict assumptions.

9. The SIMPATIC project aims to contribute to micro-assessment of the causal impact of R&D grants and tax credits, by assessing the net private and social rates of return using structural modelling and integrating this micro-assessment into an endogenous R&D macro model to assess the long-term impact on growth and jobs (see www.SIMPATIC.eu).

5 IMPLICATIONS FOR POLICY

When one considers the potentially substantial growth dividend and social rates of return from R&I investments, at least in the long-run, and the risk of market failure before these social rates of return can be secured, public support for R&I investment is a good candidate to be prioritised in the midst of smart fiscal consolidation. But smart consolidation featuring R&I investment needs to take a long-term perspective and to have sound evaluation frameworks in place to assess whether the potential for high growth returns from public R&I are indeed being realised. Evaluating the effectiveness of public R&I budgets should go beyond assessing short-term additionality impacts on private research and development and innovation. Smart fiscal consolidation by EU member states should include assessments of the longer-term social rates of return in excess of private rates of return, and a blending of micro-evaluation results into macro models to assess the long-term growth impact. Such an integrated approach will allow an assessment to be made of the complementary framework conditions needed to realise the growth dividend from own public R&I, and from R&I investments made elsewhere. The approach will also enable the identification of the structural reforms (in product markets, labour markets, financial markets) that are needed to generate innovation-based endogenous growth. This is an agenda for smart consolidation in member states, whether they are innovation lagging, following or leading countries. It is only when this agenda is tackled that we will start to see if the growing R&I divide we have witnessed since the crisis is an example of smart fiscal consolidation or, on the contrary, a bad omen for an increasing growth divide in Europe.

But beyond the member states, there is also an important role for the European Commission to support the member states in their analysis of public R&I for smart fiscal consolidation. The remainder of our recommendations focus on the Commission's role.

5.1 What the European Commission can do: own spending

The Commission should ensure that its own increasing public R&I funding is used smartly. The effectiveness of Horizon 2020 and the Structural Funds for R&I needs to be properly evaluated, using transparent, state-of-the-art evaluation methodologies, with proper counterfactuals.

This evaluation should involve an assessment of the effects of EU public R&I funding on private R&I investment, and should also assess the effects of EU R&I funding on national public R&I funding: does it complement or crowd-out member state R&I funding? Most importantly from a smart fiscal consolidation perspective, the analysis should assess the impact on European growth.

All this requires an integration of micro and macro assessment exercises. This will allow an assessment to be made of how the EU budget can be better used for European growth and how it can be used to tackle the growing public R&I divide between member states.

5.2 What the European Commission can do: country-specific recommendations

The Commission should improve its analytical capacity to underpin the country-specific recommendations on public R&I that it makes to member states in the European Semester. The Commission should use operational models blending micro and macro evaluations, to evaluate how member states' public R&I proposals will boost their long-term growth enhancing capacity, and to identify the complementary reforms that need to be made to improve this capacity.

The Commission should devote more resources to further develop its applied macro-models as tools in support of the country-specific recommendations for R&I (such as the QUEST model). This requires further developing the R&I modelling and endogenous growth characterisation in these

'Smart consolidation featuring R&I investment needs to take a long-term perspective and to have sound evaluation frameworks in place to assess whether the potential for high growth returns from public R&I are indeed being realised.'

models. This also requires calibrating these models with the latest insights from country specific micro-empirical assessments of the efficiency and effectiveness of each country's public R&I spending.

An advantage of deploying integrated macro-models at the EU level compared to a country-by-country approach is that the EU scale allows assessment of the cross-country spillovers from national R&I policies. If Italy spends less public money on R&I, does this increase the supply of foreign R&I employees in the UK? If the UK introduces a patent box scheme, should France follow? How much could be gained from coordinating member states' R&I tax credits, in order to avoid the negative effects of R&I tax competition? Such an integrated analysis of public R&I spending would also allow assessment of the effectiveness of alternative public R&I strategies for lagging countries to better absorb R&I spending done elsewhere. How much does Greece, for example, benefit from increased German R&I expenditure?

This spillover analysis requires well-developed modelling and an empirical calibration of the various mechanisms via which knowledge transfers between member states: for example, through cooperation in innovation networks, through mobility of researchers, through multinational firms or through licensing. Better assessment of spillovers and their effects should be at the core of the European Commission's European Research Area (ERA) project to establish a fully integrated internal market for knowledge flows¹⁰.

Only when member states public R&I plans are properly assessed for their growth impact in an integrated framework, will we be able to conclude if the growing EU public R&I divide is a good or a bad trend, the implications it might have for the future growth divide in Europe and what country-specific recommendations on public R&I the European Commission should issue to minimise the chances the growth divide becoming critical.

5.3 What the European Commission can do: activating the investment clause

The investment clause exemption for national co-investment of Structural Funds should be implemented, at least the R&I component of it. But the exemption should be made conditional on putting in place ex-ante and ex-post evaluation of the projects that will be funded. The evaluations need to be approved by the Commission before exemption can be granted.

The investment clause exemption should be extended to national R&I co-funding of other EU investments beyond Structural Funds, such as the European Investment Bank (EIB)/European Investment Fund funding and Horizon 2020 funding. Because EIB projects are assessed by the EIB *inter alia* for their social rates of return before they are funded, national co-investments for these funded projects can be exempted. The EIB's analyses include assessment of social rates of return.

The Commission's new guidelines for state aid for research and development and innovation specify proper *ex-post* evaluation as a condition for approval of member state R&I schemes (grants and tax credits). The evaluation strategy proposed by each member state needs to satisfy some minimum methodological conditions. Conditional on receiving clearance from the Commission competition authorities, member state spending on R&I grants and tax credits can be included in the investment clause exemption.

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10. http://ec.europa.eu/research/era/index_en.htm.

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ANNEX: Table (page 13): EU Structural funds 2007-13 for RTDI, EU FP7 funding and EU's country specific recommendations for innovation and member states' pressure for fiscal consolidation

Source: Bruegel on the basis of Innovation Union Competitiveness Report 2007, Eurostat and Council Recommendations document, 2013 (and Economic Adjustment Programme for programme countries, latest available).

Notes to table: the programme countries in italics (Ireland, Cyprus, Portugal and Greece) had a different template for their country specific recommendations. (1) Implementation as a percentage of allocated funds in the period 2007-13. (2) Average annual allocation (2007-2013) as percentage of average annual GBOARD (2007-2012). We considered the innovation ranking according to the Innovation Competitiveness report 2013. In this classification, innovation leaders are SE, DE, DK and FI, innovation followers are NL, LU, BE, UK, AT, IE, FR, SI, CY and EE, innovation laggards are IT, ES, PT, CZ, GR, SK, HU, MT, LT, PL, LV, RO and BG.

Country	Innovation Union rank (2010)	Fiscal consolidation above the median	Economic Adjustment Programme	GBARD 2012 vs 2007		GBARD 2012 as % of exp [change vs 2007]		Structural Funds 2007-13 for RTDI		FP7 funds 2008-12	Commission recommendations mentioning innovation					
				UP	DOWN	UP	DOWN	Implementation rate, % (1)	Allocation as % of GBARD (2)		Contribution as % of GBARD	Improve intervention in R&D	Enhance connections between public research institutes and business sector	Improve efficiency of public intervention in R&D and policy evaluation	Improve framework conditions for innovation	
Sweden	1			UP		1.69 (UP)		96	2	9						
Finland	2			UP		1.89 (DOWN)		89	3	8		V				
Denmark	3			UP		1.73 (UP)		87	1	8						
Germany	4			UP		2.02 (UP)		84	3	5		V				
UK	5			DOWN		1.19 (DOWN)		76	2	10						
Luxembourg	6			UP		1.49 (UP)		81	1	3		V	V			
Ireland	7	V		DOWN		1.09 (DOWN)		360	3	12		n.a.	n.a.	n.a.		n.a.
Austria	8			UP		1.56 (UP)		65	2	8						
Netherlands	9			UP		1.54 (DOWN)		128	1	11		V				
France	10			UP		1.31 (DOWN)		77	2	5			V			V
Belgium	11			UP		1.2 (DOWN)		98	2	13						V
Estonia	12	V		UP		2.12 (UP)		85	79	14		V	V			
Czech Rep.	13	V		UP		1.53 (UP)		84	56	5		V		V		
Slovenia	14			UP		1.12 (DOWN)		84	59	14						
Italy	15	V		DOWN		1.11 (DOWN)		83	8	7						V
Cyprus	16		V	UP		0.86 (DOWN)		116	7	19		n.a.	n.a.	n.a.		n.a.
Spain	17	V		DOWN		1.26 (DOWN)		68	10	7						
Malta	18			UP		0.69 (UP)		79	76	25						
Lithuania	19	V		DOWN		1.01 (DOWN)		84	96	8		V				
Hungary	20	V		DOWN		0.71 (DOWN)		64	57	13		V				
Portugal	21	V	V	UP		1.99 (UP)		102	31	5		n.a.	n.a.	n.a.		n.a.
Greece	22	V	V	UP		0.71 (UP)		53	40	22		n.a.	n.a.	n.a.		n.a.
Slovakia	23	V		UP		1.1 (UP)		61	75	5			V			V
Poland	24	V		UP		0.85 (UP)		86	107	6		V		V		
Bulgaria	25	V		UP		0.71 (UP)		71	34	18						V
Latvia	26	V		DOWN		0.4 (DOWN)		97	211	17			V			
Romania	27	V		DOWN		0.6 (DOWN)		82	30	7		V	V	V		V