2011:6

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Achieving Europe's R&D Objectives

Delivery Tools and Role for the EU Budget

Sieps
Swedish Institute for European Policy Studies

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- SIEPS 2011:6 -

Report No. 6
June 2011

Publisher: Swedish Institute for European Policy Studies

The report is available at
www.sieps.se

Cover: Svensk Information AB
Print: EO Grafiska AB
Stockholm, June 2011
ISSN 1651-8942
ISBN 978-91-86107-28-4

Preface

The EU's Research & Development policy has been undergoing important changes since the Lisbon Strategy determined that it was a pillar for the EU's future competitiveness. It is also a central element in the recently launched strategy "Europe 2020", which reiterates the need to increase the level of investment in R&D in the EU to 3% of GDP.

The authors of this report, Jorge Núñez Ferrer and Filipa Figueira, review the theories according to which EU funding of R&D is justified and they evaluate, *inter alia*, the EU's potential to reach its self-imposed objective of increasing the spending on R&D to 3% of GDP. The report pinpoints the strengths and weaknesses of EU R&D policy and examines areas in which the EU should pay particular attention in order to ensure that results are delivered. It also explores the underdeveloped area of loan guarantees, using the EIB as a means to reach the R&D investment needs of the EU.

By issuing this report, SIEPS hopes to contribute to the on-going debate on the future of the EU budget and the role it should play in the EU's R&D policies.

Stockholm, June 2011
Anna Stellinger
Head of Agency, SIEPS

SIEPS carries out multidisciplinary research in current European affairs. As an independent governmental agency, we connect academic analysis and policy-making at Swedish and European levels.

About the authors

Jorge Núñez Ferrer is an Associate Research Fellow at CEPS and Associate Researcher at LICOS, University of Leuven. He has studied in the UK, at the London School of Economics and Wye College, and he has a PhD in Agricultural Economics from Imperial College. For four years he worked as an expert on the enlargement and evaluator of EU expenditure policies on agriculture and the Structural Funds in the European Commission's Economic and Financial Affairs Directorate General. For the past five years he has been working as a consultant and adviser for member states, EU institutions, the World Bank and the United Nations. He has recently published various reports on EU policies, particularly on the EU budget, for various organisations, including the European Parliament.

Filipa Figueira is a visiting researcher at the School of Public Policy, University College London, and formerly an Associate Researcher at CEPS. Her research interests include the EU budget, cohesion policy and the allocation of competences between EU and national levels (fiscal federalism, subsidiarity).

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Executive summary

The EU's R&D policy has recently come under the spotlight, as it is a central element both in the recently launched "Europe 2020" strategy for promoting economic growth in Europe and in the review of the EU budget. One of the objectives of the Europe 2020 strategy is to increase the level of investment in R&D in the EU to 3% of GDP. This has been taken on board by the European Commission in its budget review, which calls for a reinforcement of the EU's R&D policy, even if it does not specify by how much funding should be increased.

However, despite stressing the importance of R&D spending as a part of both strategies, the Commission has yet to make concrete proposals on how EU spending on R&D should be boosted. The question on the size and role of the EU's budget support to R&D will be central in the discussions over the next Multiannual Financial Framework. EU support will need to be justified before the level of investment can be increased.

It is a widely accepted fact that there are advantages to funding research at the EU level, mainly because of economies of scale. However, there is much less consensus on how funding should be allocated and how much of the EU budget should be spent on R&D. Although several studies have advocated an increase in the EU's spending on research, the analyses have tended to avoid specifying how a beefed up EU research budget could be used.

Even though the EU budget attracts most attention, this report argues that the financing opportunities that the EU makes available are just as important. Loans by the European Investment Bank (EIB) and the mechanisms for public–private partnerships also play an essential role in supporting research in the EU. In particular, although grants are most appropriate to fund basic research, financing instruments based on loans may be preferable for research that has a direct commercial application.

This report, therefore, analyses both EU spending on R&D and the financial instruments at the EU level that can support R&D. In doing so, it looks at historical changes in research policy in Europe. These changes have been little short of a silent revolution; the functioning of R&D policy is crucial

for the successful achievement of EU objectives and needs to be carefully assessed. The present study then makes recommendations on how both types of instruments should be used at the EU level.

The report shows that from a theoretical multidisciplinary analysis combining the insights from the economics of the public sector, fiscal federalism, political criteria and EU law, the EU has a strong role to play in R&D as a coordinator and financier. A larger share of R&D should be allocated to the EU than is the case at present. A rise in the level of spending at the EU level could lead to important efficiency gains without causing problems from the perspective of legitimacy. That increase should come both from a rise in the funding available from the EU budget from grants and from the better and expanded use of financial instruments. To achieve the objectives in the Strategic Energy Technology Plan for energy research it is estimated that the EU's R&D share would need to increase by at least 1 billion. An increase in the R&D budget from 15% to up to 50% of funding, including the funds to expand the use of loan instruments, is thus highly recommended.

However, as far as grants are concerned, before expanding the financial capacity of the EU, there is a need to ensure that it has the appropriate institutional setting to handle R&D efficiently. The main instrument currently in place to finance R&D at the EU level is the Framework Programme. The latest evaluation shows that this has managed to foster basic research and maintain a selection procedure based on excellence. It has nevertheless a number of important weaknesses. The main problems are a still excessive bureaucratic burden despite a number of reforms, unsuitable financial rules and budgetary controls based on excessive risk aversion, a lack of participation by the private sector and a lack of coordination and follow-up of research undertaken in the EU. These points need addressing before any substantial increase in funding is envisaged. Nevertheless, it is acknowledged that the European Commission is aware of the importance of those problems and that the EU budget review and innovation strategy set the principles for reforming the policies.

One of the fundamental needs is a review of the financial regulations, which treat R&D with the same risk aversion as other funds in the EU. It is of primary importance that member states and the European Parliament,

in their respective roles in budgetary control, allow the EU's R&D to undertake ground-breaking target-driven research. R&D, by nature, operates in areas higher in risk and with higher unknowns, and this demands better risk management tools rather than rigid procedural barriers. The focus on value and results rather than process should take priority. Similarly, public and private interests should be better met to ensure increased private sector participation and funding. Although they are outside the scope of this report, the present bureaucratic and intellectual property rights rules present the wrong incentives, effectively discouraging the participation of companies.

This report considers the use of financial instruments, such as debt financing and loan guarantees through the EIB, as indispensable to approaching and meeting the EU's R&D objectives. Such loan-based instruments can expand R&D investment in research and innovation fivefold. This has been successfully achieved with the EIB's Risk Sharing Financing Facility instrument. It is important to distinguish between the role of the grants and loans; loans cannot replace public funding in basic and fundamental research nor can they replace public funding in high-risk areas of research with long terms to maturity.

These are only appropriate to guarantee the stages of demonstration and deployment. Financial engineering cannot replace grants but it can complement them to increase R&D financing, helping potentially viable new developments to become mature for the market. Loan mechanisms, if well handled, can also help distinguish between projects with a commercial potential and those that need more grant support.

Presently, there is a need for "bridge financing", as long-term, risky or expensive demonstration and deployment stages can discourage private investment. In many areas, "bridge financing" consisting of debt financing or loan guarantees by the public sector can reduce the associated risks of new technological developments and attract private venture capital. This is a necessity in some areas, such in the energy or medical sectors, as well as in space-based applications.

This paper also recommends finding solutions outside the budget for projects such as the International Thermonuclear Reactor (ITER) project, which is increasingly eating away the Framework Programme because of

cost overruns. ITER is an international undertaking that includes non-EU countries and should be treated as other supranational research undertakings, such as CERN[1] or the ESA.[2] Further research is needed to understand how space research should be handled in the future, clarifying the role of the EU and ESA budgets. The EU budget as it stands is overburdened with objectives without the appropriate funding commitments. Finally, it is clear that EU funding alone in R&D will not help achieve the objectives of the EU in R&D. More public financing at the EU level and even at the national level does not dispense member states from improving their regulatory frameworks to encourage research, nor does it guarantee success without well-functioning and appropriate administrative structures. Similar to this study's request to review the EU's financial and administrative procedures, member states should undertake a review of domestic policies and their impacts on R&D.

[1] CERN is the European Organisation for Nuclear Research based in Switzerland.

[2] ESA is the European Space Agency.

1 Introduction

In October 2010, the long-awaited communication on the review of the EU budget was finally issued by the European Commission (European Commission, 2010a). The communication reiterated the importance of R&D for Europe and the need to achieve a total private and public R&D investment level in Europe of 3% of GDP, an objective of the Lisbon Agenda that should have been achieved by 2010.[3]

However, the document did not call for a specific increase in the EU budget allocation to R&D, limiting itself to reminding member states of the importance of a coordinated R&D approach at the EU level. Similarly, although it emphasised the need to mobilise more resources, including non-grant instruments by the European Investment Bank (EIB), it did not specify by how much those resources should be increased.

The extent to which public expenditure for R&D should increase in the EU, and which proportion of this increase should be channelled through the EU budget, are questions that still require an answer. Although several studies have advocated an increase in EU spending on research, the analyses tend to stay quite general and do not go into the specifics of how a beefed up EU research budget could be used. Moreover, analyses generally focus only on the EU grants for research, but this report argues that EU loans are equally important; thus, any discussion on how the EU budget should contribute towards research policy needs to take into account both types of support. In particular, it is essential to differentiate between the different types and stages of research (basic research, demonstration and deployment) to see which should benefit from each type of instrument. Although this study uses the term R&D for simplicity, we are in fact considering RDD&D, where the last two terms stand for deployment and demonstration.

This study aims to delve into the specifics by looking at the detail of which funding and financing programmes would add value at the EU level, thereby

[3] According to Eurostat data, however, the share of expenditure on R&D has not changed since 2000, stagnating at around 1.85%. Provisional Eurostat figures for 2008 seem to indicate a slight increase to 1.9% of GDP, but this is way below the mark and the impact of the global financial crisis from 2008 to today does not raise any hopes of a large improvement.

indicating where the focus on additional spending is needed and how that funding should be used. For example, it will review the needs of the European Commission's ambitious Strategic Energy Technology Plan (SET-Plan) proposal, which not only has large budgetary implications but also could have an important strategic impact on the industrial competitiveness of Europe in this area.

In what concerns EU funding, the report will mainly focus on the Framework Programme budget for R&D. Other R&D support from EU funds, such as structural funds, is only briefly mentioned where necessary. Other R&D programmes, some financed separately from the EU budget by European governments, such as CERN, the European Space Agency (ESA) and the European Molecular Biology Laboratory, are not analysed here. Spending under the budget heading Research and Development currently amounts to approximately €6.7 billion per year on average, or about 4.9% of the budget. The entire amount is spent according to a multiannual "Framework Programme"; presently we are in the Seventh Framework Programme (FP7).

The programme is divided into six categories. The biggest of these programmes, "Cooperation", funds research projects; "People" gives scholarships and fellowships to researchers; "Capacities" funds research infrastructures; and "Ideas" finances frontier research. The other categories are funding for the EU's Joint Research Centre (JRC), a network of seven research centres across the EU, and the Euratom nuclear research programme.

In what concerns EU non-grant based financing, we will analyse three main types of instruments: EIB loans, European Investment Fund (EIF) loans and PPPs (public–private partnerships). The EIB is a bank created by the EU to support its policy objectives. In the area of research, the EIB provides loans to support investments in R&D where these cannot have access to funding from private banks because they present too much risk. To finance those loans, the EIB has access to funding from the EU budget.

The EIF is an investment fund owned by the EIB, the Commission and other banks. Similar to the EIB, it promotes EU policy objectives via investments, but its focus is on loans for small and medium-sized enterprises (SMEs). Finally, PPPs are projects run in partnership between the public and private sectors. Although the EU does not finance these projects, it provides structures that lead to their creation, such as networks and platforms.

The present study will be structured as follows. The next section will provide a theoretical justification for EU support to R&D. The following two sections will then focus on the existing EU funding and financing programmes. Section 3 will focus on funding programmes; it will present a short overview of the EU R&D policy and its performance. Section 4 will then focus on financial engineering instruments for R&D and assess how they could best contribute to achieve the EU's objectives. Based on the analysis, recommendations will be made on how EU funding and the financing of research should be modified so that it contributes better towards EU objectives.

2 Should R&D be an EU-level priority?

R&D has particular characteristics that, based on the economic theories of fiscal federalism, make it a particularly good candidate for supranational coordination and support. Both governance and financing would be better handled at the EU level under efficient structures. Fiscal federalism, nevertheless, is rather limited as a policy guideline because of the absence of policy criteria.

For this reason, Figueira (2009) presented a multidisciplinary methodology combining insights from the economic theories of fiscal federalism with economics of the public sector, political criteria and EU law to assess the role of the EU in financing different policies. It is argued that a multidisciplinary methodology is needed, because each academic discipline by itself would not take into account all the different aspects that influence the desirability of having a certain spending function at the EU level.

Each discipline offers a number of insights on whether a certain policy area needs government intervention at the EU level. Only an assessment based on the combination of these analytical instruments can determine if the EU has the appropriate capacity to intervene efficiently and effectively in an area of policy and if the EU budget has a role to provide financial support.

Public economics can provide the first important answer to the question of whether there is a need to publicly fund a certain policy area at all, be it at the EU level or at a national level. This may seem an obvious step, but at a political level it is not. The risk of the public sector substituting functioning private markets is always present. This branch of economics that analyses the activities of governments provides the analytical tools needed for such an assessment.[4] This assessment rests on two points: firstly, whether there is a need for government intervention; secondly, should that intervention involve funding or other forms of government action such as regulation. In addition, public economics also enables us to assess whether government intervention is cost-efficient.

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[4] Fiscal federalism is a subfield of public economics. The analysis in this section uses the other subfield of public economics.

Fiscal federalism offers insights into which level (local, national or supranational) of governmental policy should be governed and funded. It is based on pure economic theories of efficiency and offers an insight into whether policies would be better handled at the EU level if the institutional framework is adapted to it. According to fiscal federalism, a certain policy should be allocated to a more central/EU level if this can make the policy more cost-efficient (Musgrave, 1957; Oates, 1972). To assess that cost-efficiency, fiscal federalism uses three main criteria: economies of scale, externalities and the heterogeneity of preferences.

Economies of scale in the EU context are present when the costs of financing a certain policy are lower if it is performed together by several countries. Externalities occur when policies have an impact not only on the country where they are implemented but also on its neighbours. These two factors are then balanced against the heterogeneity of preferences and whether those preferences concerning a certain policy differ greatly between countries. If preferences are very different, the policy should not be centralised, so that each member state can continue designing the policy in the way that suits its population. More recent contributions to the literature have added elements of political economy to fiscal federalism; they are known as "second generation fiscal federalism" (Oates, 2005).

The weakness of fiscal federalism is that it does not take into account the reality of the institutional setting, nor does it fully reflect the potential increased complexity of running a policy at a supranational level compared with lower levels of governance. The capacities to better target interventions at local levels are also not taken into account.

Political science is based on the concept of legitimacy rather than a field of study. Legitimacy describes the notion that a government, or its actions, can be scrutinised for their acceptability. It is a subjective concept, and authors have proposed a large number of definitions and ways to measure it. Figueira (2007) proposed a conceptualisation of legitimacy that was designed particularly to make it possible to compare the legitimacy of different policy areas. An adaptation of this conceptualisation should be used combining three factors that have been used in the literature to assess legitimacy: procedural legitimacy, public opinion and distributive fairness. Procedural legitimacy exists when the government follows an acceptable political process (Dahl,

1956), where "acceptable" is generally seen as a synonym of "democratic". Public opinion[5] is one of the best ways of measuring legitimacy, and surveys can assess whether EU citizens support a certain area being handled at the EU level.[6]

Finally, distributive fairness refers to whether a government's actions are seen as fair and equitable (Weatherford, 1992). In particular, if there is a widely held perception that the government is favouring one group of people at the expense of others (for example, if it favours the rich or a certain ethnic background), it will be considered illegitimate by the groups whose interests are not being represented. In the case of the EU budget, it could be perceived as illegitimate if the EU favours some countries at the expense of others. This can be measured by the net balances of these countries, namely the difference between how much they pay into the budget and how much they receive from it.

As the EU is based on a legal agreement between its member states, the analysis should also take *EU law* into account. EU law, in turn, is based on the EU Treaty, which forms the basis of legislation relating to the EU. Two sections of the EU Treaty are useful here. Part 3 of the Treaty describes the different areas of EU policymaking and the role the EU should play in each. It thus provides a useful indication about whether a certain spending programme fits well within the activities that the Treaty foresees for the EU in this area.

The second part of the Treaty that is relevant here is Article 5, which sets out the legal principles that must be applied when deciding whether a policy should be made at the EU level, namely subsidiarity and proportionality. The concept of *subsidiarity* says that the EU should only take action in areas where it can be more efficient than are the national governments. Article 5 also includes the condition of proportionality in that "[a]ny action by the Community shall not go beyond what is necessary to achieve the objectives

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[5] Public opinion is a factor that measures legitimacy, whereas the other two factors proposed are preconditions for legitimacy. However, those two types of factors can and, it is argued, should, be used in conjunction to obtain a complete assessment of legitimacy.

[6] The European Commission's Eurobarometer surveys can be used for this purpose. Question A24 of Eurobarometer No. 66, December 2006: "For each of the following areas, do you think that decisions should be made by the (NATIONALITY) government or made jointly within the European Union?"

of this Treaty." Hence if the EU does intervene, the intervention should be proportional, i.e., in the case of the EU budget, funding should be limited to what is necessary to achieve the objective of the policy.

2.1 R&D and public sector economics

From an economic efficiency point of view, an intervention by the public sector is justifiable when there are *market failures*. For R&D there is a case for intervention. Research is to a considerable extent a so-called *public good*, as it can be non-excludable, when it is impossible to keep others from benefiting from the research, and non-rival, as one more firm benefiting from the research does not reduce the knowledge available. This causes a market failure, as the developers do not benefit fully from the innovation, which may reduce the interest of researchers pursuing the development of innovative discoveries. Therefore, given that the return that each individual firm obtains from its investment in research is lower than the return for society as a whole, it is likely that the total investment in research will be suboptimal. This justifies government intervention not only to increase the amount invested in research, but also to reduce the externalities through legislation to protect intellectual property.

Moreover, R&D and innovation are main drivers of economic growth, which can benefit the entire society. This is particularly relevant in the most advanced countries, such as EU countries, where the main source of growth is innovation (Aghion, 2006).

Another justification for public intervention is the large costs for some types of research that can only be undertaken by large companies or even only by the government (and even by the EU). These types of investments tend to have large *economies of scale* with increasing returns to scale over the relevant range of production and thereby they will become cheaper at a large scale.

Finally, there is an issue of *asymmetric information*, because potential investors in R&D have less information about the project than do researchers. This can make them less willing to invest, which again contributes towards a suboptimal level of research. The government can intervene through the provision of funding, financing and loan guarantees.

Although market failures justify public intervention, the intervention could be in the shape of public funding or regulatory action. In addition, as is the focus of this report, funding interventions should be differentiated between grants and loans (other policies such as tax credits are not analysed here because of the lack of an EU tax policy). This report will analyse which support mechanisms are more appropriate at the EU level and for which activities.

It is important to ensure that public R&D investment does not replace private R&D investment but complements it. This is not only for issues of crowding out (i.e. excessive public investment could discourage private investment) but also because public R&D compares badly in terms of efficiency in some areas and stages of research. We can summarise the justification for public intervention in R&D as based on two cases:
Research where outcomes have primarily a public good nature and where results have unknown commercial applications; and
Research where the expected result, although potentially economically viable, is too risky, too expensive or has too long a time to maturity to enable the private sector to take the full financial responsibility.

Concerning the former, many examples – such as fundamental research in physics, astronomy and biology – have an impact on our understanding of nature, but no present commercial application. Concerning the latter, public support should only be granted if the results also produce wide benefits to society and not exclusively private rents. There are important cases today, in particular in the area of energy, as will be discussed later.

2.2 R&D and fiscal federalism

Although public sector economics offers a justification for public intervention, it does not clarify directly at what level of governance it should occur, even though this has already transpired under the economies of scale argument.

In fact, this is the central argument of fiscal federalism: it concludes that R&D policy should largely be run at the EU level because of the existence of economies of scale, as member states can pool their research capacities and human capital and avoid the duplication of research (Hoeller, Louppe & Vergriete, 1996). This applies particularly to “strategic areas” of research, where the EU needs to reach a critical mass through collaboration between

member states to be globally competitive. Only in limited cases where the focus has been on specific localised issues is research better had fiscal federalism not placed R&D at the supranational level.

Economies of scale are fundamentally an issue of cost-efficiency, namely that EU research should meet its objectives as efficiently as possible at a cost lower than the benefits it brings. Market failures are as valid at a national level as they are at the EU level. The objective of EU research policy is not only to intervene to solve the market failures described above, but also to be more cost-efficient than are the actions at a national or local level. The objective should be both to increase investment in research and to improve the productivity of research. Owing to the potential ability at the EU level to reduce the duplication of efforts, create collaborative structures, finance research that is too costly for individual countries and concentrate investment on areas of the highest EU value added (externalities at a local or EU level can be very different), there is a strong case for giving the EU a substantial role as well as a large centralised R&D budget. It is also important not to neglect the leverage effect EU interventions can achieve, i.e. the capacity to attract national public and private money into R&D objectives with high value added to the EU.

Furthermore, the potential indirect effects of collaboration at the EU level on the efficiency and productivity of research institutes and on public sector policies regarding research should not be neglected. This is addressed by second generation fiscal federalism, which provides arguments to support both EU-level and national-level research funding. Persson, Roland and Tabellini (1996) argued that since research institutions are inefficient and badly organised in European countries, harmonisation could increase efficiency by increasing the competition between countries. By contrast, it could be argued that EU-level research policy may, if badly designed, present several efficiency problems that could be avoided at a national level.

2.3 Political science insights into R&D

EU-level R&D seems to benefit from a high level of legitimacy. According to the Eurobarometer survey (Eurobarometer, November 2010), there is wide support for EU action on “scientific and technologic research”, with 72% of the sample population thinking that the EU should be active in this field. This may be because people support transferring policies to the EU when they feel

that cooperation between the member states can lead to more efficient results. However, it should also be noted that public support for increasing funding at the EU level is low.

Political science is also concerned with procedural legitimacy and efficiency. In what concerns grants, government funding for R&D is in some countries, such as the US and Ireland, allocated by an independent agency. Many countries have not adopted this system despite the fact that decisions on which research to support can be made more efficiently if they are impartial and independent. Using an independent agency at the national or EU level could lead to the same degree of procedural legitimacy. However, at present only approximately 15% of EU R&D funding is allocated by an independent council. It is therefore possible that accountability is lower at the EU level and that there is a risk that R&D policy will fall prey to political interests imposed on the European Commission, such as territorial equity interests. Fortunately, the FP7 mid-term evaluation (European Commission, 2010d) found no evidence that this was the case.

In what concerns loans, the procedures for awarding them are largely independent of government control since they are taken by banks. Therefore, the degree of procedural legitimacy will be similar at the national or EU level. Nevertheless, the government can have an influence, through government-controlled investment banks such as the EIB or KfW Bankengruppe in Germany.. Even those banks need to ensure the bankability of projects and will thereby retain an important independence from central control.

Distributive fairness is also an area of concern for political economy and public policy analysts. Research policy funding at the EU level can lead to problems of distributive fairness, because funding for research is distributed on the basis of excellence (rather than being subjected to preset country quotas), which implies that some countries will benefit more from R&D funding than will others. Moreover, as funding is allocated on the basis of excellence, wealthier countries will be at an advantage since they have more established research institutions. This can be seen as making the distribution unfair, as poorer countries are effectively subsidising the research in richer countries. If we de facto isolate R&D policy from the EU budget using the same method as that used for budget contributions, poorer countries would be net contributors to the EU's FP7.

However, this problem should not be addressed by distributing the funding on the grounds of distributional fairness rather than excellence, because that would compromise the efficiency of the entire policy. Part of the justification for an EU-level policy is the fact that it leads to competition for funding, thereby forcing researchers to become more efficient. Moreover, it also allows for countries to specialise in areas where they have comparative advantages.

The EU has attempted to mitigate this problem by offering opportunities for weaker institutions, for example allocating a share of FP7 funds to the development of R&D capacities and a share of EU structural funds for R&D to poorer countries and regions to increase their research infrastructures. In addition, the EU's FP7 project selection criteria tend to award points for gender or territorial balance with partner institutes. This may increase fairness, although it can be considered a violation of the strict excellence criteria.

It could be argued that research is a core aspect of the national industrial structure, and that losing it would be damaging. However, the same can be said of several types of economic restructuring at the EU level because of the Single Market, as they can also lead to a restructuring of the industry throughout Europe and to a concentration of certain industries in certain countries rather than others. It is therefore necessary to strike a balance between reaping the benefits of a common research area, on the one hand, and ensuring that countries can keep their R&D infrastructures, on the other. However, this would only become a serious issue if EU R&D funding was expanded well beyond its current level.

2.4 Legal justification of R&D

Research is covered by Title XIX in Part III of the Treaty. The articles make it clear that the main objective of EU intervention in this area is to promote the cooperation of researchers across borders in order to create a European Research Area (ERA). EU activities in this area, therefore, should involve stimulating cooperation among member states. Article 187 (171 in the Maastricht consolidated Treaty) states that "[t]he Union may set up joint undertakings or any other structure necessary for the efficient execution of Union research, technological development and demonstration programmes."

Concerning the specific areas of research, the Treaty does not indicate which areas should be at the EU level or at the national level (with the exception of

space policy, in Article 189). However, it does state that research activities deemed necessary because of other chapters of the Treaty should be undertaken, indicating that research is more justified at the EU level when it is related to an area where the EU is more active. This justifies more support for areas of research that are related to policy areas where the EU is active.

The subsidiarity condition is met satisfactorily because the analysis of fiscal federalism works in favour of EU-level activities, as it can be shown that there are clear gains in efficiency from cooperation in this area. Concerning proportionality, the next sections of this report will argue that there is a need for additional funding at the EU level; for funding to become proportional to what is needed to achieve its objectives it should be increased.

3 The changing R&D policy of Europe

It is clear from section 2 that, from a theoretical and legal point of view, the EU should play an important role in coordinating and financing its R&D efforts. Nevertheless, the idea of using the EU budget (and recently also the EIB) to contribute significantly to R&D in Europe is rather novel, except for the strategic areas of coal and steel and nuclear power. These areas were considered not only strategic to secure Europe's energy needs, but also a matter of internal European security in the aftermath of World War II.

R&D operations in the European Community started, nevertheless, as early as 1984, with the objective of financing R&D where the scale was so vast that a single country would be unable to do so and to finance actions that had a value across the EU: to finance research aiming at European norms and actions to facilitate economic integration. Industrial competitiveness was also cited as an objective; not in today's sense, but as a reaction to the industrial development in the US, for example in telecommunications. The GSM standard[7] can be considered one of the first results of European R&D investment with clear global relevance but the focus was restrictive and strategic. Over time, the scope of EU R&D has increased considerably and it is now open to most areas of research.

Today, it is possible to summarise the research being funded by the EU into the following 10 areas:

- *Health*, which includes medical research and technologies to deliver health to patients;
- *Food, Agriculture, Fisheries and Biotechnology* research focusing on promoting food safety, increasing agricultural productivity while protecting biodiversity and soils, protecting fishing stocks and marine life and developing better and more environmentally friendly fishing;
- *Information and Communication Technologies* (ICT) research on IT and wireless communications;

[7] The GSM (Global System for Mobile Communications, originally Groupe Spécial Mobile) standard was developed by the European Telecommunications Standards Institute (ETSI), which is globally used for cellular networks.

- *Nanosciences, Nanotechnologies, Materials and New Production Technologies* research and the use by industry of new research for new materials and products;
- *Energy* projects relating to renewable sources of energy, a more efficient energy system and reducing greenhouse gas emissions;
- *Environmental* research projects with an environmental objective. The main focus is on climate change, but research on other areas is also financed;
- *Transport* research in transport by air, road, rail and water. This focuses on improving the safety, efficiency and environmental impact of transport;
- *Socio-economic Sciences and the Humanities* funds research in those fields of study that relate to EU policymaking;
- *Space* research related to the exploration of space and to space-based applications such as satellites; and
- *Security* research, which relates to tackling security threats such as terrorism and crime, as well as improving the security of infrastructures.

It is clear that these areas all merit promoting and can generate a value added at the European level. Their development can be accelerated through EU funding and international collaboration. In all areas, economies of scale and the benefits of knowledge transfer are potentially rewarding.

Based on the rules of public economics, fiscal federalism and political and legal considerations, there are few reasons to challenge EU financial support. In general terms, the arguments for transferring public support completely to the EU level in order to reap all of the benefits of cross-border collaboration are compelling. The main question is rather why countries should maintain their national R&D policies.

3.1 The emergence of a policy-driven global R&D strategy

As mentioned earlier, a strong R&D public policy for promoting growth at the European level has only recently become a central issue. The turning point arguably was the launch of the Lisbon Strategy for Growth and Jobs in 2000. This was partly because of the prevalent economic growth theory before the 1990s, which considered technical change as an exogenous rather than an endogenous variable in growth.[8] Only basic research in universities

[8] Based on the Nobel Prize winning theory of Solow (1956).

and strategic R&D (military or energy) were the concern of the public sector. In the 1990s, influential new economic theories emerged on endogenous growth (e.g. Romer, 1990; Aghion and Howitt, 1998), which considered technological change at least partly to be determined endogenously. This implies simply that the level of technological change is affected by the policy environment. Although today this may seem an obvious statement, the real impact, level and long-term influence of policies on technical change and economic growth are still poorly understood.

Public sector R&D support is not universally approved. According to an influential document by the OECD (2003), which questioned the relationship between public R&D and growth, there is a risk that public R&D crowds out private R&D, thereby weakening rather than fostering growth. However, a recent JRC report (Cox and Gagliardi, 2009) found that public R&D expenditure, if focused, not only does not displace private funding but also can leverage additional private investments. Central to the impact of R&D support is its governance. Europe's sluggish economic performance in comparison to major economic powers and weak investment in research (see e.g. Sapir *et al*. (2003) and Aho *et al*. (2006)) prompted the EU to start a strong reform of its policy format. There is still work to do to develop the correct structures.

The central funding mechanism at the EU level for research and innovation comes through the Framework Programmes, which started in 1984. Today we are at the FP7 with a budget of just above €50 billion over the 2007–2013 programming period. This represents less than 5% of total government expenditure on research in the EU, but can be significant in the areas it intervenes. The public R&D expenditure for member states also covers capital costs, which the FP7 programme does not finance.

Up to the FP6, the main aim was to create collaboration between research centres and expand economies of scale in R&D rather than promote a concerted action to reach specific objectives. Today, EU R&D policies are increasingly aimed at fostering the competitiveness of the European industry, leveraging private investment in R&D and increasingly assisting demonstration, deployment and commercialisation. This is particularly striking for energy, where the R&D policy has transformed into a *mission-oriented* policy.

This new central relevance of R&D has allowed the budget to increase in size and relevance and the formerly loose policy on R&D to take central stage and develop into a fully-fledged EU policy. The recently published Europe 2020 strategy by the European Commission again calls for a substantial reinforcement of R&D coordination and expenditure in the EU (European Commission, 2010b), as does the budget review (European Commission, 2010a) and the recent Innovation Union strategy (European Commission, 2010c).

Today's FP7 provides a particularly important turning point, as it coincides with the consolidation of the ERA objective and the emergence of a number of new EU R&D institutions. The EU's research strategy is based on the development of the ERA initiative, which focuses on increasing the number of scientists, the level of research funding (aiming to reach 3% of the EU's GDP) and the quality of research in Europe, taking advantage of the economies of scale created by cross-border cooperation. In addition, the EU has created the European Research Council (ERC), which concentrates on funding frontier research, as well as a number of other agencies[9] to better manage the programmes. This enables the European Commission and the ERC to concentrate on policy and research excellence rather than on procedures. To this, one has to add the creation of the European Institute of Innovation and Technology and its "Knowledge and Innovation Communities", which should bring together research from all over the EU. All these institutional academic structures are then linked to the industry through European Technology Platforms (ETPs), Joint Technology Initiatives (JTIs) and European Industrial Initiatives (EIIs).[10]

The objective of the EU's Framework Programme for research is to develop a *real* ERA, where the research potential is expanded through seamless collaboration between institutes across Europe. Although large areas of research are covered by the policy, it is clear that the focus is on research efforts that require cross-border collaboration. Although all this sounds

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[9] Such as the Research Executive Agency and the European Research Council Executive Agency.

[10] ETPs are a general framework structure for defining the research objectives of the FP7 based on the Strategic Research Agenda's research areas; JTIs and EIIs are subgroups that focus on specific results in particular areas within a research field.

promising, experiences of the rules on which the Framework is built begs the question of whether the EU is capable of harnessing the results. For this we need to examine the performance of the Framework Programmes.

3.2 Performance of the Framework Programmes for R&D

Before moving onto discussing the new areas of research and the new research architecture, it is important to see how the Framework Programmes perform, as they are key delivery tools.

A recently completed mid-term evaluation of the FP7 programme (European Commission, 2010d) provides a rather positive picture of the results, in particular for basic research. The report considers that the principle of excellence has been safeguarded in the programme. It also sees as promising the emergence of new financing instruments, such as the Risk Sharing Financing Facility (RSFF), that offer debt financing for loans in the later stages of innovation, demonstration and deployment when venture capital is scarce.

The FP7 positively leverages national public funding into EU research priorities. Procedurally, programmes operate within the rules imposed with few disruptions. Nevertheless, despite important reforms in the administrative procedures under the banner of simplification, the administrative burden is still considered excessive and counterproductive. This has direct consequences on the participation of institutes and businesses, preventing and discouraging participation by the private sector and SMEs. This is important, as it is exactly private sector R&D that is the central problem of the EU.

The FP7 mid-term evaluation reflects the position of the "Carvalho" report of the European Parliament (2010) that called for a large simplification of FP7 procedures. Both reports call for a change in the excessive procedures and risk aversion associated with the programmes. In the end, the marginal benefits of excessive budgetary control are most likely overtaken by the lost opportunities in research, waste of resources (in particular human resources) and the lack of increased attention on output quality.

The EU proposal for an Innovation Union seems to be moving in the direction of improving the performance of research programmes as needed, and those will be central to making sure EU budget interventions can deliver the potential outputs it can achieve under appropriate policies.

For the ERC, encouragingly, the criticism expressed by the independent expert review panel on its procedures and mechanisms (Meny, Freiberga & Sainsbury, 2009) seem to have largely been overcome. This report considered the ERC's procedures unsustainable and unsuited for frontier research, which is the objective of the organisation. The mid-term review instead found the operation of the ERC successful and improving.

For non-commercial basic research the reports all propose using more grant systems for pure research based on lump sums, average staff costing and delivered objectives, rather than cumbersome cost-based auditing and procedural controls. Many of the problems cited by the expert group are unfortunately not rectifiable without a change in the underlying rules and regulations, including the complex financial regulations, which luckily are listed as a priority in the budget review and the EU's Innovation Union objectives.

The EU's ambitions in R&D, however, go beyond the grant funding of basic research. It is developing a fully-fledged industrial policy that should accompany new technologies and innovations from the drawing board to commercialisation. To do so there is a need for a real overhaul of procedures, if EU funds increase in importance and take over some of the particularities of venture capital, which are appropriate for innovative research.

The EU's R&D objectives cannot be achieved without the intervention of more public funds to leverage private funding, but this private funding will not occur unless companies are encouraged to participate. Here, JTIs have been a partial disappointment. Corporations have complained that the procedures are too rigid (van den Biesen, 2009). Given that the private sector is in most research areas ultimately the motor for the practical development, testing and diffusion of new technologies, their concerns need to be addressed.

The EU's rules do not seem to reflect the legitimate concerns of companies, thereby discouraging their participation. Patenting rules, for example, imply an obligation to cooperate in a manner that is contrary to the interests of the corporations and their business practices (Rietschel & Arnold, 2008). The rules require relinquishing rights over shared technologies, and it thus acts as a strong disincentive. A balance between intellectual property protection and the concept of open innovation with shared knowledge needs to be found. The evaluation by Idea Consult (2008) also confirms that intellectual property rights (IPR) and procurement rules need improving.

It is also important that these numerous new research infrastructures go beyond increasing the administrative size and cost of the policy rather than generating results and increasing the level of research and innovation – and ultimately growth – in Europe. Europe is still badly integrated in the area of R&D, and it is telling that the EU still does not have a Community patent. The present system is costly and fragmented; Danguy and van Pottelsberghe (2010) estimated that a patent covering "only" six EU countries costs four times more than it does in the rest of the world. If it covers the whole EU, it costs 15 times as much as that in the US. The Europe 2020 strategy mentions the need for a single EU patent, and the European Commission presented a proposal for a single European patent on 14 April, but some members may still block progress on this issue.

3.3 The new industrial "mission-oriented" R&D

The R&D approach of the EU has been changing over the years, from one of a general nature supporting research projects in agreed areas of common interest to one with clear industrial competitiveness and specific focus. During FP6, new structures were developed to coordinate research and decide on strategies. ETPs were created and today they number 36 (see Annex 1). These platforms are stakeholder groups, which determine the research priorities in their respective fields to determine the focus of the Framework Programmes and calls for proposals. This allows for industries to present their interests.

However, more structured and focused institutions have been created for certain key areas where the EU has strong common industrial objectives or stringent policy objectives such as for ICT, climate change and energy. These

are based on the Treaty Article 187 (see section 2.4). The interpretation of this article and actions to be undertaken are rather open, but initially led to the following Joint Technology Platforms (JTPs):

- Innovative Medicines Initiative;
- Embedded Computing Systems (ARTEMIS);
- Aeronautics and Air Transport (Clean Sky);
- Nanoelectronics Technologies 2020 (ENIAC); and
- Fuel Cells and Hydrogen.

With the strong energy objectives of the EU, new EIIs have been set up in key areas to support the SET-Plan:

- Solar Europe (PV and CSP);
- European Wind;
- Bio-Energy Europe;
- European CO_2 capture, transport & storage;
- European electricity grid; and
- Sustainable nuclear fission (gen-IV).

The new EII moniker seems to be cosmetic, as its structures are based on the JTIs, and this creates more confusion rather than helping understanding its function. What is clear is that those EIIs have ambitious goals and aim to take PPPs to new levels.

One issue worth reflecting on is *flexibility*. How flexible will the EU be in introducing new structures such as these or, even more importantly, how will it be able to dismantle those no longer needed? The tendency to create new and complex structures does not seem to be counterbalanced by the elimination of old inefficient ones. There is also a question of the process of deciding such structures: do they reflect political priorities or actual research needs? Eventually, as those forms of partnership expand, there will be a need to ensure an appropriate review mechanism is in place.

4 Leveraging private sector resources

It has been thus far recognised that R&D policy cannot be focused only on basic research and be in the hands of academic circles; it needs to be better integrated with the needs of both society and the private sector. This is especially so if the aim is to foster the growth and competitiveness of European businesses or induce the private sector to produce the outputs needed to reach European objectives.

For this purpose, the involvement of the private sector through various forms of PPPs is essential. The private sector holds the key when it comes to bringing discoveries to market. There is a need for the corporate sector to be aware of the advances made in research so that it invests in the demonstration, scaling up and ultimately commercialisation of discoveries. The private sector can also be active in solving specific problems by searching for innovative solutions to cover present needs.

To get this working more effectively, there is a need to create the right structures of collaboration and set up support mechanisms that will ensure the most effective leverage. This implies that:
Financial support for research involving the private sector should not replace private R&D expenditure, but complement and expand it; and
Support should be geared towards R&D collaboration, where the private sector complements academic research by providing assistance in the demonstration and deployment of new technologies.

PPPs are a central strategy for the EU's R&D efforts – from the soft ETP structures to the more pushy EIIs – and this should guarantee that private stakeholders understand the EU's objectives and the opportunities offered in the priority areas.

What are the consequences of having developed the EIIs on the EU's budget? Apart from creating a slight increase in administrative costs, these structures should help ensure that funds spent on R&D are matched by a larger contribution from the private sector and thereby have a larger impact on the economy's growth. The result could be a larger R&D financial contribution

by the private sector without – or with much lower proportional – increases in EU funding. This will be discussed at a later stage.

Grant funding in earlier stages of R&D can be complemented by other forms of assistance, for example through loan guarantees or debt financing instruments. There is a need to strike a balance between EU grant financing, guaranteed loans and pure private funds leverage. Depending on the stage of development and the maturity and risks of each technology, the most efficient financial tool needs to be chosen.

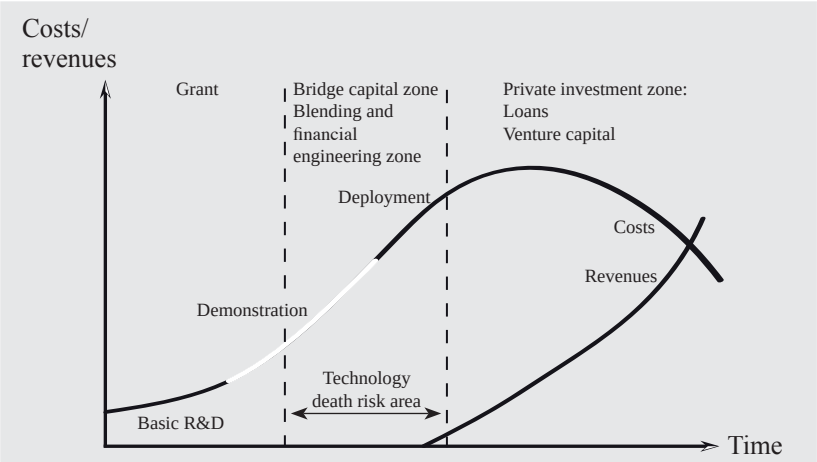
As mentioned above, securing funding for new energy technology can be difficult because of the complexity of the technologies and the lack of awareness of the private financial sector. With PPPs, these obstacles can be overcome, as the corporate sector can help the EU define the appropriate messages and strategies to attract private financing.

4.1 Financing R&D: the role of innovative financial instruments

In the case of late stages of R&D, in particular for the demonstration and deployment of new technologies, the EU can play a crucial role in reducing the costs of risk financing and expanding investment into new technologies. The EU is needed for the development of new technologies of high European value added that encounter difficulties attracting venture capital. Many worthwhile R&D projects are never commercialised because there is no funding to bring the concept through the demonstration and deployment phase. There is what can be called a "technology death risk zone" where after the initial basic research through grants new technologies are just abandoned (Figure 1). This has been a considerable problem in the renewable energy sector because of the strong subsidies given to fossil fuels,[11] but can also be found in medical research where research on products with a high social value are abandoned at the research level because of the costs of bringing the product to market. Apart from costs, long time lags to maturity can also keep venture capitalists at bay.

[11] According to IEA (2010), global subsidies to the fossil fuel industry reached $557 billion in 2008, around 12 times the figure for renewables.

Figure 1 Financial engineering for R&D



In areas where new technologies have a positive internal rate of return (IRR), but the risks are too high and/or the time to commercialisation and profitability too long, the EU can assist in providing the "bridge funding" necessary to accompany the new technologies to a position where it can attract venture capital. Figure 1 presents a simple diagram of the rationale behind blended grant loan instruments and the use of guarantees. Basic research is generally too uncertain and risky and thereby generally funded by grants. To bring breakthroughs in basic research to a deployable and in particular commercially viable technology, there is often a risky, expensive long-term testing period, often too risky at initial stages to attract private funding.

Grants may need to initiate demonstrations, but support can be needed beyond this testing phase through other public financial instruments to help overcome the "hurdle rate" of private participation, which is the project profitability level required beyond a simple positive IRR or net present value to attract private investment. It is here that "bridge funding" is essential to avoid promising technologies dying off. In this zone, innovations that may have important public good characteristics and be profitable in the longer term may die off.

The EU has set up such an instrument in the RSFF. This financial mechanism has generated loans in the present Multiannual Financial Framework (MFF) of €10 billion by offering just €2 billion debt financing through the EIB (€1 billion from the EU budget and €1 billion from member states). The RSFF is a risk-bearing instrument that covers the risks of loans of the EIB (when lending directly) or of loans made by intermediaries.

In fact, loan guarantees through the EIB are expected to be used extensively in the next MFF. The financial engineering mechanisms have been tested in the area of transport (the Loan Guarantee instrument for Trans-European transport network projects, LGTT) and for offering loans to SMEs across the EU (i.e. Jeremy, Jaspers, Jessica and Jasmine). The LGTT is financed by a capital contribution of €1 billion – €500 million each from the Commission under the Trans-European transport network budget and the EIB – which is intended to support over €20 billion worth of senior loans.

For the RSFF the demand for loans for innovations has been impressive and has been positively evaluated by an expert group (Mann et al., 2010). Since its start in 2008 it has already reached its target and limit of €10 billion in loans. The RSFF is also serving as a model for the establishment of other similar funds and mechanisms in the EU, such as the Marguerite Fund.[12] Of course, there are caveats to declaring it a success, as the disbursement of loans is not per se a guarantee that the final outcome will be positive. There is also no appropriate guarantee that the RSFF has targeted projects that would otherwise not have been funded. Maybe there should be a more rigorous testing on this aspect.

It is important to consider the potential of these loan-financing instruments as long-term revolving financial mechanisms where repaid loans are reinvested into new loans. This is proposed in Mann *et al*.'s (2010) evaluation. However, this is difficult because the RSFF is not strictly a loan guarantee instrument as is often presented, but rather a debt financing tool not conceived to recover the €2 billion capital base. It is supposed to cover the bank's expected risk

[12] The 2020 Marguerite Fund is a pan-European fund for energy, climate change and infrastructure, launched in December 2008 by six of Europe's leading financial public institutions, including the EIB.

of default, estimated at 20% of the loans. If the risk of default is as high as predicted no funds would be recovered. Making it revolving would require higher interest rates or financing less risky lower default risk projects, but that runs counter to the nature of the RSFF. Nevertheless, if default risk is well managed, the loan guarantee funds could be stable over time and even increase. This potential is for the moment not taken sufficiently seriously into account by EU decision-makers, as illustrated by the fact that the RSFF is not set up to be revolving and there is no provision to continue its operations beyond the present MFF. Given its cost, €2 billion over seven years for €10 billion in loans, it is not outlandish to consider increasing the RSFF's operations. It could make an important contribution to the R&D objectives of the EU in fostering investment in R&D and achieving the SET-Plan objectives for example. A note of caution is necessary, however, as a clear balance between the expansion of the facility and quality of the projects financed has to be kept. With the expansion of the facility the EU may overexpose itself through higher default risks. The size of the RSFF should not go beyond the demand for serious projects with high European value added.

Owing to its loan nature, it is particularly suited to the demonstration and deployment phases of EIIs. RSFF-guaranteed loans are also attractive to the private sector, because they are exempted from the stringent nature of FP7 agreements, in particular the restrictive IPR obligations of grants.

Another positive aspect of the loans is that they allow for a further identification of those projects that are too risky for the private sector to invest in, while avoiding the grant use in projects that are viable. Retaining more stringent rules for grants should ensure that the right balance between grants and loans is kept. It is thus recommended that while grant procedures should be adapted to the needs of research, those grants maintain high requirements to avoid financing bankable stages of research. Grants, guaranteed loans and normal financing by private financial institutions should be complements not substitutes.

Similarly, there is a need to explore the role of the EIF, the EU's specialised financial body for SMEs that provides venture capital funding and guarantees to promote innovation and growth in Europe. The EIF is part of the Competitiveness and Innovation Policy, supporting investments in technological development, innovation (including eco-innovation), technology

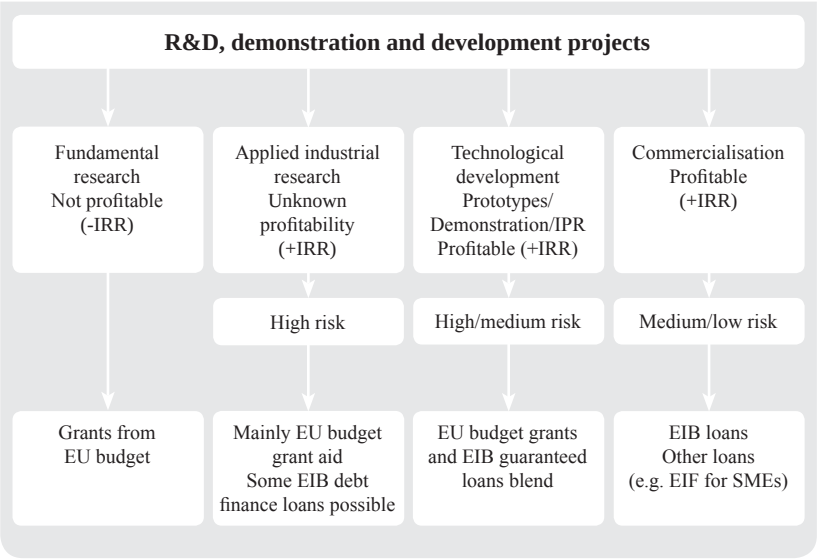
transfer and the cross-border expansion of business activities. Its role in assisting SMEs to participate in EU technology platforms should be assessed, as the RSFF tends to be geared (even if not officially) to large projects by large companies, although for small projects it provides (mezzanine) loans through partner banks.[13] The evaluation carried out by Mann *et al.* (2010) shows that despite the provision by the RSFF of mezzanine loans to banks to finance SMEs, the uptake has been weak.

For the present MFF, the EIF has raised €30 billion in new finance with only a €1.1 billion guarantee. This leverage effect would, of course, not be possible for SMEs participating in risky R&D projects, but a share of a larger future EIF fund could be diverted to innovative operations related to the EU's R&D objectives. There is a need to raise awareness of the opportunities and create clear and accessible mechanisms.

How should the EU determine which instruments to use – grants, loan and grant blending or pure loans – to achieve a higher level of investment in R&D for Europe's research objectives? Figure 2 on the next page presents the system based on the IRRs of projects and the level of risk. The EU grant and EIB loan mix will depend on the kind of research, the profitability of the project and the level of risk. For projects with positive social and economic rates of return, but where the IRR is too low, the EU will have to decide the form of support. For fundamental research, which is by nature not profitable (at least in a foreseeable time), grant financing is the only possibility. For applied industrial research there may be some scope for EIB loans, as the research is expected to be profitable in the future. Nevertheless, depending on the timing to maturity and risk, grant-based mechanisms are mainly going to be possible. At the stages of final prototype and demonstration, where depending on risk level long-term EIB loans may become possible, a blend of grants and loans can be envisaged. For the final stages of the demonstration and deployment of new technologies, the EIB may support projects that are still too costly and risky to attract venture capital, but pure commercial loans should be favoured wherever possible.

[13] Mezzanine loans are unsecured debt given to companies to bolster their business operations. Being unsecured the banks take a considerable risk.

Figure 2 Determining the use of blending mechanisms for EU R&DDD



However, expanding loan guarantees or debt financing instruments requires an increase in the capital for those guarantees. The EU budget provides guarantees based on budgetary margins and limited financing. Under the present rules, the EU budget will be unable to expand its role as loan guarantor unless more money is liberated in the budget for such purposes. This would be achieved by reducing expenditure in certain budget lines, increasing the EU budget or setting aside funds traditionally used for grants in the initial years of the MFF. Given the importance of R&D for the EU, member states should consider increasing the capital base of the EIB to expand the RSFF rather than using the EU budget.

5 What level of resources should be mobilised from the EU budget?

It is not possible to determine the absolute level of resources necessary to reach the EU's overall objective of a 3% investment in R&D. It is clear that the answer is that a considerable mobilisation of resources is necessary at the level of the EU, namely an additional 1% of EU GDP (approximately €125 billion). The role of the EU budget, in view of such a challenge, seems insignificant, but this is not the case. The leverage capacity of the EU budget is high and can go from one to one for grants to one to 10 for loan guarantees.

What does this mean in practice? We know very little about what the right share from the EU budget should be, but we do know that a dramatic rise in the EU budget is unlikely. It is also clear that some countries may even take the opportunity to reduce their R&D investment budgets in proportion to their financial allocations to the EU budget in today's austerity environment, or will – in order to avoid violating the principle of additionality – cut future projected increases in funding, as would have been the case without EU support.

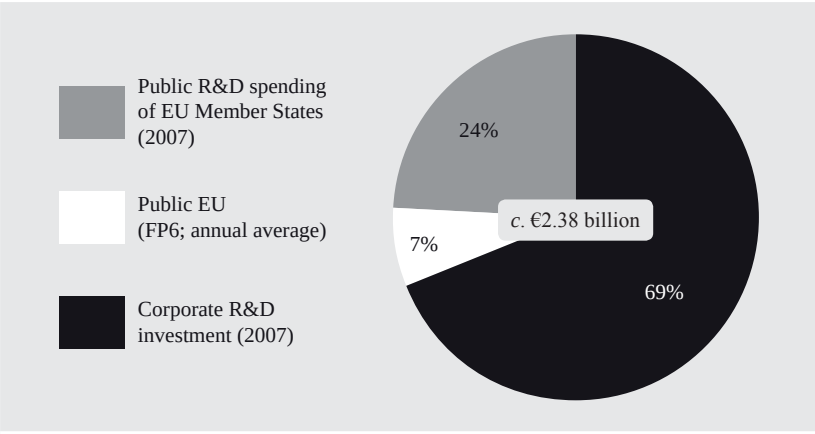
However, some points are clear. First, the SET-Plan on energy R&D is a European priority and calls for an increase of €5 billion annually in investment compared with the present €3 billion (European Commission (2009a, b). This is an area of high European value added and high economies of scale, with the need for pooled resources and large cross-border implications and spillovers. Second, there are other important priorities, such as research in agriculture and food, new materials and environmental protection. However, the EU budget is constrained and member states are exercising strong pressure to keep expenditures of the EU budget stable.

This rise in R&D funding can only be modest and it should mainly be achieved through a transfer between existing EU budget headings. Unfortunately, for the moment there is little chance of any policy being reduced considerably to transfer funding to R&D. This poses problems because public finance is a major element in several areas of research, energy in particular. This is because of the important costs involved in developing new technologies and their long time to maturity.

R&D in the energy sector is presently strongly dependent on public financing because of the high costs of capital requirements and the public nature of many of its benefits. In the area of renewables, we also should not neglect the fact that, until recently, fossil fuels were too cheap to make other technologies bankable. In the case of renewables, public investment makes up over 30% of the support (Figure 3), and a little less than a third of it comes from the EU budget. It is difficult to envisage that the private sector will increase its investment without an increase in public sector budgets, including the EU budget share.[14] It is also realistic to assume that every increase in funding will target ever more complex and risky projects, implying that leverage from the private sector is likely to become harder to get for each extra public euro invested. It is thus not outlandish to suggest that the proportional percentage increase in public funding will need to be higher than is the increase in R&D funding by the private sector. In addition, given the European value of a more integrated energy grid, which often clashes with national energy interests, there is a risk that national public funding will not follow suit. Consequently, the highest public share growth would need to fall on the EU R&D budget.

[14] Even though private R&D could be incentivised by eliminating fossil fuel subsidies globally, most subsidies are beyond the EU's control.

Figure 3 Indicative R&D investment in non-nuclear SET-Plan priority technologies from industry (2007), the public national sector (2007) and EU funds through FP6 (annual average)



Source: JRC-IPTS (2009)

If these assumptions were true, it would seem reasonable that public funding may require an additional €1-2 billion for the SET-Plan to leverage the necessary private funding to reach the target expenditure of €8 billion per year. Given the cross-border nature of energy security issues, and the new competences of the EU in energy policy, this increased funding may need to be primarily provided through the EU budget. This is, of course, difficult given the present pressure on the EU budget to keep or reduce funds, but not outlandish considering that it represents only 1 to 2% of the EU budget.

For total R&D investment, it is highly advisable that the EU budget restructures its priorities and improves implementation. The mid-term review on the FP7 recommends keeping the R&D budget at least equal for the next period. It would be advisable to increase it given the needs of the SET-Plan by increasing the allocation to R&D from 15% to 30% yearly in the next MFF, or €1-2 billion, partly for grant support and partly for debt financing or guarantees. This is based on calculations by Núñez Ferrer, Egenhofer and Alessi (2011) in a report dedicated to the SET-Plan on how to reach the €8 billion energy R&D target investment for Europe. Higher amounts may be needed if ambitions rise in areas beyond the SET-Plan. Compared with the

overall size of the EU budget and the importance and size of the challenges ahead this seems insignificant. However, in the present atmosphere of austerity and the current positions of member states on the EU budget, this seems a tall order. It is important to realise that this funding has important economies of scale potential and a strong leverage impact, especially in the later stages of product development and innovation. It is one of the key factors to achieving the central aims of the Europe 2020 objectives. An additional €1-3 billion from the EU budget, which includes a provision of €2 billion for an RSFF style instrument over the MFF period, is recommended. The leverage could be considerable.

5.1 Other financial mechanisms and considerations

Even though they were not intended for R&D, the EU budget review proposed the use of bonds for financing European infrastructures. Some countries use bonds for specific R&D projects. For the EU, one could envisage bonds for large projects in the demonstration and commercialisation stages. This would be useful, for example, in the case of Carbon Capture and Storage (CCS) technologies. It could also be used for the Galileo position system.

To liberate the EU budget from requirements it is not set up to handle, this paper supports the budget review's position on the International Thermonuclear Reactor (ITER)[15] fission project, which has unpredictable financial requirements and is eating up EU budget margins and parts of the FP7. ITER is not strictly an EU initiative but rather a long-term multinational project (including non-European countries such as Japan and the US) with a time to profitable deployment of over 40 years. For these reasons, ITER should be financed separately by member states, as is the case of CERN or the ESA.

Another area needing reform is state aids. The Treaty allows for state aid rules to be lifted when the assistance is for important projects of European common interest (TFEU Article 107 3(b)). As long as support is in line with important objectives, national support for R&D in key sectors should be allowed to exceed the state aid rule level. This is at the moment not applied appropriately and needs to be clarified.

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[15] ITER is a large-scale internationally funded demonstration plant being constructed in Caradache, France to test the theory that a fusion reaction can be produced in a reactor to produce commercial energy.

In summary, for R&D it is recommended here that the grant element of FP7 funding is increased by an annual additional funding of €1-2 billion for fundamental research, including €1-2 billion for the RSFF, which should if possible become a revolving fund. Further coordination with other instruments, including the EIF for SMEs, could assist in some of the operations under the ETPs, JTIs or EIIs.

6 Conclusions and recommendations

The present analysis has shown that in all the different areas of research – public sector economics, political economy and fiscal federalism – there is a clear justification for funding at the EU level. In general, R&D is a prime example of a policy that the theory of fiscal federalism advocates to allocate at higher levels of governance. However, the EU's integration process is not advanced enough, and for the moment the EU R&D budget just covers 5% of public R&D investment. Notwithstanding this fact, at the level of specific research areas, EU R&D can be a sizeable contribution towards project financing.

The EU has ambitious objectives in R&D. The question is how it can manage its small budget to increase its leverage to achieve those objectives. First, it needs to focus on areas aiming at research that addresses public goods provision with added value to the EU. This means that research on local problems with no EU relevance should not be funded by the EU. R&D funding at the EU level should seek to foster cross-border cooperation and the dissemination of results that benefit either the EU as a whole or several member states. EU R&D also has the objective to leverage national funding, public or private, for EU objectives. Most importantly, one of the main justifications for funding at the EU level is that cooperation between countries allows for the reaping of economies of scale and the creation of a "critical mass", allowing the EU to be competitive in certain areas of research.

Given the limited size of the EU's R&D budget, there is a need to focus most of the funding on a small number of strategic areas, especially those that are central to achieving the EU's objectives, as well as to retain some funding in non-priority areas that generate value added to the EU. Some examples of areas that should receive more intensive funding include health, biotech, ICT, transport, energy and the environment.[16] In those areas, the EU has both a comparative advantage and ambitious objectives. They also represent areas where funding is needed on a large scale. Those areas contribute towards important policy objectives for the EU: productivity and competitiveness, dealing with an ageing population and protecting the environment.

[16] These are just indicative and should not be considered exclusive.

There is also a case for reinforcing mission-oriented R&D intervention. In this case, private R&D exists but is not sufficient to allow the EU to reach its ambitious objectives. This is because the motivations of the private sector and the public sector are not the same. To align the priorities of the public and private sectors, the EU has developed joint undertakings, JTPs and EIIs, which are PPPs that have a strategic focus and seek contractual agreements between the public and private sectors in technology development and funding. This is particularly the case with energy R&D.

The EU has set up large institutional infrastructures to create an ERA, which incorporates the ERC to focus on ground-breaking research, ETPs to determine research priorities and specialised PPPs (e.g. JTIs EIIs) to focus on the demonstration and commercialisation of new technologies in areas of central European interest. These developments are welcome, but evaluations point out important weaknesses that need redressing.

The first weakness is a persistence of bureaucratic rigidities all along the structures; new as well as old. There is a clear tension between the focus on excellence in R&D and its inherent risks, on the one hand, and the bureaucratic needs of predictability and strict budgetary control, on the other. There is a need, in particular for the Council and the Parliament, to address these concerns with the objectives of the Innovation Union in mind.

It is important that when the financial regulations are revisited, as announced by the budget review, member states and the European Parliament balance the rules with the needs and risks associated with R&D. The present risk adverse rules can have a breaking effect on the whole system.

Several areas of R&D, such as medical research or energy, also often require large investment with considerable risk and long lead times to maturity, such as for the CCS or smart grids. Here, public investment support is of paramount importance, even (or especially) in the demonstration phase.

The use of debt financing or loan guarantee mechanisms have proven their worth, and the RSFF has been successful and should be expanded, if possible making it into a revolving fund to ensure long-term signals to the market and a continuing effort in industrial and commercial R&D. In any case, the RSFF should be continued, and even if the guarantee acts as a debt cover for

losses due to risk, the leverage of the RSFF of one to five makes it worth the additional expense.

Concerning the total amount allocated to R&D in the budget, the analysis has shown that additional funding would be beneficial, as it would help achieve critical mass in the strategic areas. Given the present objectives, particularly the targets for the energy sector, it is recommended that the R&D budget is increased by a minimum of 15%, preferably 30% or more. This would include a larger provision for debt or risk financing in the RSFF. The EU could leverage up to an additional €20 billion with a €4 billion provision over the duration of the MFF,[17] half of which (or more) could be offered by the EIB. The increases are important if the EU wants to have any chance of running the SET-Plan successfully.

This paper also recommends finding solutions outside the budget for projects such as ITER, which is increasingly eating away the Framework Programme because of cost overruns. Further research is needed to understand how space research in the EU budget should be handled, while the distribution of costs between the EU budget and the ESA budget needs to be clarified. The EU budget as it stands is overburdened with objectives without the appropriate funding commitments. In this context, it is interesting to note that the areas in which the EU has the largest economies of scale and which are consequently best handled on a supranational level – i.e. R&D, security and external action – are underrepresented in the budget.

[17] This is not a yearly equivalent. It is the investment level at any one time for a guarantee. The effective leverage every year depends on the project cycles and the reinvestment rates of loan reimbursements. The RSFF, not yet being revolving, will over this MFF only leverage €10 billion.

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Annex 1 List of abbreviations

CCS	Carbon Capture and Storage
CERN	Conseil Européen pour la Recherche Nucléaire (European Organization for Nuclear Research)
EIB	European Investment Bank
EIF	European Investment Fund
EII	European Industrial Initiative
ENIAC	Nanoelectronics Technologies 2020
ERA	European Research Area
ERC	European Research Council
ESA	European Space Agency
ETP	European Technology Platform
EU	European Union
FP6	Framework Programme 6
FP7	Framework Programme 7
GDP	Gross Domestic Product
ICT	Information and Communication Technologies
IPR	Intellectual Property Rights
IRR	Internal rate of return
ITER	International Thermonuclear Reactor
JRC	Joint Research Centre
JTI	Joint Technology Initiative
JTP	Joint Technology Platform
LGTT	Loan Guarantee instrument for Trans-European transport network projects
MFF	Multiannual Financial Framework
OECD	Organisation for economic co-operation and development
PPP	Public–private partnerships
R&D	Research & Development
RSFF	Risk Sharing Financing Facility
SET	Strategic Energy Technology
SMEs	Small and medium-sized enterprises

Annex 2 The European technology platforms

- Advanced Engineering Materials and Technologies – EuMaT
- Advisory Council for Aeronautics Research in Europe – ACARE
- Embedded Computing Systems – ARTEMIS
- European Biofuels Technology Platform – Biofuels
- European Construction Technology Platform – ECTP
- European Nanoelectronics Initiative Advisory Council – ENIAC
- European Rail Research Advisory Council – ERRAC
- European Road Transport Research Advisory Council – ERTRAC
- European Space Technology Platform – ESTP
- European Steel Technology Platform – ESTEP
- European Technology Platform for the Electricity
- Networks of the Future – SmartGrids
- European Technology Platform for Wind Energy – TPWind
- European Technology Platform on Smart Systems
- Integration – EPoSS
- Food for Life – Food
- Forest based sector Technology Platform – Forestry (FTP)
- Future Manufacturing Technologies – MANUFUTURE
- Future Textiles and Clothing – FTC
- Global Animal Health – GAH
- Hydrogen and Fuel Cell Platform – HFP
- Industrial Safety ETP - IndustrialSafety
- Innovative Medicines Initiative – IMI
- Integral Satcom Initiative – ISI
- Mobile and Wireless Communications – eMobility
- Nanotechnologies for Medical Applications – NanoMedicine
- Networked and Electronic Media – NEM
- Networked European Software and Services Initiative – NESSI
- Photonics21 – Photonics
- Photovoltaics – Photovoltaics
- Plants for the Future – Plants
- Robotics – EUROP
- Sustainable Chemistry – SusChem
- Water Supply and Sanitation Technology Platform – WSSTP
- Waterborne ETP - Waterborne
- Zero Emission Fossil Fuel Power Plants – ZEP

Sammanfattning på svenska

Europeiska unionens politik för forskning och utveckling (FoU) har fått förnyad aktualitet. Den är central i såväl EU:s budgetöversyn som i den nyligen lanserade Europa 2020-strategin för främjande av ekonomisk tillväxt i Europa. Ett av målen i Europa 2020 är att öka nivån på FoU-investeringar i EU till tre procent av BNP. Detta har anammats av Europeiska kommissionen i budgetöversynen, där man argumenterar för en förstärkning av EU:s FoU-politik – även om man inte i detalj går in på hur mycket finansieringen ska öka.

Men även om vikten av FoU-investeringar betonas i både budgetöversynen och i Europa 2020, återstår det för kommissionen att presentera konkreta förslag till hur FoU-utgifterna ska öka. Frågan om storleken på EU:s budget och vilken roll den ska spela när det gäller att stödja FoU, kommer att vara viktig i diskussionerna om nästa fleråriga finansiella perspektiv. Att EU ska stödja FoU är något som måste vara välmotiverat innan investeringsnivån kan höjas.

Det är allmänt accepterat att det finns stora fördelar med att EU finansierar forskning, något som huvudsakligen härrör från så kallade stordriftsfördelar: effektiviteten i forskningen ökar när den bedrivs i stor skala. Däremot råder det idag oenighet om hur finansieringen ska fördelas, liksom om hur stor del av EU:s budget som ska satsas på FoU. Flera studier har argumenterat för en ökning av EU:s satsningar på forskning, men de tenderar att vara generella och går inte i detalj in på hur en större forskningsbudget skulle kunna användas.

Även om det är EU:s budget som får störst uppmärksamhet i dessa diskussioner, argumenteras det i denna rapport för att satsningar utanför den gemensamma budgeten är precis lika viktiga. Lån från Europeiska investeringsbanken (EIB) och olika mekanismer för offentlig-privat samverkan är också viktiga när det gäller stöd till forskning inom EU. Även om anslag är lämpligare för finansiering av grundforskning, kan lånebaserade finansiella instrument vara att föredra när forskningen är direkt och kommersiellt tillämpbar.

Rapporten analyserar därför både FoU-satsningar ur EU:s budget och andra tillgängliga finansiella instrument på EU-nivån som kan ge stöd till

FoU. I det syftet granskas också historiska förändringar i den europeiska forskningspolitiken. Senare års reformer kan ses som något av en tyst revolution: en väl fungerande FoU-politik är idag en förutsättning för att ett antal av de mål som EU har ställt upp ska kunna uppfyllas. Det är därför av avgörande betydelse att forskningspolitiken utvärderas ordentligt. Rapporten lyfter fram ett antal rekommendationer om hur de två typerna av instrument – anslag och lån – bör användas på EU-nivån.

Med utgångspunkt i en teoretisk multidisciplinär analys – som kombinerar offentlig ekonomi, fiskal federalism, politiska kriterier och EU:s lagstiftning – visar rapporten att EU har en stark roll att spela inom FoU, både som samordnare och som finansiär. En större andel av FoU bör hanteras på EU-nivå än vad som för närvarande är fallet. En ökning av EU-stöden, vilket kan leda till stora effektivitetsvinster utan att det orsakar legitimitetsproblem, skulle kunna komma från ytterligare anslag från EU:s budget, liksom från en bättre och ökad användning av andra finansiella instrument. För att uppnå målen för den strategiska planen för energiteknik (SET-planen), skulle EU:s satsningar på FoU behöva öka med åtminstone 1 miljard euro. Därför rekommenderas i rapporten att EU:s forskningsbudget bör höjas från 15 procent till så mycket som 50 procent, en höjning som inkluderar finansiering för att expandera befintliga låneinstrument.

Innan EU:s anslagskapacitet förstärks är det dock viktigt att försäkra sig om att EU har ett institutionellt ramverk som kan hantera FoU på ett så effektivt sätt som möjligt. Det huvudsakliga instrument som finns på plats idag är det så kallade sjunde ramprogrammet för utveckling inom forskning och teknik (FP7). Den senaste utvärderingen visade att programmet har lyckats att både förstärka grundforskningen och upprätthålla en urvalsprocedur baserad på excellent forskning. Samtidigt avslöjade den ett antal svagheter: trots att ett flertal reformer har genomförts, lider programmen fortfarande av överdriven byråkrati, olämpliga regler, en budgetkontroll baserad på överdriven riskaversion, bristande deltagande från den privata sektorn och en alltför svag forskningskoordinering och uppföljning. Det här är sådant som bör åtgärdas innan en finansieringsökning av betydelse är tänkbar. Det ska dock påpekas att Europeiska kommissionen är medveten om problemen och att reformer för att åtgärda dem föreslås i såväl budgetöversynen som innovationsstrategin.

Det är vidare nödvändigt med en grundläggande översyn av EU:s budgetförordning, där FoU behandlas med samma typ av riskaversion som andra EU-fonder. Det är också viktigt att medlemsstaterna och Europaparlamentet, i deras respektive roller i budgetkontrollen, gör det möjligt för EU att med sin FoU-politik driva en banbrytande och målinriktad forskning. FoU-satsningarna kännetecknas ofta av hög risk och okända resultat, och man bör därför prioritera effektiva riskhanteringsverktyg istället för rigida procedurbarriärer. Tonvikten bör ligga på värde och resultat snarare än på processer. Samtidigt bör såväl offentliga som privata intressen tas till vara på ett bättre sätt, för att på så sätt öka den privata finansieringen. Även om de inte ryms inom ramen för denna rapport, förtjänar de nuvarande byråkratiska reglerna för immateriella rättigheter ett särskilt omnämnande, eftersom de idag snarast motverkar medverkan från den privata sektorn.

Den här rapporten ser användandet av finansiella instrument – som lånefinansiering och lånegarantier via EIB – som ovärderliga för att uppnå EU:s FoU-mål. De lånebaserade instrumenten skulle kunna åstadkomma en femfaldig expansion av FoU-investeringarna. Detta har uppnåtts på ett framgångsrikt sätt med EIB:s finansieringsinstrument för riskdelning (RSFF). Men det är viktigt att skilja mellan de respektive roller anslag och lån spelar: lån kan inte ersätta offentliga grundforskningssatsningar och de kan heller inte ersätta offentliga satsningar inom områden där det finns stor risk för låg eller ingen framtida avkastning; eller där det tar lång tid att gå från forskning till produktkommersialisering.

Lån och lånegarantier är därför lämpliga endast under demonstrations- och utvecklingsfaserna. Dessa finansiella instrument kan inte ersätta, utan endast komplettera FoU-stöden och hjälpa nya projekt att komma ut på marknaden. Därtill kan lånemekanismer, om de hanteras väl, göra det möjligt att skilja mellan projekt med kommersiell potential och projekt som behöver anslagsstöd.

Det finns idag ett behov av ”bryggningsfinansiering” – det vill säga skuldfinansiering eller lånegarantier från offentlig sektor – eftersom långsiktiga, riskfyllda eller dyra demonstrations- och utvecklingsfaser kan avskräcka privata investeringar. Inom många områden kan ”bryggningsfinansiering” minska de risker som kännetecknar ny teknisk utveckling och därmed attrahera privat riskkapital. Detta är en nödvändighet inom områden som exempelvis energi eller medicin, men även inom rymdforskningen.

Vi rekommenderar också att man hittar lösningar utanför EU:s budget för projekt som till exempel ITER, vilket på grund av för höga kostnader i ökande grad slukar de tillgängliga medlen för FP7. ITER är ett internationellt projekt som inkluderar även länder utanför EU och det bör behandlas som andra överstatliga forskningsprojekt, som CERN eller ESA. Ytterligare forskning behövs också för att förstå hur rymdforskningen bör hanteras i framtiden och för att klargöra de roller EU:s och ESA:s respektive budgetar ska spela. EU:s budget är idag överbelastad med mål som saknar lämpliga finansieringsåtaganden. Det är i sammanhanget intressant att notera att de områden där EU åtnjuter de största stordriftsfördelarna och som därmed bäst hanteras på EU-nivån – FoU, säkerhet och externa åtgärder – är underrepresenterade i budgeten.

Det står avslutningsvis klart att EU:s finansiering av FoU inte på egen hand kan uppfylla de forskningsmål som unionen har ställt upp. Mer offentlig finansiering från EU-nivån och den nationella nivån ger inte medlemsstaterna dispens från att förbättra det egna regelverket för FoU. För att politiken ska bli framgångsrik måste välfungerande administrativa strukturer finnas på plats och den rekommendation som förs fram i denna rapport om att låta EU:s finansiella och administrativa procedurer genomgå en översyn bör även omfatta medlemsstaterna. Det är nödvändigt att de granskar effekterna av den inhemska forskningspolitiken på FoU.

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