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Overcoming innovation gaps in the EU-13 Member States

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Study

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Abstract

Investing in research is considered essential for achieving smart, sustainable and inclusive growth and jobs in Europe. The framework programme (FP) is the EU's primary instrument for the creation of the European Research Area. FPs are expected to produce European added value, so the principle of *juste retour* does not apply here. Research needs to be of the highest quality, produced in international collaboration and selected on a competitive basis.

Under these conditions, uneven participation is unavoidable. However, FP participation appears to be biased against an entire region of the EU. After almost 20 years of access to the opportunities of the FPs, the EU-13 countries are still lagging behind the EU-15. Moreover, the knowledge that is produced needs to be applied in national contexts, and the FPs also aim to increase cohesion and promote social responsibility. This is why uneven participation is an issue that impacts on the achievement of the higher objectives of the EU FPs as such.

The aim of this study is to explore, identify and shed light on the reasons for the low participation and success rate of the EU-13 countries, in order to improve their future performance in Horizon 2020 and FP9. A combination of methods was used to achieve this aim. The study includes an extensive literature review on various aspects of EU-13 participation in FPs, a comprehensive data analysis to allow a number of hypotheses regarding the origins of the low participation and success rates of the EU-13 countries in FP7 and Horizon 2020 to be tested empirically, an online survey among public research institutions, universities and business enterprises, and interviews with policy-makers.

The results point in the direction of possible solutions. Some solutions will be the responsibility of each Member State government. The EU needs to take action where low participation is caused by the design and governance of the FPs, as well as where patterns of participation, which have emerged over time and have now become self-reinforcing, create barriers to entry.

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List of abbreviations

AG	Advisory group
BSG	Benefit of specific groups
CEEC	Central and eastern European countries
CNCI	Category normalised citation impact
CP	Collaborative Project
CSA	Coordination and support action
ERA	European Research Area
ERAC	European Research Area Committee
ERC	European Research Council
ESIF	European structural and investment funds
EU	European Union
EU-13	Group of 13 EU countries: Bulgaria (BG), Croatia (HR), Cyprus (CY), Czech Republic (CZ), Estonia (EE), Hungary (HU), Latvia (LV), Lithuania (LT), Malta (MT), Poland (PL), Romania (RO), Slovakia (SK) and Slovenia (SI)
EU-15	Group of 15 EU countries: Austria (AT), Belgium (BE), Denmark (DK), Finland (FI), France (FR), Germany (DE), Greece (EL), Ireland (IE), Italy (IT), Luxembourg (LU), Netherlands (NL), Portugal (PT), Spain (ES), Sweden (SE) and United Kingdom (UK)
FET	Future and emerging technologies
FNCS	Field-normalised citation score
FP7	Seventh Framework Programme for Research and Technological Development
FP9	EU Framework Programme for Research and Innovation beyond 2020
FPs	Framework programmes
FTE	Full-time equivalent
GDP	Gross domestic product
GERD	Gross (domestic) expenditure on research and development
H2020	EU Framework Programme for Research and Innovation Horizon 2020
IA	Innovation actions
LEIT	Leadership in enabling and industrial technologies
MSCA	Marie Skłodowska-Curie Actions
NCP	National contact point
R&D	Research and development
R&I	Research and innovation
RIA	Research and innovation actions
RPO	Research performing organisation
S2E	Stairway to excellence
SF	Structural funds
SME	Small and medium-sized enterprises
SNA	Social network analysis
WOS	Web of Science

Executive summary

This study synthesises the outcomes of a project undertaken on behalf of the Science and Technology Options Assessment (STOA) Panel from November 2016 to May 2017. The aim of the project was to explore, identify and shed light on the reasons for the low participation and success rate of EU-13 countries in the FPs, in order to improve their future performance in Horizon 2020 (H2020) and FP9.

This executive summary reflects the structure of the report. A lot of research has already been done to explain the gap in participation in European framework programmes of the Member States that joined the EU in 2004, 2007 and 2013. The study therefore begins by extracting the main conclusions about the factors and mechanisms that cause low EU-13 participation from policy reports, Commission documents, and scientific papers. A statistical summary of various aspects of EU-13 and EU-15 participation in FP7 and Horizon 2020 is then provided. A literature review and statistical analysis enable the formulation of a set of hypotheses about reasons for the low participation and low success rate of EU-13 countries, these are tested empirically using a variety of methods and sources. The data analysis is complemented by the viewpoints of participants in FP7 and H2020 gained through the online survey and by the views of policy-makers and experts interviewed. The study concludes with a set of policy options.

Literature review

The literature review is based on a combination of three sources: (1) reports internal to the framework programme, such as monitoring and evaluation reports, and impact assessments; (2) policy studies, ERA progress reports, and other documents produced in the policy environment of the framework programme; and (3) scientific literature.

At the start of their integration into the European Research Area (ERA), most of the EU-13 countries faced numerous challenges related to the legacy of previous governance systems and a lack of focus on research and innovation. In many EU-13 countries, research and higher education systems are still split between academies of sciences and universities, fragmenting the public research system. The development of private research has been determined by economic development since the transition and by the position of domestic companies in global production networks.

At the time of EU accession, the national research systems in the EU-13 suffered from de-capitalisation of the physical research infrastructure in the transition period (Schuch 2014). The physical research and development infrastructure began to be improved only at the end of the 2000s with the help of massive investments from the EU structural funds. Most industrial research and development in EU-13 countries concerns development rather than research. Economic development is still mainly driven by diffusion, absorption and adoption of technologies. In addition, the lower position of companies in global value chains together with their limited innovation capability and performance translates into a low absorption capacity of domestic companies and branches of multinational corporations for research results.

Even though they have similar transformation backgrounds, the EU-13 are socioeconomically a very heterogeneous group of countries. The EU-13 exhibit pronounced differences in size, levels of economic development, general research and innovation efforts, levels of research and development expenditure, areas of scientific excellence, degrees of internationalisation, mobility and interaction of human resources, as well as institutions responsible for policy-making in science and information services and advice on the FPs in each country (Rauch & Sommer-Ulrich, 2012; Titarenko & Kovalenko, 2014).

As a result, the participation of individual EU-13 countries is also very different. CY, EE, MT, and SI are smaller countries that score lowest on EU funding per successful project, but high on EU funding per million GDP. CZ and HU are always among the top five best performing EU-13 Member States in research and innovation indicators; however, they are less able to convert this into FP participation. BG, HR, LT, LV, PL, RO, and SK score low on all indicators of funding and size.

There are many explanations for the underperformance of the EU-13 in the European FP. A number of key publications (the Commission monitoring reports, the interim FP7 expert report, the High-Level Expert Group reports) has produced a long list of possible explanations, relating to general socioeconomic characteristics, excellence, quality, competition, experience, networks, FP design and governance, and other obstacles, such as a lack of funds to start international contacts or a lack of options for the exploitation of research results at national level.

Analysis of EU-13 participation in FP7 and Horizon 2020

EU-13 underperformance is a complex problem and no single indicator can adequately provide a complete picture of FP participation. The statistics provide a framework for a deeper analysis of participation patterns and the related barriers. The data cover (1) participation, (2) characteristics of project consortia, and (3) financial contributions.

In FP7 about 21 per cent of all projects involved at least one EU-13 organisation. In Horizon 2020 this percentage has fallen to about 17 per cent. On the other hand, about 90 per cent of all projects involve one or more organisations from the EU-15. In FP7, the average EU-13 organisation took part in just over three projects compared to five projects for the average EU-15 organisation. In Horizon 2020 these averages were approximately two and three projects respectively.

In FP7 and Horizon 2020, EU-13 participation is below average in funding schemes that focus on excellence and innovation (ERC, MSCA, and IA/RIA). It is particularly low in the ERC. CP/IA/RIA projects, on the other hand, comprise about 45 per cent of all EU-13 participations. EU-13 participation is also relatively strong in CSA-projects. CSA projects represent 17 per cent of EU-15 participations in FP7 and 15 per cent in Horizon 2020; for EU-13 organisations these shares are 33 and 35 per cent respectively.

The new programme Spreading Excellence and Widening Participation introduced under Horizon 2020 is geared towards those Member States with relatively lower performance in research and innovation. The results of the first four calls show that there is a considerable variation among EU-13 countries in their participation in the three key instruments of this programme. The EU-13 countries that benefit most seem to be HU, SI and CY. Less active and successful countries are LT, MT and HR.

The composition of consortia in FP7 and Horizon 2020 projects shows that only a small minority of projects involving EU-13 organisations do not also involve EU-15 organisations. On the other hand, the majority of projects in FP7 and H2020 involve only EU-15 organisations. EU-13 consortia are different in composition than comparable EU-15 consortia. EU-13 project consortia are smaller, particularly when they do not involve EU-15 participants.

Financial contributions are a key issue in understanding EU-13 participation. In financial terms, the EU-13 obtained 3.7 per cent of total EU-28 financial support from FP7 while the EU-15 obtained the remaining 96.3 per cent. The average European Commission contribution per EU-13 participation is lower than that of EU-15 participations regardless of funding scheme or the role in project consortia (coordinator versus project member).

Hypotheses on possible explanations

In order to explore possible explanations for the low participation and low success rate of EU-13 countries in FP7 and H2020 we chose 11 hypotheses and used a data analysis to test them. The results of these tests provided an indication as to where the heart of the problem of low EU-13 participation really lies.

Hypothesis 1: There are not enough (eligible) participants in the EU-13 relative to the EU-15.
This hypothesis is rejected. Low levels of participation and activity are found in specific EU-13 Member States but not in the entire region. CY, EE, LV, MT, and SI participate at EU-15 levels. Only CZ, PL and SK have relatively low numbers of active organisations.

Hypothesis 2: EU-13 organisations are less active in the framework programme than EU-15 organisations.
The hypothesis is tentatively confirmed. On average, EU-13 Member States have lower levels of participation in proposal submission than the EU-15 Member States. On aggregate, the EU-13 have lower participation in FP proposal submissions per million population, per FTE researcher and per active organisation. Only the level of participation in submissions per million euro of GERD is much higher in the EU-13 compared with the EU-15. Some countries are far more active – notably CY, EE, MT, PL and SI.

Hypothesis 3: The quality of proposals involving participants from the EU-13 is lower than that of proposals not involving participants from the EU-13.
The hypothesis is confirmed. Yet it has two dimensions: administrative quality determines eligibility and substantive quality determines the success rate. Proposals involving EU-13 organisations are more likely to be ineligible and where they are eligible, they are less likely to be successful. The gap between the EU-13 and EU-15 is concentrated in proposals coordinated by EU-13 organisations. Coordination requires special skills that are rare among EU-13 organisations.

Hypothesis 4: Prospective participants from the EU-13 are not good enough relative to the EU-15.
The hypothesis is tentatively accepted. The quality of EU-13 science is lower than that of the EU-15, based on the average citation impact per publication and the presence of national universities in two global university rankings. However, on a global scale, many EU-13 Member States (particularly CY, EE, MT, SI, and HU) achieved high average quality, higher than or near the level of the EU-15. The FP7-related output of the EU-13 is equal to that of the EU-15, provided they collaborated with EU-15 co-authors.

Hypothesis 5: Prospective participants from the EU-13 have weaker connections to the collaboration network in FPs than participants from the EU-15 who have more connections and are more central to the network.
The hypothesis is confirmed. The FP network is dominated by EU-15 organisations, in particular by a small group (the so-called TOP15 organisations) that form the 'core' of the network. Only a handful of EU-13 organisations qualify as hubs, giving them a strong position in the FP collaboration network. The average network position of EU-13 organisations is weaker than that of EU-15 organisations; in Horizon 2020 this position is weaker than in FP7. EU-13 organisations have a much lower intensity of collaboration with the TOP15 and TOP20 organisations than EU-15 organisations.

Hypothesis 6: There is a cognitive distance between the scientific and technological portfolio of prospective participants from the EU-13 and the portfolio of the more successful EU-15.
The hypothesis is tentatively confirmed. The results of the comparison of scientific output portfolios suggest that the odds of finding a cognitive overlap – that is, two organisations with the same or similar thematic interests and specialisations – is much higher within the EU-15 and within the EU-13 than between the two regions.

Hypothesis 7: Low rates of participation in the FPs are a reflection of the relative weakness of the research and innovation systems of the EU-13 compared with the EU-15.
The hypothesis is confirmed. As a group, the EU-13 has lower research and development expenditure and lower innovation performance. They have, however, achieved much stronger growth of per capita GDP and are consequently catching up economically with the EU-15. Some EU-13 Member States – specifically CY, CZ, EE, and SI – perform much better than the rest of the EU-13.

Hypothesis 8: Prospective participants in the EU-13 have alternative and more easily accessible funding opportunities that are less easily available in the EU-15.

The hypothesis is rejected. The EU-13 organisations have easy access to a large alternative funding source, the European structural and investment funds. Yet, the essence of the hypothesis was that EU-13 organisations submitted fewer proposals because easily accessible alternative funding sources were available. However, contrary to the expectations formulated as part of this hypothesis willingness to submit is greater among the EU-13 than among the EU-15. This is a reflection of their smaller size: small Member States tend to submit more proposals (per million population) than large Member States.

Hypothesis 9: It is too soon to expect a rise in participation rates as EU-13 research and innovation actors still have to prove their capabilities.
The hypothesis is rejected. For the hypothesis to be confirmed, the FP participation of Spain, Portugal, Sweden, Finland and Austria would be expected to show a continued increase at high rates long after their accession to the EU. There is an increase in participation numbers, but in relative terms – in the number of participations per Member State as a percentage of total FP participations – there is stability.

Hypothesis 10: The problem of FP participation is specific to certain instruments in FP7 and Horizon 2020.
The hypothesis is confirmed. The participation of EU-13 organisations in FPs is relatively low and declining in funding schemes aimed at excellence and innovation. It is relatively high in areas where existing knowledge is used for specific purposes, particularly in coordination and support actions.

Hypothesis 11: The EU-13 have insufficient influence on the work programme of the FP.
The hypothesis is rejected. Although the EU-13 Member States have lower representation in the European Commission's advisory groups for research and innovation in absolute terms, their representation related to the size of research and innovation systems is adequate.

Perspective of participants in FP7 and H2020

The online survey of FP participants was carried out in order to gain a better understanding of the position of FPs in national research and innovation systems, motivations for participation in FPs, and barriers to successful participation. The survey covered 89 FP7 participants from public research institutes (44 per cent), universities (37 per cent) and private companies (19 per cent). All EU-13 countries were represented in the survey.

In general, the respondents were positive about participation in FP7/H2020 programmes and the benefits for the further development of their research topics, as can be demonstrated by the fact that, according to 94 per cent of respondents, the topic of FP7/H2020 calls corresponded to the long-term research agendas of the participating institution.

According to the respondents, the most important barrier to their participation in FP7 and Horizon 2020 was the low success rate of project proposals, followed by limited in-house internal skills in drafting proposals or managing projects.

The questionnaire survey also confirmed that the behaviour of researchers and research institutions (including private companies) and their willingness to participate in FP7/H2020 is to a large extent determined by certain structural characteristics of national research and innovation systems. The most serious structural barriers to participation in FP7/H2020 mentioned by respondents are: the wage gap; slow professional career growth; and an inadequate evaluation system with a low emphasis on internationalisation.

The perspective of policy-makers and policy experts

The interviews validated the findings of the data analysis and online survey and complemented them by providing the additional perspective of experts on research and innovation policy at both national and European levels. Twenty-one policy experts from national and European state administrations were interviewed as well as independent analysts and representatives of national FP support bodies.

The interviews proved that the participation of EU-13 countries is generally perceived to be inadequate both in absolute terms and in relation to the size and quality of research and innovation systems. The low success rate of project proposals submitted is the main factor hampering the participation of EU-13 countries in FPs and further discouraging research teams from preparing and submitting new project proposals. Rules for the calculation of personnel costs in H2020 and remuneration gap are also topics intensively discussed in national debates on how to make H2020 more attractive for researchers from EU-13.

The interviews also highlighted the need for EU-13 research teams to be ready for international collaboration and to be able to connect with existing European research collaboration networks. The

Spreading Excellence and Widening Participation Programme launched in 2014 goes in the right direction in this respect. National research and innovation policies could also be more active in motivating and facilitating strategic partnerships between research organisations and infrastructures with excellent European research organisations.

It has been further emphasised that the conditions for synergies between H2020 and the European structural and investment funds need to be improved and better communicated – not only among the various DGs in the European Commission but also within the individual Member States.

The responding policy-makers and experts also stressed the importance of the active participation of the EU-13 in EU research and innovation policy design through involvement in advisory bodies or professional partnering associations.

Policy options

The issue of the low participation of the EU-13 in the framework programme has no one-size-fits-all-solution. On the basis of the literature review, data analysis, survey results and interviews with policy-makers and policy experts, a summary has been made of the main barriers to the participation and success of the EU-13 countries in the FPs. It is clear from the evidence and the combination of barriers that any strategy to stop the pattern of persistent, low participation in the FP requires action at three levels: (1) the local level of research and innovation organisations, (2) the national level of research and innovation systems, and (3) European level. Policy options will be most successful if they address the situation at multiple levels.

Option No 1: Creating and exploiting the existence of pockets of excellence

It is vital to increase the opportunities for researchers and research groups from the countries with the lowest level of participation to create or develop pockets of excellence (Reid et al. 2016, RISE group 2017) within these countries. Such pockets of excellence can act as regional or national hubs within European research and innovation programmes, and become drivers of change within their own country. This requires long-term planning and a well-balanced interaction between the EU structural funds, FP instruments and national funding. (RISE group, 2017)

Option No 2: Improving the governance of national research and innovation systems

The differences between EU-13 countries in the participation rate and several of the barriers identified indicate that improving the governance of national research and innovation systems is a key factor in raising participation rates. Many EU-13 countries lack a sophisticated system of periodical evaluation of research organisations closely linked to institutional funding. The national steering of research and development is thus void of some basic information required for influencing the desired behaviour of research organisations management effectively.

Option No 3: Improving the use and exploitation of FP research and development projects

The impact of the FP projects is the crucial problem of the FP. The FP is aimed at increasing the global competitiveness of the EU. If the EU-13 have a positive experience of enhancing their competitiveness via their participation in FP projects, then they will hardly complain about their low participation in this programme. The impact depends on the effectiveness of project results implementation. Thus exploitation of research and development outputs resulting from FP projects is a significant factor enhancing a country's motivation to participate. However, effective exploitation of project results frequently requires additional capital investment (e.g. for the continuation of research within national institutions, converting research results to technologies, bringing the results close to markets, etc.), which might be less available in the EU-13 than in the EU-15. Therefore, supporting different ways of following up on successful projects might stimulate EU-13 motivation to participate in the FP and enhance their involvement in project proposal preparation.

Option No 4: Strengthening national contact points (NCPs)

Several barriers identified refer to insufficient understanding within low participating EU-13 countries of FP opportunities and insufficient capabilities to develop eligible and high-quality proposals. While it is beyond the scope of this study to assess the actual performance of the national contact points, given their remit and budget, it seems that there is some space for further action in this respect. The real problem, however, seems to be the lack of institutional support from within the university/research organisation. Therefore, the development of capacities within institutions to aid researchers in preparing and managing their projects should be given political support.

Option No 5: Expanding Spreading Excellence and Widening Participation

If the FP is to contribute to increasing the EU's global competitiveness, then it must be driven by an uncompromising emphasis on excellence. The Spreading Excellence and Widening Participation programme, though still in the early stages of implementation, has introduced a fresh impetus for strengthening the research and innovation potential of EU-13 countries and improving their integration within the ERA. However, it should be emphasised that the Spreading Excellence and Widening Participation programme represents approximately 1 per cent of the H2020 budget, and is rather small for achieving the desirable changes in the 13 national research and development systems of EU-13. The instruments of this programme need to be implemented in synergy with other investments at national level, mainly those supported by ESIF and/or developed in the respective national research and innovation strategy for smart specialisation.

1. Introduction

The European Research Area (ERA) is 'a unified research area open to the world based on the internal market, in which researchers, scientific knowledge, and technology circulate freely and through which the Union and its Member States strengthen their scientific and technological bases, their competitiveness and their capacity to collectively address grand challenges', European Commission (2012). Support for cooperation among the Member States in research and innovation is a significant element of European research policy. There are several instruments at EU level for this purpose, the most substantial being the EU Framework Programme for Research and Technological Development (FP).

Most of the EU-13 countries began participating in the FP in FP5 (1998 – 2002). They shared an ambition to succeed in European cooperation in science and technology. The opening of FP5 to the EU-13 via specific association agreements raised expectations in the EU-13 research and development community that have, however, never been met. While the EU-13 represent about 20 per cent of the EU population, their participation in FP7 and Horizon 2020 projects represents less than 10 per cent of total EU-28 participation and less than 4 per cent of European Commission financial contributions. Therefore, in terms of participation and success rates, the EU-13 are still lagging behind the EU-15.

The association agreement also stipulated the obligation to contribute to the FP5 budget, and therefore the EU-13 knew the precise cost of their opportunity to take part. Naturally, they started to check whether their participants in FP5 projects won back in contracts what the state had paid out. Therefore, since the FP5, the *juste retour* principle has been part and parcel of EU-13 participation in the framework programmes. Although Member States' contributions to the FP budget are hidden in their EU membership fee, the *juste retour* principle has been raised since the FP5 generally since this principle is wrongly interpreted as meaning the fair sharing-out of the FP budget. Namely, the purpose of the FP is to attract excellent (European) research teams to solve major problems and contribute to the EU's global competitiveness. However, since FP5 some EU-13 countries have been wrestling with the problem that they permanently contribute more to the FP budget than what their teams contract back. Their research communities have the feeling that they cannot fulfill their ambition to succeed in European cooperation in science and technology. Essentially, the low participation can be expressed in financial terms.

However, 'contributing more than contracting back' is not specific to the EU-13 countries. Section 4.3.2 includes a detailed analysis that shows that, for instance, even Germany, France and Italy could claim to increase their share of the FP budget. The serious objection against the *juste retour* principle is that it completely disregards the value of results achieved in the FP projects.

The EU-13 is not a homogeneous group of countries. Some have long had and still have very low research and development intensity, with gross expenditure on research and development (GERD) less than one per cent of gross domestic product (GDP). Other EU-13 countries have considerably increased their research and development intensity to levels even above those of some EU-15 countries that are globally known for the high level of their research institutions, universities and high-tech industry. However, it is not clear how long increased research and development investments has to last in order to increase the competitiveness of the EU-13 countries' research and development to the level of their EU-15 counterparts. Nevertheless, none of the EU-13 countries are likely to achieve the target of investing three per cent of GDP in research and development by 2020 as stipulated in the Europe 2020 strategy.

The situation of low EU-13 participation presents a political dilemma specific for the EU-13. The EU-13 ministries responsible for research and development are asking for participation conditions that will increase their participation in the FP projects. European tax payers on the other hand, whether from the EU-13 or the EU-15, expect EU research and development funding to attract the most excellent European research and development teams, which will produce solutions to grand challenges, breakthrough innovations, and competitive advantages for industry.

The FPs can hardly achieve their goals if they merely serve to expand the financial sources of national research performing organisations (RPOs). The FPs are expected to produce European added value but also to produce solutions for problems specific to national contexts, such as problems that occur in specific regions of the EU or among specific segments of the EU population. This is why uneven participation is not only a problem for the RPOs that compete for funding to perform research projects. It is a problem pertaining to the achievement of the higher objectives of the FPs as such.

The aim of this project is to explore, identify and shed light on the reasons for the low participation and success rate of EU-13 countries, in order to improve their future performance in Horizon 2020 and FP9. On the basis of the analysis of the key factors hampering the successful participation of EU-13 countries in the framework programme, recommendations and policy options will be developed that will allow policy-makers to propose measures to increase the effectiveness of H2020 and future FPs in terms of promoting excellence in research, fostering competitiveness and economic growth, contributing to solving social challenges, strengthening human potential and researcher mobility, and fostering transnational research cooperation.

The structure of this report is as follows. Chapter 2 describes the methodology and resources used for the purposes of this study. Chapter 3 reviews the existing literature and extracts the main conclusions about the factors and mechanisms that cause low EU-13 participation from policy reports, Commission documents, scientific papers, and FP project results. Chapter 4 provides a detailed statistical analysis of the patterns of participation of organisations from the EU-13 and the EU-15 Member States in FP7 and Horizon 2020. An examination is made of participation, the characteristics of project consortia, and the distribution of financial contributions in the entire FP, per Member State, distinguishing participants and coordinators as well as different types of funding schemes. Chapter 5 offers a set of hypotheses, mainly on the basis of the existing literature. These hypotheses are empirically tested using a variety of methods and sources. Chapter 6 sets out the results of the online survey conducted among participants in FP7 in order to improve the understanding of motivations for and barriers to participation in FPs. Chapter 7 describes the perspective of interviewed policy-makers and experts on the role of FPs in national research and innovation systems. Chapter 8 provides policy options for the increased participation of EU-13 countries in the ERA. Finally, in Chapter 9, all the insights and information are pulled together to formulate conclusions and answer the main research question on the key reasons for the low participation and success rate of EU-13 countries in the FP.

2. Methodology and limitations of the study

2.1. Methodology and resources used

The central research question that guides the analysis is: What are the key reasons for the low participation and success rate of EU-13 countries?

No single reason can fully explain the problem. Most likely there is a combination of reasons that need to be analysed from different perspectives. In order to answer the central question, we will investigate reasons that are related to:

- quantity and quality of research;
- conditions for collaboration and networking;
- environmental conditions (national research and innovation systems);
- time since EU accession;
- design, governance, and implementation of the Framework Programme.

Concerning the quantity and quality of research, the overall performance of EU-13 and EU-15 countries will be compared while taking into account the size and quality of national research systems. This overall assessment will enlighten the research potential for the participation of EU-13 countries in EU framework programmes.

Regarding the conditions for collaboration and networking, reasons for the low participation of EU-13 countries will be sought in proximity and past connections of research teams in the EU-13 compared to the EU-15. This will enable us to assess (1) how research teams from the EU-13 have gained access to established collaboration networks in Europe and (2) what the conditions are for linking research activities of the EU-13 internationally.

Features of national research and innovation systems will be explored in order to assess possible structural barriers to more intensive and successful participation of EU-13. Hampering factors will be sought in strategic policy orientation of STI policies, level of accessibility of different financial resources for research as well as in motivation schemes for international collaboration in national research systems and related level of support infrastructure.

Regarding the time since EU accession, possible explanations for the low participation and success rate of the EU-13 will be explored from the perspective of the flexibility of national research systems and their ability to adjust to ERA goals and EU Framework programme funding schemes.

With respect to the design, governance, and implementation of the Framework Programme, individual instruments, as well as the process of designing FPs and work programmes, will be assessed against the criteria of appropriateness for and sufficient involvement of EU-13 countries.

The 5 groups of reasons cover various types of factors ranging from structural, over cultural and behavioural to organisational factors. It is beyond the scope of this study to order these factors according to their importance, impact or level of difficulty for addressing them.

Difference between EU-13 and EU-15 can be hardly exhaustively described if the impact of their participation in the EU research and innovation programmes is not considered. Unlike analysis of MS participation in the EU FPs, there are no accessible data making it possible to analyse the impact of these programmes either at the level of the EU-13 and EU-15 blocs or at individual EU Member States. In this study, we attempt to study the impact of FP7 research projects by employing bibliometric analysis of publications resulted from FP7 projects. The other facet of the impact might be found in an analysis of spreading excellence via collaboration of EU-13 institutions with excellent EU institutions, which is implemented further. The analysis the EU-13 and EU-15 ***innovation*** gap would require analysing achievements of industrial and other business organisations. This is very demanding because the adequate analysis should be based on the counterfactual approach, i.e. on processing not only data

pertaining to achievements of participants of EU projects but also data of entities that have not participated in these programmes. Implementation such approach considerably exceeds the scope of this study and is thus left for future research.

We use a combination of methods to achieve the aims of the study:

1. *A review of the literature on the participation of EU-13 countries in FP7 and Horizon 2020.*

   The literature review is based on a combination of three sources: (1) reports internal to the Framework Programme, such as monitoring and evaluation reports, and impact assessments; (2) policy studies, ERA progress reports, and other documents produced in the policy environment of the Framework Programme; and (3) scientific literature.

2. *Statistical analysis of patterns of participation in FP7 and Horizon 2020*

   The statistical information concerns (1) participation, (2) the characteristics of project consortia, and (3) financial contributions. The analysis is comparative, using the EU-15 as a benchmark. We normalise for country size using population, the number of researchers, and gross expenditure on R&D. Results are shown for regional aggregates (EU-13 and EU-15) as well as for the individual Member States.

   The statistics on financial allocations does not consider differences in living costs among EU countries. If we analyse the distribution of the FP budget among the EU Member States (or generally to all participating countries) no ppp conversion is made. Since there is no average deflator for the EU-13 it would be necessary first make the ppp conversion for each single EU-13 country and only then compute the average received support. The same will have to be done for EU-15 and/or for any participating country. Since the sum of the finally recalculated individual supports does not equal the distributed FP budget we have decided not to convert the compared support into ppp.

   The analysis of EU Member State participation in the Framework Programmes is based on the EC's official data on FP projects. These data are contained in the E-CORDA database and available online in an abbreviated form on the European Open Data Portal. E-CORDA provides information on projects as well as proposals. The European Open Data Portal provides summary data for funded projects and participating organisations from FP1 until Horizon 2020. The Horizon 2020 data concern the first 9,055 projects granted in 2014 and 2015.

   The information contained in the databases was cleaned, harmonised, and classified. Where different names were used to indicate one and the same organisation, a unique name was assigned to that organisation. Where information was missing, for example on the country of location, this information was added. The wide diversity of FP funding schemes was classified into a limited number of homogeneous groups to facilitate analysis.

3. *Data analysis to empirically test a number of hypotheses regarding the origins of low participation and success rates of EU-13 countries in FP7 and H2020.*

   In order to explore possible explanations for the low participation and success rate of EU-13 countries in FP7 and H2020 we set 11 hypotheses and used a data analysis to test them. These 11 hypotheses have been clustered according to the 5 problem areas described above as follows:

   Quantity and quality of research

   - Hypothesis 1: There are not enough (eligible) participants in the EU-13 relative to the EU-15
   - Hypothesis 2: EU-13 organisations are less active in the Framework Programme than EU-15 organisations
   - Hypothesis 3: The quality of proposals involving participants from the EU-13 is lower than that of proposals not involving participants from the EU-13

- Hypothesis 4: Prospective participants from the EU-13 are not good enough relative to the EU-15

Conditions for collaboration and networking

- Hypothesis 5: Prospective participants from the EU-13 have weaker connections to the collaboration network in FPs than participants from the EU-15 who have more connections and are more central to the network
- Hypothesis 6: There is a cognitive distance between the scientific and technological portfolio of prospective participants from the EU-13 and the portfolio of the more successful EU-15

Environmental conditions (national research and innovation systems)

- Hypothesis 7: Low rates of participation in the FPs are a reflection of the relative weakness of the R&I systems of the EU-13 compared to the EU-15
- Hypothesis 8: Prospective participants in the EU-13 have alternative and more easily accessible funding opportunities that are less easily available in the EU-15

Time since EU accession

- Hypothesis 9: It is too soon to expect a raise in participation rates as EU-13 R&I actors still have to prove their capabilities

Design, governance, and implementation of the Framework Programme

- Hypothesis 10: The problem of FP participation is specific to certain instruments in FP7 and Horizon 2020
- Hypothesis 11: The EU-13 has insufficient influence on the work programme of the FP

Since there are great disparities among the EU Member States, the explanation will most likely be 'country-specific'. Therefore, the analysis shows results for the individual Member State of the EU-28 in addition to the regional aggregates for the EU-13 and EU-15.

4. *Qualitative assessment and verification of data analysis*

We use two sources for qualitative analysis of reasons for low participation and success rate of EU-13 countries in Framework Programmes: online survey and interviews.

Online survey

The online survey was realized in order to better understand the motivations for participation in FPs, and barriers to successful participation. We surveyed higher education institutions, public research institutions and private sector organisations from the EU-13 with practical experience with FP projects. The respondents had been selected from the E-Corda database. We selected all participants with at least one funded FP7 project and at least 10 project proposals submitted to FP7. Contacts to R&D managers (directors, vice-chancellors, CEOs) of every single organisation were identified based on an internal database of contacts and web search. The questionnaire survey was conducted through the LimeSurvey application, which generates and sends a unique questionnaire to each respondent. This enabled us to link information from the E-Corda database to the information from the questionnaire survey and to create a complete profile of each respondent.

Interviews

The interviews validated our findings of the data analysis and online survey and complemented them by providing additional perspective of experts on R&I policy on both national and European levels. Three types of stakeholders have been interviewed - (1) representatives of the state administration responsible for ERA and international research collaboration in EU-13 countries, (2) individual policy experts, (3) national contact points, liaison offices and other parts of national

support infrastructure for the FPs, and (4) representatives of EU bodies responsible for EU R&I policy. In order to identify the right experts for interviews, we created a long list of 95 experts consisting of national representatives in European Research Area and Innovation Committee (ERAC), members of the EU Evaluation Network, participants in recent EU evaluation projects, NCP coordinators and NCPs for Widening Participation and Spreading Excellence programme. Based on this long list we have selected policy-makers and policy experts for interviews so that each of EU-13 Member States was covered by at least two experts. This short list of interviewees was complemented by representatives of EC and its bodies in order to comprise their point of view. The interviews were designed as open and semi-structured with a defined set of topics but a degree of flexibility as to exactly which questions will be tackled and in what depth.

5. *Synthesis and formulation of policy recommendations and options.*

   Policy recommendations and options were formulated based on the findings from the literature review, the data analysis, the survey and the interviews. The first draft of policy options and recommendations was formulated at an internal workshop held among the project team members. They were discussed with policy-makers and policy experts during the interviews.

2.2. Limitations of the study

This study aims to explain the reasons for the low participation of EU-13 countries in EU Framework programmes. Obviously, the individual explanatory factors explored in this study are not independent of each other and do not carry equal importance with respect to the barriers to the higher participation of EU-13 countries in FPs. In this respect, an explanatory framework based on multidimensional statistical model making it possible to rank the critical factors regarding their importance and mutual relations would be an asset to the study.

However, for pragmatic and substantive reasons related to the lifespan of this study we do not employ this approach, which requires quantifying financial, cultural, behavioural, institutional and organisational characteristics, which goes beyond the scope of the study. Furthermore, creating and testing one explanatory model with the existing data, the number of possible independent variables (of which some cannot yet fully operationalised) and the number of cases being limited to the EU members, any model would suggest more certainty than warranted. Note that this position is supported by the findings of the literature review, which shows that there is no methodological consensus in the operationalisation of depending variables. So knowing the data limitations for statistical modelling and considering the main scope of the project we decided not to deploy these methods.

Instead, we combined data analysis with qualitative assessment (survey and interviews), which allowed us to get better insight into factors that are relevant for policy options formulation. Our approach employs only the already existing data and follows four subsequent steps to meet the aims of this study, namely (1) literature review, (2) test of hypotheses based on data analysis, (3) qualitative assessment and verification based on online survey and interviews, (4) synthesis and formulation of policy options.

3. Literature review

A lot of research has already been done to explain the gap in participation in the European Framework Programmes of the New Member States that joined the EU in 2004, 2007 and 2013. In this section, we provide a brief summary of the results and insights with respect to the participation of organisations from the EU-13 relative to that of organisations from the EU-15.

The aim of the following literature review is mainly to describe the existing knowledge of various aspects of EU-13 participation in FPs and not to discuss the conclusions of these studies. The literature review served as one of the starting points for the formulation of our hypotheses about the reasons for low participation. The literature review indicates that there are different views on the EU-13 participation. Some EU-13 countries have low but other high participation. The reader should be well aware that the literature does not supply an uniform answer to the question on low EU-13 participation. The literature review also contains a review of FP6 and FP7 projects that uniformly consider the EU-13 participation as low, thus they are focused on the formulation of measures that might increase the EU-13 participation. In addition, every effort to formulate brief statement/conclusion whether the participation is low will be rather subjective based on the view of the author of the literature we discuss.

This literature review is based on a combination of three sources. The so-called 'grey' literature consists of (1) reports internal to the Framework Programme, such as monitoring and evaluation reports, and impact assessments; and (2) policy studies, ERA progress reports, and other documents produced in the policy environment of the Framework Programme.

There is also rich scientific literature that can help us better understand various aspects of EU-13 participation in FPs. In this study, we have focused on the most important and most relevant scientific contributions. At the first stage, we have produced a shortlist of relevant scientific literature using a topic search in Web of Science database and a search in Google Scholar. In line with the main aim of this study we have included studies directly relevant to the problem of EU-13 participation in EU Framework Programmes; and studies on collaboration, network formation, and integration in EU Framework Programmes and ERA. From the first shortlist we produced a final non-exhaustive list of literature by (a) tracing citations to papers in the first shortlist and (b) doing additional searches in the Web of Science and Google Scholar using keywords and terms that emerged from the analysis of the literature in the shortlist. This 'snowball search method' was limited to literature produced since the year 2000 and focused on the most relevant and most cited studies and reports.

The Framework Programmes (FPs) are the largest transnational programmes for cooperation in research and development (R&D). Consequently, a number of impact assessment studies have been undertaken, either on for the entire EU or on a national level, which analyse various topics, including the participation of Member States in FPs. Although the participation of the new Member States (NMS) is a highly discussed issue and a frequent topic of many conferences and meetings, there is relatively limited common grey literature and few studies on this topic. This is why we used the Evaluation and Monitoring reports of Framework Programmes submitted by European Commission as the basis for this overview. Unfortunately, these reports contain only partial information about EU-13 participation and do not deal directly with this issue. The most important monitoring reports and studies mentioned in the literature overview are those that do contain information about EU-13 participation, mainly in FP6 and FP7, and eventually also in Horizon 2020.

Four specific policy studies feature prominently in this literature review. The first is a report prepared by the Centre for Central and Eastern Europe (Mittel Europa Zentrum Ost and - MOEZ) of Fraunhofer Gesellschaft for the German Federal Ministry of Education and Research. The report is a comprehensive study on the participation of the new Member States in FP7 and exceeds the scope and intention of a conventional analysis of EU-13 participation in FPs (Rauch & Sommer-Ulrich, 2012). The two other reports provide expert analysis of EU-13 participation. These reports are 'Participation of the New EU Member States in the European Research Programmes — A Long Way to Go' by Schuch (2014) and

'Participation in the EU FP – policy implications' by Ferligoj et al. (2011). Furthermore, we have looked at a study for EC DG Research on the impacts of the crisis on the economic structure and RDI policy of EU countries by (Izsak et al., 2013). The findings of this latter study are complemented by results of Izsak and Radošević (2017), who studied the impact of the financial crisis on the evolution of R&D systems.

A number of *FP6 and FP7 projects* have explicitly researched the problem of increasing EU-13 participation. The reports from the Stairway to Excellence (S2E) project were a very important source of information about the activity and problems of the New Member States in the FPs. The S2E project performed complex country analysis for the Member States that joined the EU since 2004. The objective was to assess and corroborate all the qualitative and quantitative data in drawing national and regional FP7 participation patterns, to understand the push and pull factors for FP7 and Horizon 2020 participation, and to identify the factors affecting the capacity to absorb cohesion policy funds.

Scientists have had a continuous interest in the development of the Framework Programme and the problem of differences in participation. This interest is growing, driven in part by the improved availability of data on projects and organisations in European FPs since 1984. The main findings of the scientific literature relate to (1) the drivers of network development and the formation of the European Research Area, and (2) the influence of excellence and experience on participation in combination with a 'Matthew Effect' that reinforces the participation of those who already participate well.

3.1. Low participation of the EU-13

It is generally acknowledged that the EU-13 underperform in the European FPs. Differences in participation are accepted. The FPs are based on quality and excellence, which implies that an even geographical distribution of funds based on the principle of '*juste retour*' cannot be applied. Participation is based on competitive grant applications.

There are, however, recurring voices that point to the issue of 'underperformance' of a whole group of countries, namely the so-called New Member States that joined the European Union in its 'Eastern enlargement' in 2004 (CZ, EE, HU, LV, LT, PL, SK, SI, MT and CY), 2007 (BG, RO) and 2013 (HR) (Ferligoj et al. 2011). We will henceforth refer to the New Member States as the EU-13.

At the start of integration into the European Research Area (ERA), Central and Eastern European countries faced numerous challenges related to the legacy of previous governance systems and a lack of focus on developing S&T. It was assumed that the association of these countries with the European FPs would contribute to internal reforms provided that local scientific communities are proactive. However, many years after the first full association, levels of FP participation among the EU-13 remain low.

3.1.1. Statistical evidence

The statistical analysis of FP participation typically uses a range of indicators including the number of project participants and participations, often correlated against factors such as GDP, population, and national investment in R&D, and the number of researchers. Additional analyses look at other measures of performance such as the number of project coordinators, financial returns, and success rates in different calls. Each indicator highlights different aspects of performance (European Union, 2011). Some indicators place the EU-13 above the EU average, while with other indicators the EU-13 falls significantly below average. This problem is complicated further when indicators are combined with other performance indicators to evaluate, for example, participation per GDP, participation per capita, FP funds per GDP, proposal success rates, etcetera (Ferligoj et al., 2011).

No single indicator can adequately provide a complete picture of FP participation. EU-13 underperformance is a complex problem. In addition, every FP is made up of different funding schemes and thematic priorities, each with its own criteria for quality and eligibility that define competitive outcomes. Only a synopsis of indicators in the context of the national research environment can inform explanatory approaches leading to recommendations for action (Rauch & Sommer-Ulrich, 2012).

The determinants of participation may be field-specific rather than nation-specific. For example, Cecere and Corrocher (2014) find that the participation of countries in ICT-related FP projects is extremely uneven. Only a few countries have both a high intensity of participation and a high number of knowledge hubs. The most frequent bilateral ties occur within the same countries and between very advanced countries. Collaboration is stronger within the EU-15 than within the EU-12 and between EU-12 and EU-15 organisations. The main drivers are proximity (geographic distance; sharing a border; the same language; common cultural values) as well as the development of the ICT sector in the countries (see also Azagra-Caro et al. 2013; Hazir & Autant-Bernard 2014). Barber and Scherngell (2013) analyse the network structure of FP5 projects and found thematically more or less homogeneous communities (e.g. Life Sciences; Environment; Sea Transport; Information Processing). Each community has its own spatial configuration, but within each community spatial integration of collaboration was more developed than in the FP5 network as a whole.

Statistical evidence shows that organisations from the EU-13 have benefited less from their participation in the European FPs than organisations from the EU-15. This is not a new observation (Schuch, 2014). Many studies and analyses concerning the FPs have arrived at the same conclusion (Fresco et al., 2015). FP7 data suggest that the divide between the participation patterns of the EU-15 and the EU-13 remain (Fresco et al., 2015). And the first monitoring reports on Horizon 2020 show the EU-13 in the same position relative to the EU-15.

In FP6, FP7 and Horizon 2020 participation is geographically concentrated. The percentage share of the EU-13 is low and it is declining rather than increasing, from 10.1 per cent in FP6 and 10.3 per cent in FP7 to 8.5 per cent in Horizon 2020 (European Commission, 2009; European Commission, 2013; European Commission, 2016b). Looking at the distribution of Horizon 2020 funding connected with grant agreements signed by participants, the share of the EU-13 in the sum total of EU contributions to the EU-13 Member States was 4.3 per cent in 2014 and 4.7 per cent in 2015 (European Commission, 2016b). The EU-13 do have higher rates of participation than can be expected based on their share in EU GDP. This is especially true for EE, SI, BG, LV, HU, LT, CY, and RO (Rauch & Sommer-Ulrich, 2012).

Funding per inhabitant and per researcher was also substantially higher for the EU-15 than the EU-13 in FP6, FP7 and Horizon 2020 (Fresco et al., 2015; Arnold, 2009; European Commission, 2009; European Commission, 2016b). In 2015, funding for a signed Horizon 2020 grant per full time equivalent researcher was 4,206 euros for the EU-15 and 1,578 euros for the EU-13; per inhabitant the difference was even more remarkable with 16.0 euros per EU-15 inhabitant and 3.3 euros for the EU-13 (European Commission, 2016b).

The success rate of most EU-13 Member States is consistently lower than that of most EU-15 Member States. This is seen as a critical issue (Annerberg et al., 2010; Schuch, 2014; Titarenko & Kovalenko, 2014; European Commission, 2013; European Commission, 2016b). In FP7 no single EU-12 Member State had a success rate above the EU-15 average of 21.9 per cent compared to an average success rate of 18.5 of EU-12. LV, EE, HU, LT and the CZ were closest to the EU average, ahead of ES, LU, PT, IT, and EL. MT, PL and SK were still ahead of IT and EL, while BG, SI, CY and RO clearly lagged behind (European Commission, 2013; cit. Schuch, 2014). In all of Horizon 2020, the success rate of the EU-13 is 3.7 percentage points lower than in the EU-15 (9.7 per cent compared to 13.4 per cent) (European Commission, (2016b).

Remarkably, across all priority areas and instruments in FP6 and FP7 the average success rate of proposals by consortia that involve participants from the EU-13 (16 per cent in FP6) is comparable to that of proposals by EU-15 consortia (18 per cent in FP6) (Arnold 2009; Albrecht 2016).

EU-13 organisations do have much lower success rates as coordinators. Coordinators are capable of attracting more researchers to the FPs and receiving more European funding (Titarenko & Kovalenko, 2014). However, EU-13 participants often play a minor role in FP projects and networks (European Commission, 2015a), assuming the role of 'follower' rather than 'leader'. FP networks operate much like

any other network: they evolve slowly and new members have to demonstrate the capability and build trust before getting major roles (Arnold et al., 2009).

3.1.2. Heterogeneity of EU-13 participation

Most of the time, the EU-13 can be found at the lower end of participation rankings. Yet, some EU-13 Member States are developing quickly and have excellent research centres with cutting-edge research facilities financed via Operational Programmes. These countries are in the process of adapting the attitude of researchers and their national research systems to the international research area. This process has only begun (NCP – Academy, 2016).

Even though they have similar transformation backgrounds, the EU-13 are socioeconomically a very heterogeneous group of countries. The EU-13 exhibit pronounced differences in size, levels of economic development, general research and innovation efforts, levels of R&D expenditure, the areas of scientific excellence, degrees of internationalisation, the mobility and interaction of human resources as well as institutions responsible for policy-making in science and information services and advice on the FPs in each country (Rauch & Sommer-Ulrich, 2012; Titarenko & Kovalenko, 2014). As a result, the participation of individual EU-13 countries is also very different.

Ferligoj et al. (2011) divide the EU-13 Member States into two groups based on EU funding per successful project and EU funding per million GDP. The first group contains CY, EE, MT, and SI. The second group contains BG, CZ, HU, LT, LV, PL, RO, and SK. The European Commission (2009) distinguishes three groups of countries. SI, CY, MT and EE had levels of participation (in FP6) close to or above the EU average. CZ and HU form an 'in-between' group, while BG, LV, LT, PL, RO and SK have levels of participation significantly below the EU average.

The small states CY, EE, MT, and SI have typically high participation per million population but score lowest on EU funding per successful project, i.e. they have likely frequent participation of smaller teams. However, they simultaneously receive high EU funding per million GDP. Thus the smaller countries either perform better in terms of GDP and GERD (EE and SI) or are more attractive for researchers (CY and MT) (Titarenko & Kovalenko, 2014; cit Ferligoj et al., 2011). The R&I systems of EE and SI have some characteristics similar to those of the EU-15. Both countries possess strong human capital resources. In the Horizon 2020 Monitoring Report 2014 SI was the only New Member States that scored above the EU-28 average for R&D Intensity, and the percentage of researchers in the active population. Only CY from EU-13 was above the EU-28 average in terms of Innovation Output In the ranking of the number of FP7 participations per thousand researchers, which measures the efficiency of the national research communities in acquiring FP7 projects, EE is ranked 4th and SI 6th. EE, CY and SI are 'net recipients' in FP7 and Horizon 2020 (PROVISO 2014; Fisch 2016), receiving more than two euros for every euro spent on the Horizon 2020 budget.

CZ and HU are always among the Top 5 best performing EU-13 Member States (European Commission, 2016c). The R&I systems of CZ and HU have similar features to the first group. They are, however, less able to convert this into FP participation. Both have a good level of competitive skills and knowledge intensity in their economy.

BG, LT, LV, PL, RO, and SK score low on all indicators of funding and size. This group varies significantly as to the size of the population and research capacities. BG, RO, and SK have still a backlog regarding the size of their R&I systems. This is accompanied by rather modest FP7 participation. In addition to low levels of competitiveness and knowledge intensity in their economies, all three countries display a low level of R&D expenditures, as well as in the results of the R&D processes. Poland is partially comparable with these countries. Latvia and Lithuania show a mixed picture regarding the development of their R&I systems. International networking and knowledge transfer are similar to that of the EU-15 MS, which is not surprising based on their small size (Rauch & Sommer-Ulrich, 2012). LT, PL, and SK are among the five 'least efficient' research communities. With the exception of PL, these are countries with limited domestic (research) market sizes. This points again towards structural problems

because the 'size effect' cannot be used as a justification for these smaller countries (Schuch, 2014b). In the Horizon 2020 Monitoring Report 2014 BG, LV and HR are counted among the five weakest performing Member States. SK, RO, PL, LT and CZ are 'net contributors' (Schuch, 2014), receiving less than 0.40 euros for every euro spent on the Horizon 2020 budget (SK, PL, RO, LT) or less than one euro for every euro spent (CZ) (Fisch, 2016b).

3.2. Participation in specific areas

Aggregate levels of participation hide differences in participation within specific parts of the FPs and of specific types of organisation. Each FP has its own thematic focus in specific programmes and calls for proposals. Each FP scheme or instrument has its own eligibility and assessment criteria. The Member States vary considerably in population, levels of human capital, and GDP. Small countries are more likely to concentrate in specific areas (European Commission, 2009; Rauch & Sommer-Ulrich, 2012).

In comparison with the EU-15, EU-13 levels of participation are (Rauch & Sommer-Ulrich, 2012; Fresco et al., 2015):

- higher in projects relating to *research infrastructures*, which continues to be an area of pronounced importance for the EU-13;
- high in FP schemes that specifically target the EU-13 (e.g. FP7-REGPOT which aims at 'unlocking and developing existing or emerging excellence in the EU's convergence and outermost regions')
- lower in *cooperation projects* within large international consortia;
- lower in the thematic area of *ICT* (European Commission, 2016a);
- very low in projects of the *European Research Council* (ERC), which promote scientific excellence through competitive funding;

Similarly, the population of EU-13 organisations active in the FPs is different from that in the EU-15.
The EU-13 population tends to contain more SMEs and more public sector organisations. Fresco et al. (2015) found that the share of SMEs among the participating organisations from the EU-13 was significantly higher than in the EU-15 (24 per cent compared to 16 per cent). Universities have a limited role in EU-13 participation, accounting for 3 per cent of total FP7 funding for universities compared to 85 per cent for EU-15 universities.

3.3. The causes of low participation

There are many explanations for the underperformance of the EU-13 in the European FP. A number of key publications (the Commission monitoring reports, the Interim FP7 expert report, a report by the Members of the High Level Expert Group) have produced a long list of possible explanations. Based on this longlist we distinguish between problems related to general socioeconomic characteristics; excellence, quality, and competition; experience; networks; FPs design and governance; and other obstacles.

General socio-economic characteristics

- low focus on R&D in policy and business (Fresco et al., 2015)
- problems specific to smaller countries that cannot be competitive in all thematic fields of the FP, given that they have narrow or specified national research priorities, and that have smaller research networks and fewer research institutions (Annerberg et al., 2010)
- the intra-EU circulation of researchers who are drawn from smaller EU-13 Member States to the bigger EU-15 Member States with more research capacities (Annerberg et al., 2010)

Excellence, quality, and competition

- the high number of weak proposals submitted by, or with partners from, the EU-13 (Fresco et al., 2015), the lower success rate of projects coordinated by EU-13 organisations (European Commission, 2015a), and weak training in preparing successful proposals (Schuch, 2014)
- a lack of leading universities and research organisations (Fresco et al., 2015) and lower numbers of excellent researchers and research institutions in the EU-13 than in the EU-15 (Annerberg et al., 2010)
- insufficient motivation to participate in FP7 owing to easy availability of national research financing (European Commission, 2009; Fresco et al., 2015; Annerberg et al., 2010)

Experience

- information barriers and language barriers (European Commission, 2009; Fresco et al., 2015)
- lack of practice in project management and international projects (European Commission, 2009; Schuch, 2014)
- lack of time and personnel competent in professional and bureaucratic issues (European Commission, 2015a) and limited understanding of FP7 (Schuch, 2014)

Network formation

- lack of professional contacts and networks (European Commission, 2009; Fresco et al., 2015)

FP design and governance

- perception of high administrative burdens of FP projects (European Commission, 2009)
- a national barrier as regards staff financing (European Commission, 2015a)

Other obstacles for participation in FPs include:

- a lack of funds to initiate international meetings, to start and enhance international contacts, collaborations etcetera (European Commission, 2015a)
- a lack of options for the exploitation of research results at the national level (Schuch, 2014)

3.3.1. General socio-economic characteristics

The level of economic development of a country – as measured by the gross domestic product (GDP) – is likely to affect the amount of funding allocated to science (Potocnik, 2009; Titarenko & Kovalenko, 2014). R&D expenditures determine to a large extent the numbers of R&D personnel available and the availability and quality of the necessary infrastructure. The capacity of a country to participate in European FPs is closely connected to gross national expenditure on R&D (GERD) and the number of researchers and developers (R&D personnel). The more resources a country spends on R&D and the more R&D personnel and organisations it can afford, the more successfully it participates in the FPs (Rauch & Sommer-Ulrich, 2012). It appears plausible that the prerequisites for successful participation in the FPs – access to equipment, high-level research competences, established international contacts, familiarity with networking processes, etcetera – are more commonly found in well-developed economies (European Commission, 2009).

The Economic crisis may have structural effects on socio economic characteristics and RDI performance. The impact of the 2001 Internet bust crisis on the knowledge intensive economic activities is rather limited. Only BE, EI, IT, NL and UK show structural breaks in the economic and RDI performance indicators for the knowledge intensive economy. For the 2008 financial crises, the indicators display a different pattern. For about half of the EU countries faced structural breaks in their knowledge intensive economic activities. (Izsak et al, 2013) The study suggests that as a consequence of the crisis, and pressures on national RDI budgets, the importance of other sources has increased, include Structural Funds and other EU funding. Izsak and Radošević (2017) suggest that after the 2008 financial crisis, Central and East countries have been able to maintain levels of RDI investments due to the use of Structural Funds, while in the three Southern European countries in their sample, public support for RDI has collapsed. The three Western European countries, DE, DK and SE, have invested in RDI.

The EU-13 receives relatively more funding through the FPs than the EU-28 average when comparing FP funding to GERD. The FPs account for a significant share of gross expenditure on R&D in EU-13 countries (Fresco et al., 2015; European Commission, 2016c). They demonstrate higher levels of FP participation than would be expected based on their national R&D expenditures. This was particularly so for BG, EE, HU, LV, and SI, which had higher rates of participation and EC contributions in FP7 relative to their R&D capacity and to their R&D personnel than other EU-13 and many EU-15 Member States (Rauch & Sommer-Ulrich 2012).

Some countries (for example, CY, EE, MT) have a 'size handicap'. A lack of research capacity and a lack of critical mass of innovators form significant barriers to higher levels of participation in the FP. By limiting the number of organisations and researchers as well as the amounts of funding that can be mobilised, the small size of these countries inhibits their possibilities to participate and to be excellent in many fields (Strogylopoulos, 2015; Ruttas, 2015; Warrington, 2015). On average the EU-13 (without CY and MT) has about 245 researchers per 100,000 inhabitants compared to an average of 560 in the EU-15 (Rauch & Sommer-Ulrich, 2012). Lower numbers of R&D personnel in the EU-13 may be a reason for lower competition in the FP, fewer connections with other research communities and fewer research proposals (Titarenko & Kovalenko, 2014). Size may also partly explain why the research networks in the EU-13 are less dense and active and less effective in attracting new participants to FPs (Rauch & Sommer-Ulrich, 2012).

The most internationally oriented countries in the FPs are small EU-13 Member States whose project portfolios show a higher incidence of projects with large international networks. This indicates that indeed for EU-13 countries FP projects can provide a channel to reach knowledge sources and research infrastructures located abroad (European Commission, 2015a). The Large EU-15 Member States that have a strong national innovation system are able to access funding without establishing wide international partnerships.

Another way of looking at participation is the measure of regional concentration. Regional and institutional disparities of participants, i.e. spatial and institutional concentration of participants in more developed regions and in research stronger and larger institutions, concentration of research resources in terms of human capital, equipment, large infrastructure as well as in project management capacities through accumulation of practical experience and skills can be the most critical factors for success in EU projects. This fact is present in many countries of the EU-13.

The 2008 global financial and economic crisis has disturbed the evolution of research and innovation (R&I) policies in Europe and it continues to have significant consequences. The article „EU Research and Innovation Policies as Factors of Convergence or Divergence after the Crisis' (Izsák and Radosevic, 2016) reviews the evolution of and changes in R&I policy funding and measures before and in the aftermath of the crisis, and analyses reactions in three groups: Southern, Central-Eastern, and Northwest European country groups. Based on the analysis of the Erawatch-Trend Chart Inventory, it is shown that the crisis induced three different responses. In Northwest Europe, it induced further support for R&I activities; in Southern Europe, it led to the collapse of national public support and its substitution only to some extent by EU Structural Funds; and in Central-Eastern Europe to an apparently much stronger compensation effect. Overall, these trends suggest that R&I policies have operated as a factor of further divergence between Northwest and South, and as a potential factor of convergence between Northwest and Central-East. The above mentioned statements can affect the participation of EU-13 countries in the FPs.

3.3.2. Excellence, quality and competition

The quality of submitted proposals and the excellence of researchers and research performing organisations is a crucial issue in understanding participation in the European FPs. According to the expert analysis, lower EU-13 participation is caused not by a bias against the New Member States, but by a comparably high number of weak proposals submitted by or with partners from the EU-13 (Fresco et al., 2015).

The potentially most significant EU support measure for modernising research and innovation in the cohesion countries which can positively impact both the widening agenda and the excellence creation agenda comes from outside the Framework Programme and covers the ERDF budget earmarked for R&D. Some experts even argue that the comparatively 'easily' accessible, national administered, but EC co-financed SF/ESIF/ERDF funding might — at least initially — distract the attention of universities and research institutes (FP participants) in the cohesion countries away from the more competitive Frameworks programme (Zizalova, 2015; Kulikovskis, 2015; Paliokaite, 2015; Klincewicz, 2015; Curaj, 2015; Balaz, 2015). Synergies between FP and ERDF funding have been on many stakeholders' agenda for many years, but problems in strategically using or even aligning these schemes also have a long tradition. It is worth noting that countries such as DK, BE, IE, NL, SE and AT have received more money from FP7 than from ERDF R&D supporting activities. Not surprisingly, all these countries belong to the best-performing countries in terms of research and innovation in Europe (Schuch (2014). Schuch (2014) mentions that the relation between FP7 funding and ERDF funding for R&D is most imbalanced in LT, LV, PL, SK, and particularly in CZ, the latter having the greatest divide between a high ERDF budget and a low amount of FP7 funds received. SF/ESIF funding is attractive, relatively easy to obtain and applicants are already familiar with the logic of the application and reporting processes. Project proposals are submitted individually, without the need of an institutional consortium and collaboration with international partners. And projects are focused on developing technologies for commercial purposes rather than on pursuing research excellence. Furthermore, applicants can get help in their national language.

EU programmes often offer financially larger opportunities, longer funding and funding for activities not covered by national programmes. Most of the activities they support are similar to those supported by national programmes and the SF/ESIF. However, in small countries – such as CY, EE, MT and SI – the limited availability of national funds is conducive to the FP participation. The scarcity of local funding is a significant factor behind the interest of these countries in participating in FPs (Strogylopoulos, 2015; Ruttas, 2015; Warrington, 2015; Bucar, 2015).

Not all regions of the EU-13 are alike. Varga and Sebestyén (2016) find that in core regions of the EU-13 FP research subsidies act as a substitute for funding from other (mainly national) sources. In peripheral regions with less developed knowledge infrastructures, R&D networks funded by European FPs support the transfer of external knowledge and, thus, stimulate innovation.

Many EU-13 Member States (e.g. EE, CZ, HR, LT, PL RO, SK) have insufficient numbers of qualified research project managers, capable of managing publicly co-funded projects. Where qualified professionals are unavailable, it may be necessary to pay for project management services. The lack of permanently employed project specialists at universities and research institutes also leads to experienced scientists nominating themselves as project managers, without having the relevant managerial or organisational skills. Moreover, many researchers and business enterprises do not maintain active international collaborations and the lack of competencies necessary to form and manage partnership networks limits the involvement in collaborative projects (Ruttas, 2015; Zizalova, 2015; Racic, 2015; Paliokaite, 2015; Klincewicz, 2015; Curaj, 2015; Balaz, 2015).

The career system of researchers does not sufficiently support an orientation towards results or international projects. Some EU-13 science systems (CZ, PL, LT) do not promote quality but quantity (measurable scientific output, such as counts of publications or patents), while FP funding focuses on high-quality achievements (including research impact measured by citations and other forms of scientific recognition). Similar problems concern the commercialisation proposals by business enterprises, which often focus on solutions that are innovative only at a country level (Zizalova, 2015; Klincewicz, 2015; Paliokaite, 2015).

Some EU-13 countries (HR, LT, LV, RO, SK) recognize major problems in the area of human resources in research. The research base is not excellent and national R&D systems are fragmented, underdeveloped and undernourished. Many researchers and research groups are not internationally competitive and lag

behind in scientific knowledge, advances and competences. EU-13 researchers often still adopt the 'outsider' role, at least when they negotiate their position in the project and when they evaluate their scientific competences (Racic, 2015; Paliokaite, 2015; Kulikovskis, 2015; Curaj, 2015; Balaz, 2015). In addition, a considerable number of EU-13 countries is struggling with the language barrier. Some small countries like CY and MT have long traditional relations with the UK and other EU countries and have an excellent command of the English language, making it easier to write proposals and communicate internationally.

A result of the abovementioned problems is that submitted proposals tend to have low quality. Moreover, in some countries (CY, SK, BG) services for proposal preparation are insufficient. Many countries support the introduction of financial instruments for proposal drafting and training events relating to proposals preparation and evaluation (Balaz, 2015; Strogylopoulos, 2015; Todorova, 2015).

3.3.3. Experience

Experience is key in improving the participation of EU-13 organisations. As Rauch and Sommer-Ulrich (2012) explain: 'The more often institutions participate in the Framework Programme, the more likely is repeated participation. Repeated participation and the assumption of a project-coordinating role lead to higher levels of participation in the future'.

The majority of participants in FP2 thru FP7 are newcomers of which almost two-thirds (63.3 per cent) are firms (Protogerou, Caloghirou and Siokas 2013). On average, about one quarter of participants also took part in a previous FP. In FP6 the share of these 'returners' was higher than in all previous FPs. In FP7 their share was about 50 per cent of all participants. Yet, the FP7 data in Table 1 is based only on the first years of FP7 (2007-2009). Protogerou et al. (2013) suggest that this 'indicates that organisations with previous experience in FPs are better prepared to participate in the next ones early enough.'

Table 1. Newcomers and returners among the participants of FP2 thru FP7 (per cent)
Source: Protogerou, Caloghirou and Siokas (2013), figure 2, p. 884.

	FP2	FP3	FP4	FP5	FP6	FP7
Newcomers	86.1	74.5	81.3	81.0	71.8	49.7
Returners	14.0	25.6	18.7	18.9	28.2	50.3
Total	100	100	100	100	100	100

Enger and Castellacci (2016) searched for the drivers of participation and grant success in Horizon 2020 among Norwegian research organisations. Their findings indicate that prior participation in European FPs (experience) is a strong determinant for the propensity to apply for Horizon 2020 funding and for grant success. Success is also determined by the scientific reputation of the applicant. An organisation's willingness to submit a proposal is also dependent on the availability of alternative national funding schemes.

Low coordination activity by EU-13 institutions is attributed to insufficient technical and managerial coordination capacities and poor management skills (Rauch & Sommer-Ulrich, 2012). EU projects have become large or very large projects with many partners organised in consortiums. They require increasingly complex and sophisticated management skills and knowledge which late-comers can hardly acquire and catch up with competitors from scientifically more advanced countries. Repeated participation will help improve coordination skills.

Many research organisations are insufficiently familiar with the FP, insufficiently informed about calls for proposals and opportunities for participants, and insufficiently aware of what participation actually entails (Todorova, 2015; Zizalova, 2015; Hegyi, 2015; Kulikovskis, 2015; Curaj, 2015; Balaz, 2015). The quality and timeliness of information are especially an issue in BG, CZ, HU, LV, RO, SK. In small countries such as CY, EE, and MT this lack of information is not so evident and high levels of awareness,

as well as a high level of interest in the FPs, are the main drivers of higher participation (Strogylopoulos, 2015; Ruttas, 2015; Warrington, 2015).

Participation in FP schemes is dependent on previous participation as a beneficiary or as an evaluator of projects. Such experience helps prepare better applications in subsequent calls for proposals. Even though many experts from the EU-13 have acted as FP evaluators in the past, there is no matching mechanism that would allow potential applicants to benefit from the knowledge and experiences of people who have evaluated proposals in previous calls.

EU-13 applicants often do not have adequate representation on the European level. Such representation could support their application efforts, help them participate in consulting FP work programmes or offer practical advice concerning projects. Some interviewees see this lack of 'science-oriented lobbying' in Brussels as the source of a Horizon 2020 work programme that is in their view biased against project proponents from Central and Eastern Europe and promotes the interests of more experienced applicants from Western European countries. The low visibility of EU-13 researchers at congresses and workshops negatively affects the overall image of research in EU-13 and thus contributes to the low institutional rate of success.

3.3.4. Network formation

Participation in the European FPs depends at least as much on an organisation's network as on the quality of its research capacity. A lack of contacts and professional networks was the 'single most important barrier' in FP6 (European Commission, 2009). Participation in collaborative projects in FP7 and H2020 requires mature collaboration with international partners. Many EU-13 teams have limited networks and few links to foreign organisations and researchers. This is a disadvantage in creating opportunities for calls and for finding relevant partners.

The European Framework Programmes provides opportunities for a wide variety of organisations from many different countries (from within and outside the Union) to collaborate on an enormous range of technological, socioeconomic, and other subjects. The FPs also have a very distinct geographic effect. Various researchers have examined the geography of European innovation that emerged from the FP. An important finding of various publications is that the Framework Programme drives the formation of a network and its structural properties shape the geography of innovation (see the publications of Scherngell, Barber, and Lata; Balland, Suire & Vicente 2013).

Proximity is a strong driver of collaboration in R&D. Various authors have examined European FP networks and found that geographical proximity continues to have a significant effect on patterns of R&D collaborations in Europe, even though European integration is lowering territorial borders (e.g. Hoekman et al. 2010; Scherngell and Barber 2009). In this context, it is important to note that the EU-15 itself has not yet become integrated into a single European Research Area (Chessa et al. 2013).

The FPs appear to be a strong force in the integration of European R&D. The accession of the New Member States in 2004 and 2007 appears to have resulted in an increase in co-publication among the EU-12 themselves and between the EU-15 and the EU-13 (Makkonen and Mitze 2016). Heringa et al. (2016a, 2016b) show that social, organisational, and geographic proximity have a positive impact on collaboration in water-related FP projects from FP1 thru FP8, even though half of the collaborating partners are not proximate in any of these dimensions. Lata, Scherngell & Brenner (2015) find that geographical integration is higher in the FP network than in the co-publication and co-patenting networks. The negative effect of geographic distance and national borders on collaboration in FP projects is gradually diminishing (Hoekman, Frenken and Tijssen 2010, Scherngell & Lata 2013).

The effects need not occur immediately or in the short term. Defazio, Lockett & Wright (2009) see R&D funding in the European FPs as an incentive for collaboration. They analysed the scientific publications of 296 senior researchers who were active in 39 projects in the Research Training Network Programme of FP4. Defazio et al. conclude that funding has a stronger direct effect on researcher productivity than

collaboration; that collaboration only has a (positive) effect of collaboration after funding ends; and that collaborations established after funding ends have a stronger impact on productivity. Funding opportunities can be seen as an important promoter of effective collaborations in the longer run.

Many EU-13 countries are small and their companies are not well-known in Europe. This creates a difficulty in finding consortium partners. Most of the already formed consortia are not willing to open up to new partners (Zizalova, 2015; Racic, 2015; Paliokaite, 2015; Klincewicz, 2015; Curaj, 2015). Among countries that joined the EU later (BG, HR, RO), there is a perception that FPs only allow for 'closed club membership' (Todorova, 2015; Racic, 2015; Curaj, 2015), which is a significant negative factor for R&I performers to participate.

The lack of international connections, networking and integration needed for engagement in the FP projects is particularly evident in some states (CZ, HR, LT, PL, RO). There is a feeling that applications in Horizon 2020 are simply hopeless. Many applicants from the EU-13 do not want to look for more difficult sources of financing abroad, especially when ESIF funding is so much easier to obtain (Zizalova, 2015; Racic, 2015; Paliokaite, 2015; Klincewicz, 2015; Curaj, 2015).

Existing networks constitute barriers to entry. These networks tend to be dominated by research performing organisations from the large countries. It is sometimes argued that this constitutes a kind of 'closed shop', which newcomers can find difficult to enter (European Union, 2011). A study by European Commission (2015) reported that some respondents highlight the existence of lobbies of countries or organisations formed in previous successful projects that create 'entry barriers' that are difficult to penetrate (European Commission, 2015a). The clustering of activity in existing networks can be seen in the concentration of activity. Since the beginning of FP6 a significant institutional concentration of participants in the EU R&I Framework Programmes can be observed. Currently, 500 organisations among more than 13,000 beneficiaries have received about 58 per cent of Horizon 2020 financing.

3.3.5. The 'Matthew Effect'

The networks that emerge in European FPs have been accurately described as 'the result of self-organized partnering by different participating entities (industry, universities, research centres and technology users) in subsidized research joint ventures selected on a competitive basis under the thematic priorities and funding rules imposed by the European Union.' (Protogerou, Caloghirou and Siokas 2013) The FPs form framework but do not enforce decisions on who will form consortia and win competitive calls for proposals. The scientific literature indicates that patterns of participation are subject to the so-called 'Matthew Effect'. Loosely translated, this means that those who participate a lot will accumulate more participations in the future than those who participate less. Experience and network position reinforce participation.

Researchers found a heavy concentration of resources in a small group of elite universities in FP6 and FP7. Lepori et al. (2015) studied the participation of 2,235 higher education institutions in 30 European countries. They found that about 150 universities accounted for c. 70 per cent of total participations in FP7 in 2011. Henriques, Schoen, and Pontikakis (2009) found a similar concentration of participations, FP funding, and publications among the top-171 universities participating in FP6.

The probability of university participation is mainly determined by the size and scientific productivity (Geuna 1998) and by university reputation (Lepori et al. 2015; Henriques, Schoen, and Pontikakis (2009). Geuna also observed that universities that have experience with competitive research funding are more likely to participate and that early entrants into the FPs are more likely to participate repeatedly.

This effect was also later found by Breschi and Cusmano (2004; see also Laudel 2006). They found that the R&D network that emerged from consecutive FPs is dominated by an 'oligarchic core' that has strengthened its position over time. The EU has actively supported the growth of this core, at least since FP6. Crucial participants and centres of excellence were to become the backbone of a European Research

Area and 'catalysts for smaller components or backward areas.' Breschi and Cusmano (2004) identify three layers of participation in the European FPs:

1. the Prime Contractors that participate very frequently and are highly interconnected, thus forming the 'oligarchic core';
2. a small group of frequent, low-profile participants who use the FPs to connect to leading actors; and
3. an extremely large group of incidental participants.

They found evidence of preferential attachment, which means that organisations with a large number of prior connections tend to acquire a disproportionate number of new connections. This 'Matthew Effect' strengthens the core.

The 'Matthew Effect' has been observed by a number of researchers. In their attempt to predict EU-13 participation of higher education institutions from their characteristics (such as size, PhD-granting status, reputation, country of location), Lepori et al. (2015) found that reputation is a crucial determinant. More importantly, in a networked environment reputation reinforces the position of institutions that already have a high reputation.

> 'While the grant selection process is a rather uncertain process where quality is contested and there are wide variations in the extent reputation determines the selection outcome […], the creation of network ties is more systematically associated with reputation, leading to a stronger association between reputation and acquisition of grants than for individual projects.' (p. 2175)

Like Lepori et al., Henriques, Schoen, and Pontikakis (2009) conclude that the participation of top universities is driven primarily by excellence rather than by country-specific economic or political factors. In their formulation of the theoretical expectation underlying this conclusion, is further evidence for a cumulative advantage for the core of elite universities:

> 'Given that individual proposals are evaluated on the basis of scientific merit and technological soundness, scientifically excellent universities should be highly sought partners. Networks formed during the application stage favour universities with distinguished research records as these should maximise the probability of a grant. It is therefore reasonable to expect that the number of FP partners each university attracts is linked to its overall scientific standing. It follows that universities with high research output and high visibility scientific research […] might become central FP actors, in terms of linking to a greater number of organisations. Centrality in those networks is both an important outcome of FP participation in itself (as can signal willingness to lead) and a determinant of further FP participation.' (p. 17)

Primeri and Reale (2012) investigate the effect of European FPs at the micro-level of university departments and research groups. They find that the FP strengthens those who are already competitive in EU R&D. A consequence of this effect is the exclusion of less experienced departments and research groups. Hoekman, Frenken and Van Oort (2009) observe that elite researchers are remarkably concentrated in specific regions, have better access to resources than non-elite researchers, and are more likely to work with other elite researchers 'since they learn much more from fellow elite researchers than from those less advanced.' (Hoekman, Frenken & Van Oort 2009, p. 724) Gazni & Thelwall (2015) find that „top institutions have more rapidly increased the proportion of their research that is collaborative' and „collaborate increasingly outside of the top 100 institutions, even though they cite increasingly inside of the top 100'.

Looking back at these observations, we may question whether the addition of the ERC in FP7 and H2020 represents a competitive advantage for more experienced EU-15 universities, particularly those that entered early.

The concentration of resources in a strong, excellent core whose competition position is reinforced through continued participation is problematic for organisations and countries that are currently excluded. This private cost may be offset by the benefits of R&D network formation for the entire EU. Breschi et al. (2009) looked back at the networks created in FP6 and found that the FPs – through its integrated projects and networks of excellence – attracted key industry actors and improved connectivity with the FP network. They argued in favour of attracting new European organisation into the 'oligarchic

core' as well as to attract technologically dynamic SMEs. New instruments introduced in FP6, particularly the Network of Excellence, were not necessary to strengthen the collaborative backbone of ERA. The 'oligarchic core' had already emerged from the early FPs, especially during FP3 and FP4.

3.3.6. Costs

Low financial contribution is partly due to lower costs of researchers in the EU-13 as well as to a limited number of coordinators (Ferligoj et al., 2011). The lack of experience of EU-13 participants in the FP limits the importance of their role in many projects. This is reflected in their 'lower than expected' share in the lucrative coordinator positions (Arnold et al., 2009). Moreover, coordinators involve other research institutions from within their own countries in the project and receive (expenditure-driven) higher EC contributions (Rauch & Sommer-Ulrich, 2012).

Differential wage levels between countries and a lack of organisational motivation due to the rules that govern the calculation personnel costs are very problematic for EU-13 countries. The salary 'gap' (which is related to the 'brain-drain' problem) is visible throughout the economy and also affects researchers. This problem is felt especially in BG, RO and SK (Todorova, 2015; Curaj, 2015; Balaz, 2015).

The problem persists in Horizon 2020. The new remuneration rules are a key factor in discouraging newcomers from the EU-13. According to present NCP Academy project results some parts of the new remuneration system in H2020 seem incompatible with some established national remuneration systems and raises a number of issues with regard to practical implementation. (NCP – Academy, 2016).

3.3.7. FP design and governance

Attitudes to EU-13 participation in the FPs have changed over time. When FP6 was being implemented, just before the 2004 enlargement, the Commission explicitly stressed the need of specific actions aimed at integrating the candidate countries into the European research system. Unlike FP6, FP7 and Horizon 2020 had no explicit objective regarding EU-13 participation.

Applicants from many EU-13 countries tend to believe that EU-level programmes are very administratively demanding and time-consuming and that Horizon 2020 applications are more difficult than the preparation of comparable documents for ESIF/SF. The experience of the interviewed stakeholders from CZ and PL reveals otherwise. The majority of interviewed representatives of research organisations that have experience with FP7 and Horizon 2020 declare that the administrative burden of these programmes is significantly lower than that of the SF programme. They also mention that the rules are less complicated and less arbitrary. Hence, the implementation of FP projects is relatively easier, even though the competition is fierce (Zizalova, 2015; Klincewicz, 2015). According to some experts, a related and more common barrier to FP participation is the administrative and teaching work overload for research staff, especially at universities (Racic, 2015; Paliokaite, 2015; Bucar, 2015).

3.3.8. Support infrastructure

One of the key problems concerns information, communication, advice and training. In some countries, the information and communication systems, notably the National Contact Points, are not working as well as they should (Strogylopoulos, 2015; Ruttas, 2015; Warrington, 2015). This is a major problem since there is ample evidence that countries with strong support systems have been very effective in building their participation. Such systems not only provide information on funding opportunities in the Framework Programme but also support potential applicants in the search for partners as well as helping with the preparation of proposals (European Union, 2011).

The countries that acceded in 2007 and 2013 (BG, HR, RO) particularly suffer from the poor quality of NCP support for potential programme applicants. These NCP networks have insufficient human resources and often provide poor quality, contradictory and incomplete information (Todorova, 2015;

Racic, 2015; Curaj, 2015). Conversely, the quality of NCP systems, advisory services and the pro-active approach of NCPs are evaluated positively in countries such as CY, EE, and MT.

3.4. Foregoing recommendations on policy measures

The challenge of boosting the FP success rates of EU-13 Member States is not the same for all of them. Since these new Member States are highly diverse, the practical goal for national policy-makers and NCPs in these countries might be to make progress and catch up with good practices within the EU-13, a group which has its own leaders and followers (Titarenko & Kovalenko, 2014).

Disparate success rates of the EU-13 and EU-15 in FPs are an exacerbating problem stemming from objective reasons such as lower expenditures on R&D in the country or a smaller number of institutions with previous experience of participating in the FPs and smaller numbers of research personnel. While in the countries where there are more FP coordinators and partners, research networks tend to grow, as a rule, and the excellence of research tends to increase, it will be more difficult for countries with fewer FP partners and coordinators (Titarenko & Kovalenko, 2014).

From a macro-level perspective, the performance of individual EU Member States in the FPs was strongly related to national R&D investments. A strong national R&I system and higher investments in R&D capacity are considered basic requirements for improved participation in the EU Framework Programmes (Fresco et al., 2015; Rauch & Sommer-Ulrich 2012). The High Level Expert Group suggests strong efforts to use Structural Funds for excellence-driven capacity building in the EU-13 and to dedicate a specific fund for this purpose (Fresco et al., 2015).

Rauch and Sommer-Ulrich (2012) identify four basic requirements for successful participation:

1. **Scientific excellence**: The higher the recognition of the research achievements of researchers of a given country by the international scientific community, the more successful the participation.
2. **Connectivity**: The more widespread the national and transnational networking between research institutions of a country, the more successful the participation.
3. **Experience and management skills**: The more often institutions participate in the Framework Programme, the more likely is repeated participation. Repeated participation and project coordination lead to higher levels of participation in the future. Coordinators involve other research institutions from their own countries in their projects and receive (expenditure-driven) higher EC contributions.
4. **R&D financing**: The larger the financial resources for researchers, the more successful the participation.

In addition to these general recommendations, more specific recommendations have been formulated, for example in the Common Position Paper of the EU-13 Member States for the next Framework Programme - FP7 (2011) and in the report by Rauch and Sommer-Ulrich (2012). These recommendations include:

- lobbying on the national and EU level for national research interests and for a greater share of project evaluators from EU-13;
- creating regional Centres of Excellence and interdisciplinary groups which would attract scholars from EU-15 and expand research networks;
- supporting young researchers' careers and Special actions for smaller countries such as for example making connections to the top research European institutions;
- inviting top researchers as experts and advisers for developing national research structures, organising mobility and experience sharing schemes;
- concentrating on a few research priorities among the broad list of priorities developed by the European Commission;
- introducing more competitive national research funding, so that researchers develop the skills of proposal writing;

- fostering national FP Coordinators, because coordinators have higher benefits per project but have to assume the responsibility for developing the proposal and management.
- enhancing cooperation with business (the 'triple helix' of universities – industry – government) as well as the links between the social and natural sciences, which improves the environment for knowledge-intensive SME and enhances the impact of interdisciplinary research produced in the European research projects.

3.5. Previous FP projects addressing the low participation of EU-13

The Framework Programmes have always contained funding schemes aimed at stimulating the participation of certain groups of potential participants. Typical examples are Accompanying Measures in FP5, Specific Support Actions (SSA) in FP6, and Coordination and Support Actions in FP7 and H2020. These actions do not cover the research itself, but the coordination and networking of projects, programmes and policies, dissemination of knowledge, studies of expert groups assisting the implementation of the FPs etcetera. Where such projects were aimed at the inclusion of the EU-13, their results create an important source of information for resolving the low participation of the EU-13 in the FPs.

The support action projects usually accept low EU-13 participation in the FPs and try to create a 'tool' that might enhance the involvement of EU-13 teams into the consortia solving the FP research projects. The typical 'tool' is a network helping potential participants to join or create a successful consortium. The networks are composed either of experts who know a specific research field or technology sector or of the sectoral National Contact Points (NCPs) who are able to help with formal issues of the prepared project proposal. Another tool is based on creating a specific 'map' of a research sector or creating publicly available software to help with partner search when a consortium aimed at submitting a project proposal being formed.

It is rather difficult to present an exhaustive list of the FP5, FP6, FP7 and H2020 projects focused on improving the participation of the EU-13 in these programmes. A lot of these projects develop tools that are not restricted to use by the EU-13, but that can be implemented on a European scale. In Table 2 we present a summary list of relevant FP6 and FP7 projects.

Table 2. Summary of FP6 and FP7 projects focused also on improving the EU-13 participation in FPs

Project acronym	Objective	Target population
SMES GO HEALTH	addressing the low participation of SMEs in FP7, especially in the New Member States and Associated Candidate Countries	SMEs, Health
PROCEED	analyse compliance with EU rules in the New Member States of East Central Europe (CEECs) after their accession	New Member States, CEECs
GRINCOH	establish development scenarios for CEECs up to 2020 under different assumptions of political frameworks, institutional conditions and development strategies; identify the implications for sustainable growth and greater economic, social and territorial cohesion; and advise on future policy options, especially for EU Cohesion policy	CEECs
DCI	develop a 'Development capacity Index' (DCI) for biotech companies in the New Member States, highlighting the growth potential of healthcare biotech	New Member States, biotech
ENFUGEN	promote the use of fuel cells and hydrogen in certain eastern European countries; investigate the current state of affairs, consider needs and barriers, and create a collaborative environment as well as guidelines	New Member States, associated candidate countries, energy
IDEALIST	stimulate, encourage and facilitate the participation in current and future Community ICT research of organisations of all types with a special focus on newcomers and SMEs, including organisations from NMS, and some other countries from broader European and non-European Countries with high technical and economic potential	newcomers, SMEs, EU, non-EU, New Member States, ICT

STAR-NET	work towards the formation and development of a consolidated structure for support of organisations in all NMS (and AC) for participation in IST activities, building on the knowledge, tools and services developed within some of the most relevant IST support actions over the recent years	New Member States, associated candidate countries, Information Society Technologies
COMIST	increase participation of NMS and ACC organisations in IST activities in eWork according to a systemic innovation approach	New Member States, associated candidate countries, Information Society Technologies
FIT FOR HEALTH	sustainably enhance the participation of European small or medium-sized enterprises in Calls for the FP7 Health Theme; strong emphasis on high leverage support for SMEs in the New Member States and Acceding and Candidate Countries	SMEs, Health, New Member States, associated candidate countries
EURORIS-NET	provide support through the Research Infrastructures NCPs network for the efficient implementation of the RIs Programme and to promote the best possible utilization of RIs, so that 'economies of scale' could be achieved at European level, capabilities increased and European Research Area and the EU competitiveness strengthened	Research Infrastructures, EU
BEWARE	support potential coordinators and potential partners in future R&D projects in the field of Aeronautics and Air Transport of Horizon 2020 in identifying innovation opportunities and building international teams and consortiums; to increase the participation of Eastern European regions in pan-European research activities through Horizon 2020 in the field of Aeronautics and Air Transport	aeronautics; EU and Eastern Europe
PROCEED	enhance the uptake of research results and foster the participation of CEEC in EU-funded research projects through S&T cooperation with other European partners	environmental research, CEECs
ENVIMPACT	enrich the EU knowledge base with the environment-related results of the CEE researchers, thus inducing new collaborations under FP7/FP8 which may lead to innovative solutions for the lasting protection of our environment	environment, CEECs
TransNEW	supporting transport research activities in the New Member States	transport, New Member States
NET4SOCIETY	analyse reasons for the low participation and success rates of EU-13 and produced a report with recommendations on how national policy-makers and NCPs can support the better inclusion of researchers from these countries, particularly in the Social Sciences and Humanities	Social Sciences and Humanities, EU-13
MIRRIS	encourage a better exploitation of European research and innovation programmes and a larger participation in the European Research Area of the EU-13	EU R&I programmes, EU-13
DANUBE-INCO.NET	supporting the non-EU countries of the Danube region in developing transnational cooperation of national programmes and research infrastructures, creating joint programmes in matching (EU-country) priority areas, tackling the problem of SME participation in the H2020, and raising the effectivity of the national research systems	Danube Region, Knowledge Society, Competitiveness

The NET4SOCIETY project concludes that improving success rates of EU-13 scholars requires paying more attention to boosting research networks and providing support for professional proposal writing. Poor networks and scarce coordinators are the main perceived difficulties encountered by EU-13 scholars. Almost 50 per cent of them indicate that their expertise is not sufficiently known to European

partners. Every fifth respondent has a network of collaborators but lacks a coordinator who might be able to unite them into a project.

The MIRRIS project examined the 'cultural factors' that hamper EU-13 participation in the FP. EU-13 organisations and stakeholders:

- have the unrealistic expectation that participation in the FPs will solve the problem of low researcher wages;
- consider themselves victims of EU-15 dominance;
- prefer using ESIF over FP funding, because ESIF is the easiest way of ensuring the financial sustainability of the participating organisations; and
- have an underdeveloped attitude towards modernisation, which means that they lack a competitive spirit or a stimulus for excellence, that research is expected to produce ready-to-use solutions, that there is little interest in open dialogue, brainstorming, creative discussions, and that the communication flow among national agencies, ministries and key players is based on highly hierarchical approach.

MIRRIS has also produced a catalogue of recommendations to improve EU-13 participation. These recommendations informed part of the questionnaire that was distributed in this STOA study in order to get insight in the perception of their relevance by the research community.

A highly relevant recommendation was produced by the DANUBE-INCO.NET project. In order to raise the effectiveness of national research systems, EU-13 governments should develop and implement research-performance-based funding that will ensure a good balance of competitive and institutional public funding. This funding should enhance the concentration of resources in the best performing organisations, which includes a suitable level of organisational funding in order to secure continuity of research efforts in strategic fields.

The participation of EU-13 organisations in FP6, FP7, and Horizon 2020 has remained unchanged, notwithstanding investments in these and other FP projects. This calls into question the effectiveness of this type of support action projects as well as their relevance for increasing the EU-13 participation in the FPs.

4. Analysis of EU-13 participation in FP7 and Horizon 2020

In this section, we analyse the data on the participation of organisations from EU-13 and EU-15 Member States in FP7 and Horizon 2020. The statistical information concerns (1) participation, (2) the characteristics of project consortia, and (3) financial contributions. The analysis is comparative, using the EU-15 as a benchmark. We normalise for country size using population, the number of researchers, and gross expenditure on R&D. Results are shown for regional aggregates (EU-13 and EU-15) as well as for the individual Member States.

The analysis of EU Member State participation in the Framework Programmes is based on the EC's official data on FP projects. These data are contained in the E-CORDA database and available online in an abbreviated form on the European Open Data Portal. E-CORDA provides information on projects as well as proposals. The European Open Data Portal provides summary data for funded projects and participating organisations from FP1 until Horizon 2020. The Horizon 2020 data concern the first 9,055 projects granted in 2014 and 2015.

The information contained in the databases was cleaned, harmonised, and classified. Where different names were used to indicate one and the same organisation, a unique name was assigned to that organisation. Where information was missing, for example on the country of location, this information was added. The wide diversity of FP funding schemes was classified into a limited number of homogeneous groups to facilitate analysis.

4.1. Participation

The analysis of participation concerns:

- the number of projects involving participants from each Member State (projects with multiple participants from one country are counted as one);
- the number of projects as participant and as coordinator;
- participation per type of organisation; and
- participation per funding instrument.

'Participation' is defined as one organisation taking part in one project. A project consisting of 10 consortium partners equals 10 participations. One organisation that takes part in 50 projects accounts for 50 participations.

An 'organisation' is a legal entity as recorded in the EU FP databases (CORDIS and E-CORDA). Some organisations consist of multiple institutes and locations. For example, CNRS consists of over a thousand 'unités de recherche et de service' (950 joint research units, 133 service units and 33 intramural research units) that are spread out across all of France. Nevertheless, in the FP databases CNRS is registered as a single organisation. It is not possible to consistently identify subunits of each organisation in the EU databases.

4.1.1. Number of participations in FP7 and H2020

Tables 3 and 4 provide a summary overview of numbers of projects in which organisations from EU-13 and EU-15 countries in FP7 and Horizon 2020 participate.

In FP7 about 21 per cent of all projects involved at least one EU-13 organisation. In Horizon 2020 this percentage had fallen to about 17 per cent. On the other hand, about 90 per cent of all projects involve one or more organisations from the EU-15. The most frequent EU-13 participants are CZ, HU, PL, RO, and SI.

Of all the organisations active in FP7 and Horizon 2020 about 13 per cent was located in the EU-13. Yet, EU-13 organisations were responsible for 9 to 10 per cent of FP7 and Horizon 2020 participations. Only

CZ, HU, and PL accounted for more than one per cent of EU participations in FP7; in Horizon 2020 RO and SI also accounted for more than one per cent of EU participations.

In FP7, the average EU-13 organisation took part in just over three projects compared to five projects for the average EU-15 organisation. In Horizon 2020 these averages were approximately two and three projects respectively. EU-13 organisations have two participations for every three participations of EU-15 organisations. In FP7, the most active EU-13 organisations came from CY, CZ, HU, MT, PL and SI. In Horizon 2020 the most active EU-13 organisations came from CY, CZ, EE, MT, and SI.

It follows from the Table 3 that out of the 10 683 EU-13 participations in the FP7 only 1 067 participations, i.e. less than 10 per cent, were in the position of coordinator. The corresponding number for EU-15 are 105 608 and 22 594, i.e. 21 per cent of EU-15 participations were performed as coordinators. Table 4 indicates that the ratio of EU-13 coordinators has slightly risen: there are 14.7 per cent coordinations out of the 3 163 participations. In the EU-15 the ratio of coordinations is 22 per cent, i.e. similar as in FP7. In FP7, CY, EE, HR, HU, MT, and PL coordinated more than 10 per cent of their projects; in Horizon 2020, CY, EE, HU, LT, PL, and SI coordinated more than 15 per cent of their projects, with EE coordinating 30 per cent.

Coordinators play a key role in creating consortia, in developing the body of proposals and in running the projects once they have been granted. Coordinators take a much larger share of the workload and budget.

Many ERC and MSCA projects are individual, involving a single organisation that is also the coordinator. In Horizon 2020 the nature of ERC and MSCA projects has changed in such way that an analysis of the role of coordinators in similar types of projects produces highly different results. This is why we focus on (R)IA and CSA projects, which are comparable across FP7 and Horizon 2020 and are (virtually) always collaborative. Table 5 presents the results.

Organisations from the EU-15 coordinated about 93 per cent of the innovative projects (IA/RIA) and about 75 per cent of the CSA projects in which they were involved. EU-13 organisations coordinate a mere 2 per cent of their innovative projects in FP7 and Horizon 2020. Coordination of CSA projects by EU-13 organisations increased from almost 9 per cent in FP7 to 18 per cent in Horizon 2020.

CY, EE, HU, and SI coordinated above-average and increasing percentage shares of their innovative projects. LT and LV coordinated more than the average share of projects in FP7 but none in Horizon 2020. Even Portugal, the EU-15 Member State with the lowest percentage share of coordinated projects, coordinated more of its projects than all EU-13 Member States.

In FP7 CY, HR, and PL coordinated more than 10 per cent of their CSA projects. In Horizon 2020, every EU-13 Member State except for BG coordinated more than 10 per cent of their CSA projects. CY, EE, LV, MT, PL, and SK experienced the strongest increase in the share of their coordinated projects. Except for PL, these countries coordinated between 20 and 30 per cent of their projects.

Table 3. Participation in FP7 by EU Member State
Source: CORDIS data made available via the EU Open Data Portal (September 2016).
Notes to the aggregates for EU-15 and EU-13 in column 2 and 3: Since multiple countries were represented in FP7 projects the aggregates (sum and percentage shares) for EU-15 and EU-13 are calculated based on the representation of at least one country from the respective group in the project. If at least one EU-15 country is represented in the FP7 project, the project is counted as a project involving organisation from the EU-15 country. The same holds true for EU-13 countries. This means, that the sum of a number of projects (column 1) and the sum of percentages shares (column 2) for individual countries does not equal to the aggregates for the group of EU-15 countries and EU-13 countries respectively. Also, the sum of a number of projects and percentages shares for the two groups of countries cannot equal the total numbers for EU-28.

	Number of **projects** involving organisations from the country	Member States percentage share in total projects	Number of unique **organisations** involved in FP projects	Distribution of organisations among Member States	Number of project **participations**	Distribution of participations among Member States	Average number of project participations per organisation	Project participations as coordinator	Percentage of project participations as coordinator
EU-15	**22849**	**89.2%**	**20903**	**86.7%**	**105608**	**90.8%**	**5.1**	**22594**	**21.4%**
AT	2401	9.4%	751	3.1%	3398	2.9%	4.5	693	20.4%
BE	3796	14.8%	1154	4.8%	5660	4.9%	4.9	959	16.9%
DE	8733	34.1%	3610	15.0%	17638	15.2%	4.9	3294	18.7%
DK	2000	7.8%	596	2.5%	2733	2.4%	4.6	535	19.6%
EL	2468	9.6%	610	2.5%	3705	3.2%	6.1	682	18.4%
ES	6320	24.7%	2590	10.7%	11219	9.6%	4.3	2466	22.0%
FI	1747	6.8%	502	2.1%	2545	2.2%	5.1	367	14.4%
FR	7131	27.8%	2396	9.9%	12632	10.9%	5.3	2771	21.9%
IE	1463	5.7%	431	1.8%	1945	1.7%	4.5	470	24.2%
IT	6185	24.2%	2442	10.1%	11715	10.1%	4.8	2046	17.5%
LU	212	0.8%	70	0.3%	243	0.2%	3.5	32	13.2%
NL	4982	19.5%	1491	6.2%	7927	6.8%	5.3	1731	21.8%
PT	1666	6.5%	555	2.3%	2349	2.0%	4.2	353	15.0%
SE	3042	11.9%	864	3.6%	4472	3.8%	5.2	756	16.9%
UK	10368	40.5%	2841	11.8%	17427	15.0%	6.1	5439	31.2%
EU-13	**5383**	**21.0%**	**3212**	**13.3%**	**10683**	**9.2%**	**3.3**	**1067**	**10.0%**
BG	535	2.1%	270	1.1%	698	0.6%	2.6	49	7.0%
CY	392	1.5%	120	0.5%	461	0.4%	3.8	78	16.9%
CZ	1126	4.4%	388	1.6%	1389	1.2%	3.6	127	9.1%
EE	452	1.8%	159	0.7%	545	0.5%	3.4	60	11.0%
HR	315	1.2%	166	0.7%	407	0.3%	2.5	43	10.6%
HU	1179	4.6%	394	1.6%	1592	1.4%	4.0	218	13.7%
LT	321	1.3%	144	0.6%	416	0.4%	2.9	28	6.7%
LV	236	0.9%	96	0.4%	332	0.3%	3.5	29	8.7%
MT	157	0.6%	50	0.2%	191	0.2%	3.8	26	13.6%
PL	1699	6.6%	597	2.5%	2183	1.9%	3.7	246	11.3%

RO	839	3.3%	378	1.6%	1071	0.9%	2.8	63	5.9%
SI	719	2.8%	259	1.1%	921	0.8%	3.6	59	6.4%
SK	380	1.5%	191	0.8%	477	0.4%	2.5	41	8.6%
EU-28	**25607**	**100%**	**24115**	**100%**	**116291**	**100%**	**4.8**	**23661**	**20.3%**

Table 4. Participation in Horizon 2020 by EU Member State

Source: CORDIS data made available via the EU Open Data Portal (September 2016).

Notes to the aggregates for EU-15 and EU-13 in column 2 and 3: Since multiple countries were represented in Horizon 2020 projects the aggregates (sum and percentage shares) for EU-15 and EU-13 are calculated based on the representation of at least one country from the respective group in the project. If at least one EU-15 country is represented in the Horizon 2020 project, the project is counted as a project involving organisation from the EU-15 country. The same holds true for EU-13 countries. This means, that the sum of a number of projects (column 1) and the sum of percentages shares (column 2) for individual countries does not equal to the aggregates for the group of EU-15 countries and EU-13 countries respectively. Also, the sum of a number of projects and percentages shares for the two groups of countries cannot equal the total numbers for EU-28.

	Number of projects involving organisations from the country	Member States percentage share in total projects	Number of unique organisations involved in FP projects	Distribution of organisations among Member States	Number of project participations	Distribution of participations among Member States	Average number of project participations per organisation	Project participations as coordinator	Percentage of project participations as coordinator
EU-15	**8224**	**90.8%**	**10640**	**86.4%**	**30239**	**90.4%**	**2.8**	**6805**	**22.5%**
AT	741	8.2%	374	3.0%	1043	3.1%	2.8	186	17.8%
BE	1075	11.9%	587	4.8%	1579	4.7%	2.7	246	15.6%
DE	2526	27.9%	1655	13.4%	4743	14.2%	2.9	843	17.8%
DK	649	7.2%	285	2.3%	850	2.5%	3.0	262	30.8%
EL	668	7.4%	317	2.6%	1045	3.1%	3.3	158	15.1%
ES	2142	23.7%	1512	12.3%	3785	11.3%	2.5	994	26.3%
FI	527	5.8%	267	2.2%	755	2.3%	2.8	144	19.1%
FR	1938	21.4%	1152	9.4%	3245	9.7%	2.8	660	20.3%
IE	481	5.3%	218	1.8%	635	1.9%	2.9	195	30.7%
IT	1923	21.2%	1387	11.3%	3439	10.3%	2.5	723	21.0%
LU	110	1.2%	58	0.5%	128	0.4%	2.2	20	15.6%
NL	1498	16.5%	784	6.4%	2338	7.0%	3.0	512	21.9%
PT	567	6.3%	324	2.6%	820	2.5%	2.5	139	17.0%
SE	769	8.5%	371	3.0%	1045	3.1%	2.8	202	19.3%
UK	3140	34.7%	1349	11.0%	4789	14.3%	3.6	1521	31.8%
EU-13	**1528**	**16.9%**	**1674**	**13.6%**	**3193**	**9.6%**	**1.9**	**470**	**14.7%**
BG	138	1.5%	133	1.1%	199	0.6%	1.5	16	8.0%
CY	145	1.6%	63	0.5%	181	0.5%	2.9	34	18.8%
CZ	306	3.4%	161	1.3%	371	1.1%	2.3	35	9.4%

EE	166	1.8%	99	0.8%	204	0.6%	2.1	62	30.4%
HR	124	1.4%	93	0.8%	160	0.5%	1.7	16	10.0%
HU	282	3.1%	186	1.5%	350	1.0%	1.9	61	17.4%
LT	104	1.1%	71	0.6%	127	0.4%	1.8	22	17.3%
LV	97	1.1%	58	0.5%	109	0.3%	1.9	15	13.8%
MT	43	0.5%	28	0.2%	56	0.2%	2.0	6	10.7%
PL	436	4.8%	318	2.6%	594	1.8%	1.9	91	15.3%
RO	234	2.6%	200	1.6%	344	1.0%	1.7	28	8.1%
SI	246	2.7%	161	1.3%	330	1.0%	2.0	59	17.9%
SK	131	1.4%	103	0.8%	168	0.5%	1.6	25	14.9%
EU-28	**9055**	**100%**	**12314**	**100%**	**33432**	**100%**	**2.7**	**7275**	**21.8%**

4.1.2. Participation per type of organisation

In this section, we examine participation and success rate of various types of research performing organisations. In this respect, we should keep in mind that there are substantial differences in the structures of national research and innovation systems in the EU that have resulted from different national traditions and different national R&D policies. For instance, while in the UK and the Nordic countries (SE, DK) a considerable part of the research activities is performed by universities, FR and DE have a very strong sector of globally significant research institutes and in DE, FR, IT simultaneously a substantial part of research activities is performed by private enterprises. Next to that, research and innovation systems of the Central and Eastern European countries have undergone considerable restructuring since 1990 when they emerged from their former totalitarian regime. All that means that we should be careful in the interpretation of the participation statistics per type of organisation since the labour division in research is very national dependent.

The FP statistics distinguishes the following five types of organisations that participated in project proposals preparation:

- HES – Higher of Secondary Education establishments,
- REC – Research organisations,
- PRC – Private Commercial organisation,
- PUB – Public body (excl. research and education,)
- OTH – Other organisation,
- N/A – Not defined organisations (not used in the H2020).

The left side of Table 5, i.e. the „participant's portfolio', contains the country proportion of participations of the above six organisations types in preparation of the eligible project proposals. In the rows EU-15 and EU-13 are the average values of the proportions for EU-15 and EU-13, respectively. Since the HES, REC and PRC organisation represent always more than 80% of participations in each member state, the most important differences between EU-15 and EU-13 should be found in the HES, REC and PRC columns. The average proportions of the EU-13 are lower than those for EU-15, the differences are not statistically significant (Mann-Whitney nonparametric test). The blue coloured columns indicate that given bloc has significantly higher values than the other bloc. Thus EU-13 have higher proportions in the „public bodies' and „other organisations' and EU-15 have a higher proportion in the N/A column (when the organisation type is not properly categorized in the E-CORDA). Hence we tend to conclude that in the FP7 the participation portfolio of EU-13 is very similar to that of EU-15.

The EU-13 and EU-15 considerably differ in the participation success rate of all types of participating organisations. The differences in the HES and PRC types are statistically significant (Mann-Whitney nonparametric statistics, $p < 0,01$). The same holds good for the OTH and N/A participants' type, which due to their smaller proportion do not influence the total participation so strongly as the HES and PRC.

Thus we can conclude that in the FP7 there were only minor differences between EU-15 and EU-13 in the portfolio of participants who prepared project proposals. However, in four of the six considered types of participating organisations the EU-15 organisations have significantly higher participation success rate.

Table 5. EU member states proportions of different participants and their participation success rate in the FP7
Source: E-CORDA database (November 2015)

	Participant's portfolio						Participant's success rate					
	HES	**REC**	**PRC**	**PUB**	**OTH**	**N/A**	**HES**	**REC**	**PRC**	**PUB**	**OTH**	**N/A**
EU-15	**36,2%**	**18,5%**	**27,6%**	**3,6%**	**7,4%**	**6,6%**	**19,2%**	**25,2%**	**23,4%**	**32,7%**	**22,2%**	**9,3%**
AT	37,7%	18,8%	27,7%	3,6%	7,1%	5,0%	20,4%	22,2%	24,4%	38,3%	20,8%	12,7%
BE	31,4%	20,2%	25,5%	3,3%	14,2%	5,3%	21,0%	30,1%	27,3%	41,4%	30,8%	13,1%
DE	32,9%	24,1%	29,4%	2,2%	5,1%	6,2%	21,2%	25,9%	27,1%	27,6%	22,1%	13,8%
DK	48,9%	9,2%	24,3%	4,7%	6,2%	6,8%	22,4%	28,3%	26,9%	34,9%	23,3%	11,3%
EL	30,6%	27,1%	26,9%	3,0%	8,0%	4,5%	15,8%	19,9%	15,8%	17,7%	13,8%	3,3%
ES	26,2%	25,6%	28,7%	4,2%	8,5%	6,7%	16,3%	22,4%	20,2%	26,0%	16,8%	7,0%
FI	37,7%	22,7%	21,6%	3,5%	5,2%	9,4%	17,3%	27,1%	25,0%	38,0%	22,2%	6,1%
FR	21,7%	29,6%	31,2%	3,0%	6,7%	7,8%	18,9%	27,4%	28,0%	33,9%	25,9%	15,5%
IE	51,9%	4,7%	26,1%	3,3%	7,9%	6,1%	20,8%	33,3%	23,4%	31,5%	22,0%	7,0%
IT	31,6%	19,0%	30,2%	3,7%	7,0%	8,5%	17,4%	22,1%	19,7%	21,1%	16,8%	5,3%
LU	21,2%	18,1%	41,6%	6,2%	11,0%	2,0%	12,8%	10,9%	17,2%	43,9%	33,3%	0,0%
NL	39,7%	16,2%	27,5%	2,9%	5,7%	8,1%	23,5%	31,9%	26,4%	34,6%	25,2%	15,1%
PT	30,1%	24,0%	28,7%	4,2%	7,9%	5,2%	16,2%	20,2%	17,9%	33,2%	17,2%	5,6%
SE	49,0%	10,8%	23,0%	4,0%	5,0%	8,2%	21,8%	26,9%	26,8%	40,0%	21,7%	10,3%
UK	53,0%	6,9%	21,7%	2,5%	6,1%	9,8%	22,1%	29,5%	24,6%	28,9%	21,2%	14,2%
EU-13	**35,8%**	**16,5%**	**26,4%**	**6,7%**	**11,1%**	**3,5%**	**16,7%**	**22,8%**	**16,9%**	**28,6%**	**16,7%**	**7,4%**
BG	28,7%	24,4%	23,0%	6,4%	13,4%	4,1%	17,4%	17,1%	16,1%	22,6%	13,8%	1,8%
CY	35,8%	5,5%	35,4%	5,4%	12,8%	5,2%	15,8%	19,1%	13,6%	13,8%	19,0%	5,2%
CZ	38,6%	23,8%	30,8%	2,1%	4,6%	0,0%	17,0%	22,0%	21,6%	32,9%	20,3%	0,0%
EE	40,3%	9,2%	29,9%	6,2%	12,3%	2,1%	17,7%	25,0%	17,7%	34,4%	27,5%	8,0%
HR	40,3%	14,9%	22,6%	7,7%	11,2%	3,3%	13,4%	20,0%	21,6%	28,2%	12,0%	2,6%
HU	33,9%	18,5%	26,1%	6,0%	10,2%	5,2%	19,6%	22,6%	19,0%	32,7%	17,8%	9,7%
LT	45,9%	15,0%	18,2%	8,0%	9,9%	2,9%	18,1%	24,3%	18,3%	35,9%	15,9%	0,0%
LV	37,6%	18,5%	21,6%	8,4%	11,2%	2,7%	23,2%	29,7%	14,6%	26,0%	12,9%	5,1%
MT	25,3%	5,6%	35,6%	13,7%	18,4%	1,4%	15,9%	37,0%	13,3%	36,8%	12,3%	57,1%
PL	39,4%	19,7%	22,8%	4,6%	7,9%	5,5%	16,6%	23,8%	18,4%	25,6%	19,1%	2,8%
RO	32,7%	16,8%	25,0%	6,7%	13,5%	5,2%	12,1%	18,7%	14,5%	23,8%	13,8%	0,5%
SI	29,5%	24,0%	27,2%	5,8%	8,9%	4,6%	14,1%	19,0%	13,7%	29,5%	13,3%	0,8%
SK	37,3%	18,1%	25,5%	5,6%	10,2%	3,4%	16,4%	17,6%	17,8%	29,5%	19,6%	2,2%

The higher EU-13 proportion of PUB and OTH organisations participating in project proposals preparation reiterates again in H2020, see Table 6. However, in H2020 the agility of EU-13 PRC organisations in submitting project proposals has considerably grown, their proportion is significantly higher than the proportion of EU-15 PRC (Mann-Whitney test, $p < 0,01$). Only three EU-13 countries (CZ, HR, LT) have a smaller proportion of the PRC organisations than the median of the EU-28 proportions! The EU-13 PRC organisations are particularly attempting to use the 'SME instruments' (i.e. the funding scheme supporting the participation of single SMEs and/or their consortia) introduced in H2020.

Table 6. Member states proportions of different participants and their participation success rate in the H2020. Source: E-CORDA database (November 2017)

	Participant's portfolio					Participant's success rate				
	HES	REC	PRC	PUB	OTH	HES	REC	PRC	PUB	OTH
EU-15	**36,1%**	**17,6%**	**38,5%**	**3,3%**	**4,4%**	**12,1%**	**16,6%**	**13,4%**	**27,1%**	**19,0%**
AT	34,9%	20,8%	37,6%	2,3%	4,4%	12,6%	16,0%	16,3%	41,3%	19,9%
BE	31,0%	17,6%	32,9%	2,4%	16,1%	12,1%	20,9%	14,6%	29,1%	21,1%
DE	34,5%	23,4%	37,9%	1,7%	2,5%	12,8%	17,3%	15,4%	24,6%	19,1%
DK	48,5%	7,7%	35,7%	5,5%	2,6%	13,6%	13,9%	12,5%	19,8%	21,8%
EL	30,2%	26,5%	37,9%	2,8%	2,6%	10,8%	14,2%	10,7%	14,5%	14,7%
ES	23,7%	25,8%	42,5%	4,5%	3,5%	10,5%	14,7%	12,5%	20,3%	15,2%
FI	40,6%	17,6%	36,2%	2,9%	2,7%	10,0%	17,8%	12,3%	25,2%	20,7%
FR	21,3%	32,4%	39,9%	2,4%	3,9%	12,5%	16,7%	15,9%	36,7%	23,8%
IE	50,7%	3,7%	39,8%	3,3%	2,6%	12,8%	24,7%	13,0%	27,8%	18,1%
IT	30,6%	18,0%	45,0%	3,5%	2,9%	9,8%	13,9%	10,4%	18,9%	15,4%
LU	20,2%	17,5%	50,3%	2,9%	9,1%	12,8%	9,6%	13,5%	47,6%	25,4%
NL	41,9%	13,4%	37,3%	2,9%	4,5%	13,6%	20,5%	14,7%	24,5%	17,7%
PT	26,4%	26,1%	37,9%	5,2%	4,4%	10,7%	12,5%	10,5%	24,6%	14,3%
SE	51,3%	8,2%	34,3%	4,4%	1,8%	12,6%	16,4%	15,0%	30,6%	20,4%
UK	56,2%	5,6%	32,9%	2,5%	2,7%	13,5%	20,4%	12,9%	21,6%	18,2%
EU-13	**31,2%**	**13,3%**	**43,7%**	**6,2%**	**5,5%**	**9,7%**	**15,0%**	**8,5%**	**25,0%**	**17,7%**
BG	18,2%	18,6%	47,4%	5,7%	10,1%	9,8%	13,7%	5,6%	21,1%	12,2%
CY	36,5%	4,3%	47,5%	6,7%	5,1%	11,2%	9,8%	8,6%	16,2%	31,5%
CZ	39,3%	16,4%	36,8%	2,5%	5,0%	11,4%	18,9%	11,9%	27,7%	12,0%
EE	35,7%	7,6%	43,4%	4,5%	8,8%	11,4%	8,1%	11,0%	20,7%	25,7%
HR	32,4%	16,9%	38,5%	8,0%	4,2%	7,5%	15,1%	8,6%	25,6%	9,2%
HU	25,9%	12,9%	52,4%	4,8%	4,0%	10,1%	15,4%	7,6%	20,7%	15,2%
LT	36,9%	11,9%	37,3%	8,7%	5,1%	8,7%	14,4%	9,5%	20,9%	17,8%
LV	31,3%	14,3%	41,1%	7,3%	5,9%	9,2%	19,7%	6,7%	36,2%	11,5%
MT	32,1%	2,9%	50,5%	10,4%	4,1%	13,4%	13,0%	6,8%	39,0%	25,0%
PL	33,6%	18,0%	41,1%	4,0%	3,3%	10,0%	16,5%	8,3%	27,1%	21,3%
RO	29,6%	16,6%	39,2%	8,5%	6,1%	6,7%	17,9%	7,5%	20,2%	23,1%
SI	23,9%	20,8%	45,2%	5,2%	4,9%	7,4%	14,3%	8,6%	18,8%	10,1%
SK	30,3%	12,0%	48,1%	4,9%	4,8%	9,1%	18,4%	10,1%	31,3%	15,8%

However, the success rate of the EU-13 PRC organisations was considerably lower than that of the EU-15. The PRC organisations from only two EU-13 countries (CZ, EE) have success rates higher than the median of the EU-28 PRC success rates. The higher activity of EU-13 PRC organisations in submitting projects thus has not yielded the desired increase of their participation in the H2020 projects.

Thus in both programmes FP7 and H2020 the EU-13 and EU-15 have similar proportions of the HES and REC organisations. The HES organisations (which represent approximately one third of all participations) have always significantly higher success rate in EU-15 than in EU-13. There are no significant differences between EU-13 and EU-15 in the success rates of the research organisations. In both programmes, the success rates of the EU-13 PRC organisations are considerably lower than the success rates of the EU-15 PRC organisations. Hence without increasing the success rate of the university

and private teams in the project proposals the EU-13 can hardly improve their participation in the framework programme.

4.1.3. Participation per type of funding scheme

FPs have always served multiple objectives. The larger they become, the more objectives they seem to have. This is why within each FP there are multiple instruments and programmes, each with its own logic, eligibility criteria, and quality definitions. The challenge of FP participation is both generic and specific. In this section, we examine participation in each type of funding scheme.

The EU-13 Member States perform below par in funding schemes aimed at research excellence and innovation, above par in coordination, support, and collaboration. Tables 7, 8 and 9 show the participation of the EU-13 and EU-15 per type of funding scheme, region and Member State.

In FP7 and Horizon 2020, EU-13 participation is below average in funding schemes that focus on excellence and innovation (ERC, MSCA, and IA/RIA). It is particularly low in the ERC. ERC and MSCA projects make up 9 to 10 per cent of EU-13 participations. CP/IA/RIA projects, on the other hand, comprise about 45 per cent of all EU-13 participations.

Table 7. Project participations in the role of coordinator as a percentage of total participations per Member State in all FP projects and in IA/RIA- and CSA-type projects, FP7 and Horizon 2020 (per cent)
Source: CORDIS data made available via the EU Open Data Portal (September 2016).

	Total FP		IA/RIA		CSA	
Country	FP7	H2020	FP7	H2020	FP7	H2020
AT	20.4%	17.8%	11.0%	10.2%	15.0%	11.9%
BE	16.9%	15.6%	9.2%	8.4%	13.9%	12.1%
DE	18.7%	17.8%	10.0%	8.8%	13.7%	17.2%
DK	19.6%	30.8%	8.3%	7.4%	8.7%	10.7%
EL	18.4%	15.1%	11.5%	12.1%	16.5%	12.2%
ES	22.0%	26.3%	11.5%	12.1%	11.7%	14.2%
FI	14.4%	19.1%	9.2%	9.2%	9.5%	7.9%
FR	21.9%	20.3%	9.4%	8.7%	13.8%	13.7%
IE	24.2%	30.7%	12.2%	12.8%	14.1%	14.4%
IT	17.5%	21.0%	10.4%	9.1%	12.9%	12.6%
LU	13.2%	15.6%	10.2%	8.8%	6.9%	17.1%
NL	21.8%	21.9%	10.9%	9.7%	12.9%	14.9%
PT	15.0%	17.0%	6.5%	6.8%	10.0%	18.1%
SE	16.9%	19.3%	8.7%	7.6%	8.9%	5.9%
UK	31.2%	31.8%	10.4%	9.2%	11.4%	13.4%
BG	7.0%	8.0%	0.0%	0.0%	8.7%	9.2%
CY	16.9%	18.8%	2.4%	4.7%	10.9%	29.8%
CZ	9.1%	9.4%	1.2%	1.9%	7.5%	12.9%
EE	11.0%	30.4%	3.0%	3.9%	9.9%	28.1%
HR	10.6%	10.0%	1.2%	0.0%	13.2%	10.6%
HU	13.7%	17.4%	2.9%	3.0%	7.6%	14.6%
LT	6.7%	17.3%	4.3%	0.0%	7.9%	13.0%
LV	8.7%	13.8%	5.6%	0.0%	6.5%	24.5%
MT	13.6%	10.7%	2.0%	0.0%	9.0%	20.7%
PL	11.3%	15.3%	3.0%	2.1%	10.9%	16.9%
RO	5.9%	8.1%	1.0%	1.2%	7.6%	14.1%
SI	6.4%	17.9%	3.4%	7.0%	7.2%	11.4%
SK	8.6%	14.9%	2.7%	2.8%	9.2%	20.6%
EU-15	**21.4%**	**22.5%**	**10.1%**	**9.5%**	**12.7%**	**13.6%**
EU-13	**10.0%**	**14.7%**	**2.4%**	**2.6%**	**8.8%**	**16.0%**

EU-13 participation is relatively strong in CSA-projects. Whereas on aggregate EU-13 organisations account for 8 per cent of FP7 participations and 9 per cent of Horizon 2020 participations, in CSA projects these percentage shares are 14 and 18 per cent. CSA projects represent 17 per cent of EU-15 participations

in FP7 and 15 per cent in Horizon 2020; for EU-13 organisations these shares are 33 and 35 per cent respectively, which is more than twice as high.

Table 8. Number of participations per type of funding scheme from the EU-15 and EU-13 in FP7 and Horizon 2020
Source: CORDIS data made available via the EU Open Data Portal (September 2016).

	FP7				Horizon 2020			
	EU-15	EU-13	% EU-15	% EU-13	EU-15	EU-13	% EU-15	% EU-13
ERC	4,490	111	84%	2%	1,808	42	85%	2%
MSCA	15,338	984	83%	5%	5,035	258	90%	5%
CP (IP and FP), IA/RIA	59,750	4,847	82%	7%	16,700	1,464	84%	7%
CSA	17,830	3,567	70%	14%	4,567	1,105	73%	18%
Benefit of specific groups (SMEs, CSOs)	980	65	84%	6%	1,623	197	84%	10%
Networks of Excellence	6,986	1,066	79%	12%				
Cofund					506	127	70%	17%
Competitiveness and innovation FP	108	20	78%	14%				
unknown	126	23	67%	12%				
Total number of participations	105,608	10,683	80%	8%	30,239	3,193	83%	9%

Table 9. Number of participations per type of funding scheme from the EU-15 and EU-13 in FP7 and Horizon 2020 per thousand FTE researchers
Source: CORDIS data made available via the EU Open Data Portal (September 2016).

	ERC		**MSCA**		**CP/IA/RIA**		**CSA**		**BSG**	
Country	FP7	H2020	FP7	H2020	FP7	H2020	FP7	H2020	FP7	H2020
EU-15	**3.2**	**1.2**	**10.9**	**3.2**	**42.6**	**10.7**	**12.7**	**2.9**	**4.4**	**1.0**
AT	3.4	1.2	11.7	3.5	54.2	14.2	18.5	4.6	3.9	0.7
BE	4.1	1.3	14.0	3.6	78.0	16.9	33.7	7.8	6.1	0.4
DE	2.4	1.0	6.6	2.0	33.9	8.1	7.9	1.8	2.5	0.4
DK	2.6	1.2	11.9	4.9	41.2	9.4	11.8	2.7	4.8	1.8
EL	1.7	0.2	16.8	3.8	85.9	21.6	33.0	5.8	13.5	0.5
ES	2.3	1.1	12.4	4.2	47.6	17.5	13.3	4.5	8.9	3.0
FI	1.8	0.9	5.3	2.2	38.5	11.4	13.5	3.3	3.3	1.5
FR	2.7	0.9	7.7	2.0	29.6	6.6	9.3	1.9	1.7	0.4
IE	2.9	1.4	24.1	6.1	65.0	15.2	24.4	4.3	12.0	2.4
IT	3.3	1.1	11.2	3.3	69.1	16.5	20.1	4.8	6.7	2.7
LU	0.4	1.1	9.0	5.1	48.2	24.7	35.5	12.7	4.1	1.1
NL	7.4	2.6	19.3	5.4	77.1	16.6	22.9	4.2	5.2	1.1
PT	1.1	0.7	8.5	2.7	30.6	11.4	13.6	4.8	5.5	0.9
SE	3.5	0.8	11.2	2.4	51.9	8.7	15.7	2.0	4.4	1.1
UK	4.8	1.6	16.0	4.6	32.8	8.0	8.6	1.8	4.5	0.8
EU-13	**0.6**	**0.2**	**5.1**	**1.1**	**25.1**	**6.4**	**18.5**	**4.8**	**5.1**	**0.9**
BG	0.3	0.0	4.0	0.6	24.0	5.5	24.7	7.9	6.6	0.3
CY	11.6	5.7	63.6	35.5	193.0	98.4	169.9	53.8	77.4	4.6
CZ	0.5	0.3	5.1	1.2	24.7	5.7	11.4	2.5	3.3	0.2
EE	1.4	0.2	9.0	3.3	47.6	18.1	48.1	15.0	20.1	8.5
HR	0.4	0.2	4.8	1.8	25.1	8.8	19.2	13.6	8.8	0.6
HU	2.0	0.5	8.0	1.1	31.0	6.4	25.3	3.7	6.0	1.4
LT	0.0	0.0	3.1	1.4	19.1	5.7	19.6	5.3	6.6	1.4
LV	0.3	0.0	4.8	1.6	27.5	10.1	47.3	13.3	4.6	1.1
MT	4.7	1.2	10.9	1.2	77.6	29.9	155.1	36.2	37.2	1.2
PL	0.3	0.0	4.0	0.6	16.7	3.2	9.8	2.2	2.4	0.5
RO	0.1	0.2	3.6	0.8	27.1	9.1	20.5	8.0	5.5	0.1
SI	0.4	0.1	8.4	2.5	63.6	20.8	33.7	10.7	10.2	4.6
SK	0.1	0.1	3.0	0.7	15.5	4.9	13.1	4.7	1.8	0.5

Some Member States participate relatively well in funding schemes that focus on excellence and innovation. CY and (in FP7) MT are the only EU-13 Member States to participate relatively well in the *ERC*. HU and EE perform better than some EU-15 Member States. In the *MSCA* CY, EE, and SI participate at or above EU-15 levels. In FP7 MT and HU also participate intensively. In *IA/RIA* projects CY, EE, MT, SI, and (in Horizon 2020) LV participate at or above EU-15 levels.

Various EU-13 Member States participate intensively in CSA projects. BG, CY, EE, LV, MT and SI perform above average in both FPs; HU participated above average in FP7; HR and RO participate above average in Horizon 2020.

In BSG projects participation of the EU-13 is higher than that of the EU-15. The highest levels of participation were found in CY, EE, MT, SI.

4.1.4. Participation in Spreading Excellence and Widening Participation programme of the H2020

The Spreading Excellence and Widening Participation programme was introduced under Horizon 2020 with the aim to '… enable the European Research Area to function in a more streamlined and homogeneous way, allowing the individual strengths of each Member State to be optimised'. Introduction of the programme was a reaction of the European Commission to the barriers to the participation of EU-12 Member States (Croatia had not yet joined) identified in 2011 (European Union, 2011). The main causes of the wide variation in FP participation that had been identified at that time were:

- size of R&I systems in terms of R&D personnel and national research investment;
- lack of synergies between national research systems and EU research in some countries;
- system learning effects related to the time needed for adaption to FPs after joining EU;
- variation in wages;
- existing networks constituting barriers to entry;
- large projects can be problematic for small countries and new actors; and
- problems with information, communication advice and training.

The results of recent analyses, as well as our own results, confirm that many of these causes still persist.

The Spreading Excellence and Widening Participation programme is oriented at the Member States with relatively lower performance in research and innovation in order to:

- provide new development opportunities through tapping into new collaboration and development patterns, including the establishment of new scientific networks, links with local clusters and opening up access to new markets (Teaming);
- strengthen a defined field of research in a knowledge institution through linking with at least two internationally-leading counterparts in Europe (Twinning);
- attract and maintain high quality human resources and implement the structural changes necessary to achieve excellence on a sustainable basis (ERA Chairs);
- improve the design, implementation and evaluation of national or regional research and innovation policies through expert advice to public authorities at the national or regional levels and their mutual learning (Policy Support Facility);
- support access to international networks for excellent researchers and innovators who lack sufficient involvement in European and international networks (COST);
- strengthen the administrative and operational capacity of transnational networks of National Contact Points (NCP networks).

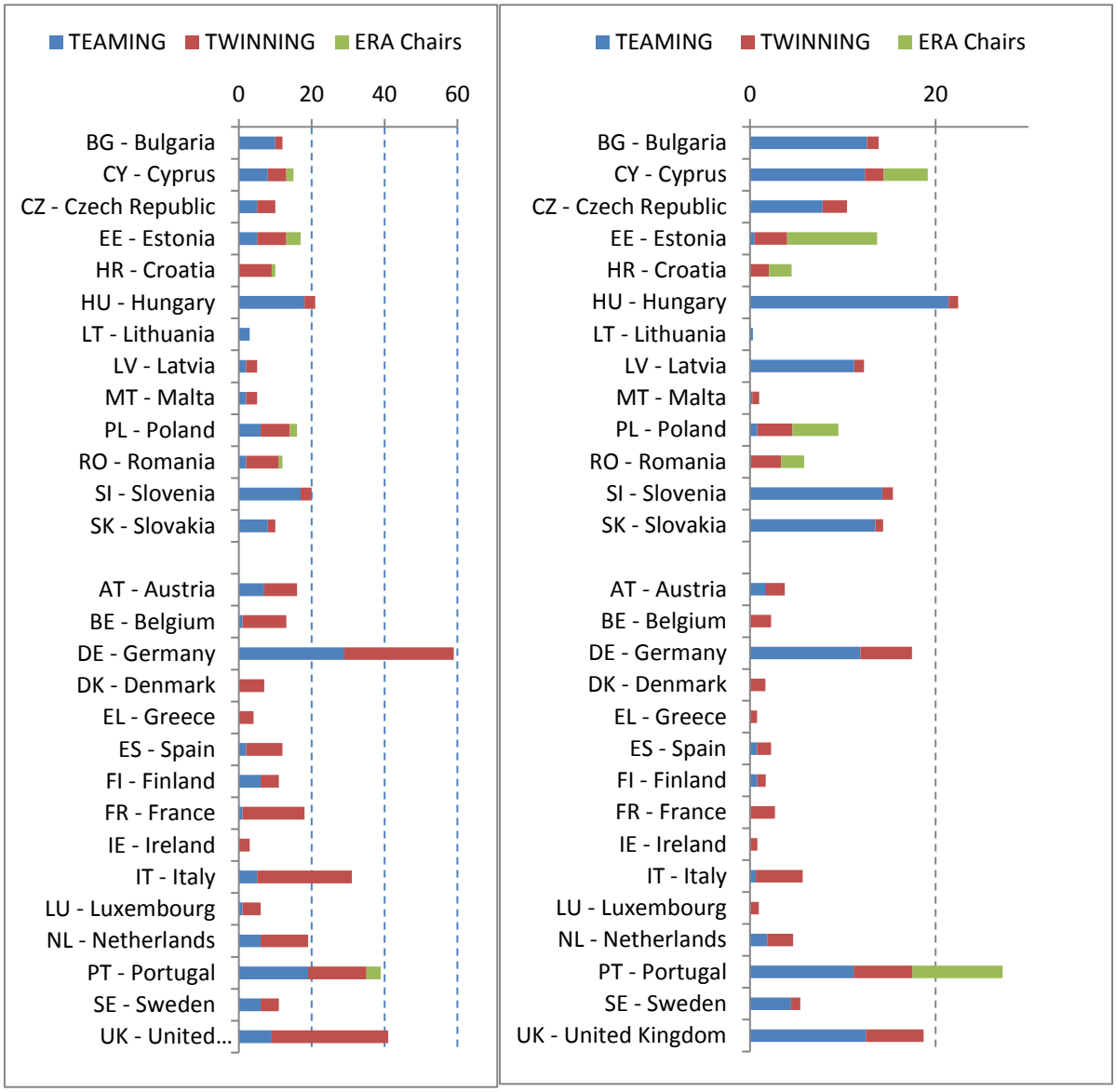
As of the end of February, around 500 entities participated in the Spreading Excellence and Widening Participation programme with a total contribution of approximately 350 million euros. Figure 1 shows that there is a considerable variation among EU-13 countries in their participation in the three key

instruments of the programme. The EU-13 countries that benefit most seem to be Hungary, Slovenia and Cyprus. Less active and successful countries are Lithuania, Malta and Croatia.

Figure 1 presents the number of participations and EU contributions (million euro) resulting from the following H2020 calls:

- H2020-WIDESPREAD-2014-1 (Teaming)
- H2020-WIDESPREAD-2014-2 (ERA Chairs)
- H2020-TWINN-2015 (Twinning)
- H2020-WIDESPREAD-01-2016-2017 (Teaming - Phase 2)

Figure 1. Participations (in number) and EU contribution (in million euro) for participants in selected instruments of the Spreading Excellence and Widening Participation Scheme
Source: E-CORDA extraction date: 2017/02/28.



4.2. Characteristics of project consortia

Gaining access to the core of European R&D networks is mentioned as one of the major barriers to raising EU-13 participation. In this section, we examine the composition of consortia in FP7 and Horizon 2020 projects. We look at differences between projects that involve EU-13 participants and projects that

do not as well as between projects coordinated by EU-13 participants and those that are not. ERC and MSCA projects do not involve consortia. In our analysis, we focus on (1) innovative projects (CP, IA/RIA) and (2) coordination and support actions.

Table 10 shows that the vast majority of consortia involving either EU-15 or EU-13 organisations involves an EU-organisation (97 per cent in FP7, 96 per cent in Horizon 2020). Only a small minority of projects involving EU-13 organisations does not also involve EU-15 organisations. Among the innovative projects – CP (IP and FP), IA/RIA – very few projects involving EU-13 organisations do not also involve EU-15 organisations (9 projects in FP7, 3 in Horizon 2020).

In consortia that contain both EU-15 and EU-13 organisations, EU-13 organisations account for an average 15 per cent of consortium partners in FP7 and 17 per cent in Horizon 2020. The share of these joint EU-15/EU-13 projects in the total number of projects involving participants from either region declined from 20 per cent in FP7 to 14 per cent in Horizon 2020. However, in the innovative projects and CSA projects the share of joint EU-15/EU-13 projects remained more or less stable.

Consortia involving organisations from the EU-13 but none from the EU-15 rarely involve organisations from other non-EU countries. Where EU-15 organisations are involved, the share of non-EU participants was 11 per cent in FP7 and 6 per cent in Horizon 2020.

Table 10. Regional composition of project consortia in FP7 and Horizon 2020, having only EU-13 participants, only EU-15 participants, or participants from the EU-13 and EU-15
Source: CORDIS data made available via the EU Open Data Portal (September 2016).
Note: AS4 = four developed countries associated to FP7/H2020 (Israel, Norway, Switzerland, Iceland); Other = other countries associated to FP7/H2020.

			Projects		EU-15	EU-13	AS4	other
All projects	FP7	only EU-13	680	3%	0%	99%	1%	1%
		only EU-15	18146	77%	89%	0%	6%	5%
		EU-13 and EU-15	4703	20%	74%	15%	6%	4%
		Total	23529					
	Horizon 2020	only EU-13	339	4%	0%	100%	0%	0%
		only EU-15	7035	82%	94%	0%	4%	2%
		EU-13 and EU-15	1189	14%	75%	17%	5%	3%
		Total	8563					
CP (IP and FP), IA/RIA	FP7	only EU-13	9	0%	0%	100%	0%	0%
		only EU-15	3846	59%	87%	0%	7%	5%
		EU-13 and EU-15	2675	41%	78%	13%	6%	3%
		Total	6530					
	Horizon 2020	only EU-13	3	0%	0%	100%	0%	0%
		only EU-15	997	59%	91%	0%	6%	3%
		EU-13 and EU-15	693	41%	78%	14%	5%	3%
		Total	1693					
CSA	FP7	only EU-13	234	9%	0%	99%	0%	0%
		only EU-15	1485	55%	82%	0%	5%	14%
		EU-13 and EU-15	994	37%	67%	19%	7%	7%
		Total	2713					
	Horizon 2020	only EU-13	74	9%	0%	100%	0%	0%
		only EU-15	428	52%	92%	0%	3%	5%
		EU-13 and EU-15	322	39%	67%	24%	4%	5%
		Total	824					

Table 11 compares two specific types of consortium, namely (1) projects coordinated by EU-13 organisations and (2) projects with EU-13 participants but not involving participants from EU-15. The key statistic in this table is the index of EU-13 consortia relative to the EU-15 where the EU-15 equals 100. It is difficult to compare all FP projects of the EU-13 and EU-15 because of differences in the distribution of projects among funding schemes. This is why we focus on innovative (CP/IA/RIA) projects and CSA projects.

EU-13 consortia are different in composition than comparable EU-15 consortia. EU-13 project consortia are smaller, particularly when they do not involve EU-15 participants. Horizon 2020 consortia are larger than FP7 consortia. The combined project experience within each FP is lower in EU-13 projects with the exception of CSA projects in Horizon 2020. The percentage of consortium partners with only a single project in the entire FP is generally higher than that of EU-15 consortia with the exception of CSA projects overall and, where they do not involve an EU-15 partner, CSA projects in Horizon 2020.

Table 11. Characteristics of projects coordinated by EU-13 organisations and projects with EU-13 participants but not involving participants from EU-15 in FP7 and Horizon 2020
Note: (a) compared to projects coordinated by EU-15; (b) compared to projects with EU-15 participants but not involving participants from EU-13.
Source: CORDIS data made available via the EU Open Data Portal (September 2016).

		Number of organisations		Average project experience		Percentage of consortium partners with one project only	
		organisations	EU-15 =100	projects	EU-15 =100	percentage	EU-15 =100
Projects coordinated by EU-13 organisations (a)							
FP7	all	4.16	76	56	23	9%	125
H2020	all	3.43	73	16	36	44%	155
FP7	CP	9.61	86	112	84	15%	107
H2020	CP	10.50	89	21	73	33%	117
FP7	CSA	5.01	51	34	27	9%	82
H2020	CSA	4.89	60	28	134	20%	81
Projects with EU-13 participants but not involving participants from EU-15 (b)							
FP7	CP	1.56	17	37	25	6%	42
H2020	CP	3.00	32	2	6	36%	134
FP7	CSA	2.95	48	21	14	7%	68
H2020	CSA	3.88	67	6	28	27%	115

4.3. EC contributions

Financial contributions are a key issue in understanding EU-13 participation. We examine (1) the average amount of funding received and the share in the project budget as participant and coordinator of organisations from each EU Member State; and (2) the relation between Member State contributions to the FP budget and country financial support gained from FP participation.

4.3.1. EC contributions per participation and per coordinated project

CORDIS does not provide full financial data for every project. For the analysis of average amounts received and shares in the project budget, we only use information on projects for which data on EC contributions are available (see Tables 12 and 13).

The average EC contribution per EU-13 participation is lower than that of EU-15 participations. Various explanations are possible: costs per researcher may be lower; EU-13 partners may have a less important

role, and they may have a more modest share in the total volume of work. In this section, we only report our observations with regard to the data.

In FP7, the average EC contribution per EU-13 participation was about half as high as the contribution per EU-15 participation. In Horizon 2020, the average EC contribution per participation was higher in both regions. The EU-13 has made marginal progress in that the average contribution yields 55 per cent of an average EU-15 contribution.

Coordinators receive a bigger proportion of the project budget. Average EC contributions per coordinator are lower but still comparable (519 thousand euros in the EU-13; 679 thousand euros in the EU-15). In both regions, coordinators receive just over half the project budget. In Horizon 2020 coordinators take a larger percentage share of the budget, especially in projects coordinated by EU-13 organisations. Yet, EU-13 coordinators receive substantially lower EC contributions than EU-15 coordinators (371 thousand compared to 635 thousand, a difference of 42 per cent).

Countries that received relatively higher EC contributions as participants in FP7 are CY, CZ, HR, PL and SI; and as coordinators BG, HR, LV, PL, RO, and SI. In Horizon 2020 the countries that received relatively higher EC contributions as participants were CY, EE, SI, and SK; and as coordinators CZ, EE, HR, PL, and SI. The number of projects coordinated by EU-13 organisations is, however, modest.

The various countries participate to a different extent in each FP funding scheme. Some of our observations have their origin in these differences. The first thing we notice is that participations in CSA projects – responsible for about one-third of EU-13 participants – yield very low EC contributions: on average 64 thousand euros in FP7 and 76 thousand euros in Horizon 2020. In CP/IA/RIA projects – responsible for about 45 per cent of EU-13 participants – the average EU-13 contribution was 58 per cent of the average EU-15 contribution per participation in FP7 and 63 per cent in Horizon 2020. Differences are generally smaller in the other types of the funding scheme, but there are differences nonetheless: EU-13 participations – whether as participants or as coordinators and regardless of funding scheme – yield lower EC contributions than the equivalent EU-15 participations.

Table 12. EC contributions per participation for EU-13 and EU-15 participants, FP7 (P=participant, C=coordinator)
Source: CORDIS data made available via the EU Open Data Portal (September 2016).

	Number of participations with financial information		Total EC contributions (million euros)		Average EC contribution per participation (ths euros)		Average project budget share per participation	
	P	C	P	C	P	C	P	C
EU-15	**53963**	**17970**	**14061**	**12193**	**261**	**679**	**9.0%**	**51.0%**
AT	1688	511	426	330	253	646	8.8%	45.3%
BE	3193	736	762	558	239	759	8.9%	55.8%
DE	9023	2528	2658	1970	295	779	8.9%	44.9%
DK	1532	459	462	341	301	742	9.8%	56.0%
EL	1728	432	347	212	201	492	8.0%	54.8%
ES	5857	1942	1285	984	219	506	8.3%	53.2%
FI	1460	264	349	214	239	812	9.5%	46.3%
FR	6229	2231	1704	1660	274	744	9.4%	51.2%
IE	941	391	230	222	244	568	9.1%	58.5%
IT	6213	1490	1456	867	234	582	9.3%	41.9%
LU	121	20	23	12	193	600	12.7%	53.1%
NL	4103	1419	1199	1220	292	860	9.0%	50.3%
PT	1335	294	246	121	184	411	7.9%	57.3%
SE	2517	603	688	536	273	889	8.0%	50.6%
UK	8023	4650	2226	2945	277	633	8.8%	50.0%
EU-13	**6456**	**837**	**882**	**434**	**137**	**519**	**7.9%**	**55.5%**
BG	428	35	46	23	108	649	8.0%	65.5%
CY	234	63	37	25	159	395	9.1%	61.2%
CZ	885	111	141	51	159	461	7.5%	56.0%
EE	335	44	46	20	137	444	7.7%	43.3%
HR	244	36	37	34	151	954	8.3%	58.3%
HU	870	167	121	80	139	477	7.6%	52.9%
LT	270	26	27	10	100	375	8.4%	58.6%
LV	206	18	18	13	86	731	8.4%	63.5%
MT	105	24	12	3	113	133	7.9%	36.1%
PL	1359	196	198	114	146	584	7.5%	52.2%
RO	691	46	78	25	112	535	7.4%	53.2%
SI	552	42	84	23	151	544	7.4%	62.1%
SK	277	29	38	14	136	485	7.8%	67.0%
EU-28	**60419**	**18807**	**14942**	**12627**	**247**	**671**	**8.5%**	**52.9%**
ERC								
EU-15		4073		6108		1500		84.1%
EU-13		96		113		1180		69.6%
MSCA								
EU-15	5483	7951	1513	2233	276	281	14.6%	88.7%
EU-13	481	365	94	66	195	180	15.1%	83.7%
CP								
EU-15	33784	3756	10344	2952	306	786	7.1%	27.0%
EU-13	3051	64	543	37	178	572	4.8%	25.1%
CSA								
EU-15	9474	1443	1396	696	147	483	7.1%	46.5%
EU-13	2112	232	135	202	64	871	5.4%	66.0%
BSG								
EU-15	4945	730	706	170	143	232	11.9%	23.5%
EU-13	776	80	106	17	136	211	10.9%	24.8%

Table 13. EC contributions per participation for EU-13 and EU-15 participants, Horizon 2020 (P=participant, C=coordinator)
Note: 'Host institutions' not included.
Source: CORDIS data made available via the EU Open Data Portal (September 2016).

	Number of participations with financial information		Total EC contributions (million euros)		Average EC contribution per participation (ths euros)		Average project budget share per participation	
	P	C	P	C	P	C	P	C
EU-15	**21665**	**6779**	**7609**	**4303**	**351**	**635**	**13.2%**	**63.2%**
AT	802	184	263	117	329	634	14.3%	57.6%
BE	1258	246	404	258	321	1047	14.3%	72.0%
DE	3599	839	1507	878	419	1047	12.7%	62.1%
DK	554	261	191	157	346	601	11.5%	67.7%
EL	867	158	238	72	274	454	16.6%	52.0%
ES	2613	992	784	435	300	438	13.5%	60.7%
FI	550	141	184	89	335	634	8.2%	62.6%
FR	2361	657	885	434	375	660	13.7%	60.8%
IE	412	195	125	127	305	654	11.5%	59.7%
IT	2554	720	810	328	317	456	14.3%	59.0%
LU	102	19	25	11	247	569	11.9%	74.5%
NL	1636	510	605	393	370	770	13.9%	60.1%
PT	646	139	167	64	259	461	6.3%	69.4%
SE	792	199	312	143	394	721	20.5%	63.9%
UK	2919	1519	1107	797	379	525	12.2%	67.3%
EU-13	**2609**	**467**	**503**	**173**	**193**	**371**	**9.5%**	**70.9%**
BG	172	16	20	2	117	151	4.6%	76.7%
CY	141	34	34	13	240	376	16.9%	64.7%
CZ	320	35	63	18	198	503	8.7%	76.7%
EE	137	62	28	31	207	500	9.6%	71.8%
HR	142	15	19	7	134	468	6.1%	87.2%
HU	272	61	55	20	202	327	12.2%	66.1%
LT	101	22	15	3	145	139	5.4%	83.8%
LV	93	14	16	3	168	204	7.0%	79.3%
MT	47	6	8	1	160	151	13.1%	49.6%
PL	487	91	99	39	202	431	9.6%	68.0%
RO	304	27	51	10	166	354	7.7%	70.3%
SI	259	59	60	23	231	391	9.8%	67.9%
SK	134	25	36	4	271	162	10.0%	53.1%
EU-28	24274	7246	8112	4476	**334**	**618**	11.7%	66.1%
ERC								
EU-15	146	518	42	761	284	1469	19.9%	99.3%
EU-13	5	13	1	17	174	1319	26.3%	100.0%
MSCA								
EU-15	2347	2592	695	737	296	284	11.9%	85.3%
EU-13	184	71	42	27	228	376	13.2%	88.6%
CP								
EU-15	14935	1578	6024	1686	403	1068	7.4%	23.7%
EU-13	1421	38	359	24	252	630	4.9%	20.1%
CSA								
EU-15	3718	608	502	297	135	489	10.4%	41.9%
EU-13	860	174	65	62	76	358	8.2%	47.7%
BSG								
EU-15	59	1451	25	515	424	355	28.7%	99.0%
EU-13	13	171	5	43	347	253	20.2%	99.2%

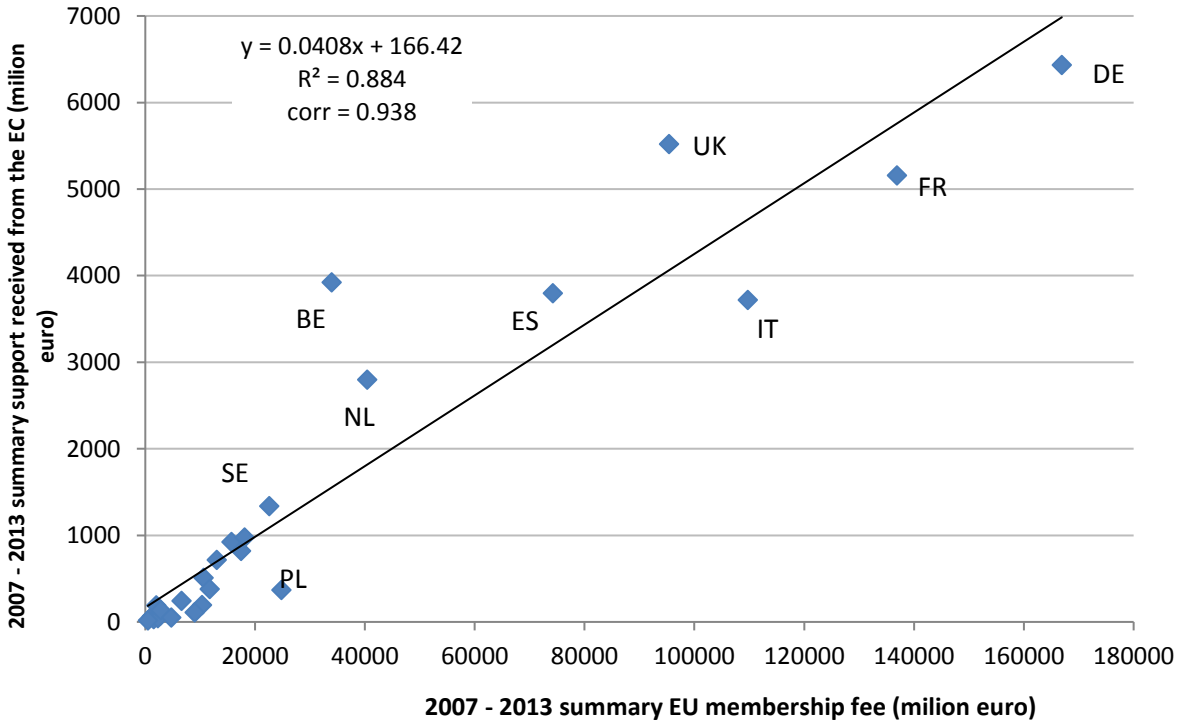
4.3.2. Relation between Member State contributions to the FP budget and country financial support gained from FP participation

The distribution of financial contributions is more skewed than that of project participations. The EU-13 has 20 per cent of the EU population. EU-13 participations comprised 8 per cent of total participations in FP7 and 9 per cent in Horizon 2020. Yet, in financial terms, the EU-13 obtained 3,7 per cent of total EU-28 financial support from FP7 while the EU-15 obtained the remaining 96,3 per cent.

Member State contributions are the primary source of the EU budget. Even though the FP7 budget (55,000 million euros) only represents a small proportion (5.6 per cent) of the total EU budget in the fiscal period 2007-2013, we can estimate each Member State's financial contribution to FP7 according to its contribution to the total EU budget. The distribution of FP7 contributions among the Member States is the outcome of a rigorous competitive process. There are no territorial or economic preferences. The only characteristic that matters is the quality of the proposed projects.

In Figure 2 we compare each Member State's EU membership fee in the period 2007-2013 with the distribution of FP7 contributions among the 28 Member States.

Figure 2. Relation between national EU membership fees and financial contributions from FP7 to each Member State, 2007-2013
Source: EU 'Budget in figures' web page (http://ec.europa.eu/budget/figures/index_en.cfm)



First, the distribution of support from the FP7 budget among the Member States is highly correlated with the distribution of membership fee (corr = 0.938). Membership fees explain almost 88 per cent of the variation in support received. This suggests employing a simple linear regression model how the FP7 support depends on the membership fee (see Figure 2). Some Member States – for example, UK, ES, NL, BE, SE – are above the regression line, which implies that they receive more from FP7 than they contribute to FP7 via the EU budget. Other Member States – such as DE, FR, IT, PL – are situated below the line. **All EU-13 Member States are below the regression line, which implies that they receive less from FP7 than they contribute to FP7** via their EU membership fees.

We conclude from Figure 2 that the distribution of the FP7 budget is '**statistically** (i.e. with individual deviations) **proportional**' to the Member State contributions to the EU budget, in other words, the EU membership fee is a good statistical predictor of the FP7 financial support gained by the country).

Of course, it is possible to consider also other predictors of the support that the Member States gained from the FP7 budget. We considered GERD, R&D intensity (i.e. GERD/GDP), capacity of the R&D system in FTE and also tested multidimensional regression models making it possible to analyse the simultaneous influence of these predictors on the distribution of the FP7 budget on the Member States. However, none of the tested models improved significantly the precision of the prediction of the support based only on the country EU membership fee.

This conclusion that the country EU membership fee is the best predictor of the gained support is rather surprising particularly when realizing that successful participation in the FP projects results from a strong competition between different consortia. If instead of the country membership fee and country FP7 support the respective percentages (EU-28 = 100 per cent) are used then we can say: the portion of the FP7 budget gained by the country is linearly dependent on the portion of the country contribution to the EU budget, i.e. the distribution of the FP7 budget follows *statistically* the *juste retour* principle.

The EU-13 covered some 8 per cent of the EU budget in the period 2007-2013 but received only 3.7 per cent from the FP7 budget in return. Had the distribution of FP7 funding precisely follow the principles of '*juste retour*', they would have received 1,742 million euros rather than 1,416 million euros. In other words, the EU-13 missed out on 326 million euros in the period 2007-2013 or 46 million euros per year (for 13 countries).

However, should the *juste retour* principle be applied generally, then we must also require that DE, FR and IT are shifted to the regression line thus they were gained by some 2,036 million euros less than what was their FP7 support. Moreover, the *juste retour* principle would also require that UK, ES, NL, BE, SE (and other countries above the regression line) should have been gaining less than they really gained etc.

Then again, '*juste retour*' is not a requirement that applies to the EU FP. The aim of the European Framework Programme is to enhance EU competitiveness, growth, and cohesion through investments in collaborative R&D. The implicit assumption is that the competitively selected consortia consisting of excellent teams are best suited to achieve the EU's objectives. Figure 2 only indicates, what distribution of the FP budget on the EU Member States we should expect.

5. Hypotheses on possible explanations

In this section, we systematically explore possible explanations for the low participation and success rate of EU-13 countries in FP7 and H2020 using data analysis. Since there are great disparities among the EU Member States, the explanation will most likely be 'country-specific'. Therefore, the analysis will show results for the individual Member State of the EU-28 in addition to the regional aggregates for the EU-13 and EU-15.

The following testable hypotheses represent possible explanations that originate in the relatively low performance of the EU-13 compared to the EU-15:

Quantity and quality of prospective participants

1. There are not enough (eligible) participants in the EU-13 relative to the EU-15.
2. EU-13 organisations are less active in the Framework Programme than EU-15 organisations.
3. The quality of proposals involving participants from the EU-13 is lower than that of proposals not involving participants from the EU-13.
4. Prospective participants from the EU-13 are not good enough relative to the EU-15.

Collaboration and networks

5. Prospective participants from the EU-13 have weaker connections to the collaboration network in FPs than participants from the EU-15 who have more connections and are more central to the network.
6. There is a cognitive distance between the scientific and technological portfolio of prospective participants from the EU-13 and the portfolio of the more successful EU-15.

Environmental conditions

7. Low rates of participation in FPs are a reflection of the relative weakness of the R&I systems of the EU-13 compared to the EU-15.
8. Prospective participants in the EU-13 have alternative and more easily accessible funding opportunities that are less easily available in the EU-15.

Time

9. It is too soon to expect a raise in participation rates as EU-13 R&I actors still have to prove their capabilities.

The Framework Programme

10. The problem of FP participation is specific to certain instruments in FP7 and Horizon 2020.
11. The EU-13 has an insufficient influence on the work programme of the FP.

5.1. Quantity and quality of prospective participants

5.1.1. Hypothesis 1: There are not enough (eligible) participants in the EU-13 relative to the EU-15

This hypothesis concerns the population of potential participants. There is little information on the total number of organisations that might potentially participate. Instead, we compare the ratio between the total number of participations from a Member State in each FP with the total number of researchers as well as with the total value of R&D expenditure (GERD). If the number of potential participants in the EU-13 explains the low rate of participation, we expect the ratios of participations to researchers and to GERD to be similar in the EU-13 and the EU-15. If the ratios are not the same, other explanations must be found.

Methods and data

Testing hypothesis 1 requires information on:

- the total number of participations from every Member State in FP7 and Horizon 2020;
- the total number of researchers; and
- the total value of Gross Expenditure on R&D (GERD).

For every country and region, we have calculated the ratio between the total number of participations in all of FP7 (2007-2013) and in H2020 (2014-2015) and the average annual number of researchers (full-time equivalents) as well as the average annual amount of GERD (millions of euros) in each country and region. All ratios are expressed relative to the average for the EU-15 where EU-15 values equal 100.

Results

The percentage share of EU-15 Member States in the total number of participations is mostly higher in Horizon 2020 than it was in FP7. The percentage share of EU-13 Member States is the same in ERC, MSCA, and CP/IA/RIA projects, but has increased in other projects. Overall, the percentage share of EU-15 participations has increased from 80 to 83 per cent and that of EU-13 participations from 8 to 9 per cent.

The low rate of participation is to some extent a size effect. The EU-13 share in participations is slightly higher than can be expected based on Gross Expenditure on R&D and lower than can be expected based on the number of researchers. Tables 14 and 15 show that in 2007 87.7 per cent of researchers (in full-time equivalents) worked in the EU-15 and 12.3 per cent in the EU-13. In 2014 these percentage shares were more or less the same (87.5 and 12.5 per cent). In 2007 the EU-15 was responsible for 94.8 per cent of EU GERD and the EU-13 for 5.2 per cent. In 2014 the EU-15 was responsible for 92.6 per cent of EU GERD and the EU-13 for 7.4 per cent. The increase in the relative share of EU-13 Member States was the result of a much higher rate of growth of R&D expenditure. The compound annual growth rate of per capita intramural R&D expenditure (GERD) in purchasing power standards (PPS) per inhabitant at constant 2005 prices was 1.6 per cent in the EU-15 and 7.2 per cent in the EU-13.

Table 14. Participations in FP7 and Horizon 2020 per researcher FTE and per unit of GERD
Sources: CORDIS data made available via the EU Open Data Portal. Eurostat, total researchers by sectors of performance, all sectors, FTE (http://ec.europa.eu/eurostat/en/web/products-datasets/-/TSC00004).

Region	Total number of participations	Average annual FTE researchers	Number of participations per FTE researcher (EU-15=100)		Average annual total GERD (millions of euros)	Number of participations per euro of GERD (EU-15=100)	
FP7 (2007-2013)							
EU-13	10,683	193,206	0.055	(73)	9,264	1.153	(264)
EU-15	105,608	1,403,187	0.075	(100)	241,972	0.436	(100)
Horizon 2020 (2014-2015)							
EU-13	3,193	229,242	0.014	(72)	12,804	0.249	(231)
EU-15	30,239	1,558,195	0.019	(100)	279,616	0.108	(100)

Table 15. EC contributions for participation in FP7 and Horizon 2020 per researcher FTE and per unit of GERD
Sources: CORDIS data made available via the EU Open Data Portal. Eurostat, total intramural R&D expenditure (GERD), all sectors (millions of euros), current prices (http://ec.europa.eu/eurostat/web/products-datasets/-/rd_e_gerdtot).
Note: Total EC contributions for projects with known financial data, used to calculate average EC contributions per project, multiplied by total projects.

Region	Estimated total EC contributions (millions of euros)	Average annual FTE researchers	EC contributions per FTE researcher (EU-15=100)	Average annual total GERD (millions of euros)	EC contributions per euro of GERD (EU-15=100)
FP7 (2007-2013)					
EU-13	2,005	193,206	0.010 (32)	9,264	0.216 (115)
EU-15	45,607	1,403,187	0.032 (100)	241,972	0.188 (100)
Horizon 2020 (2014-2015)					
EU-13	712	229,242	0.003 (35)	12,804	0.056 (113)
EU-15	13,762	1,558,195	0.009 (100)	279,616	0.049 (100)

Both for participations and EC contributions, EU-13 participation in FP7 and Horizon 2020 is lower than that of the EU-15 relative to the researcher population but higher relative to gross expenditure on R&D. Table 16 shows that participation varies widely among the Member States.

- Cyprus, Estonia, Latvia, Malta, and Slovenia participate at EU-15 levels.
- Normalised participation of some EU-15 Member States is relatively low, particularly that of France and Germany, but also that of Sweden, Portugal and to some extent Denmark, the UK, and Finland.

There are also differences in the number of unique organisations that participate. Since differences in the number of organisations reflect differences in the institutional make-up of the EU Member States, these numbers are somewhat harder to interpret.
Table 17 shows that the number of unique organisations per thousand FTE researchers is about 10 per cent higher in the EU-13 than in the EU-15. Per million euros of GERD, the EU-13 has between 3½ and 4 times as many unique organisations as the EU-15. Most of the EU-15 also has above-average activity. The counterpart is the relatively low level of activity of the largest science systems in the EU: Germany, France, and the UK as well as Poland, the Czech Republic and Slovakia in the EU-13.

Table 16. Number of participations in FP7 and Horizon 2020 per Member State in relation to the total number of researchers and gross expenditure on R&D
Sources: CORDIS data made available via the EU Open Data Portal. Eurostat, total researchers by sectors of performance, all sectors, FTE (http://ec.europa.eu/eurostat/en/web/products-datasets/-/TSC00004). Eurostat, total intramural R&D expenditure (GERD), all sectors (millions of euros), current prices (http://ec.europa.eu/eurostat/web/products-datasets/-/rd_e_gerdtot.)

	Ratio participations / researchers FTE (EU-15 average = 100)		Ratio participations / GERD (EU-15 average = 100)	
	FP7 (2007-2013)	H2020 (2014-2015)	FP7 (2007-2013)	H2020 (2014-2015)
EU-15	**100**	**100**	**100**	**100**
AT	124	128	95	94
BE	184	160	167	146
DE	72	69	57	51
DK	98	105	89	99
ES	116	159	184	269
FI	84	103	86	111
FR	69	61	66	62
GB	90	89	123	108
GR	205	166	596	609
IE	175	155	167	198
IT	150	148	137	144
LU	132	240	92	182
NL	178	157	160	161
PT	80	109	219	335
SE	117	80	82	69
EU-13	**73**	**72**	**264**	**231**
BG	80	75	774	476
CY	708	1067	1300	2035
CZ	60	52	137	108
EE	171	247	459	640
HR	81	132	260	414
HU	99	70	315	220
LT	66	76	361	307
LV	112	153	600	640
MT	394	360	1016	808
PL	45	35	191	134
RO	77	100	386	469
SI	156	206	280	350
SK	45	59	260	195

Table 17. Number of unique organisations active in FP7 and Horizon 2020 per Member State in relation to the total number of researchers and gross expenditure on R&D
Sources: CORDIS data made available via the EU Open Data Portal. Eurostat, total researchers by sectors of performance, all sectors, FTE (http://ec.europa.eu/eurostat/en/web/products-datasets/-/TSC00004). Eurostat, total intramural R&D expenditure (GERD), all sectors (millions of euros), current prices ().

	Ratio active organisations/ researchers FTE (EU-15 average = 100)		Ratio active organisations / GERD (EU-15 average = 100)	
	FP7 (2007-2013)	H2020 (2014-2015)	FP7 (2007-2013)	H2020 (2014-2015)
EU-15	**100**	**100**	**100**	**100**
AT	139	131	107	96
BE	189	169	172	155
DE	74	69	59	51
DK	108	101	98	94
EL	171	143	495	525
ES	135	182	215	306
FI	84	104	86	112
FR	66	62	63	63
IE	195	152	187	193
IT	158	171	144	165
LU	192	310	134	234
NL	169	150	152	153
PT	95	123	261	377
SE	114	81	80	69
UK	74	70	101	87
EU-13	**112**	**107**	**401**	**344**
BG	157	143	1513	904
CY	931	1059	1709	2013
CZ	85	64	194	133
EE	253	342	677	883
HR	166	219	536	684
HU	124	106	394	333
LT	115	121	632	489
LV	164	232	876	967
MT	521	513	1343	1148
PL	62	53	263	204
RO	137	165	688	774
SI	222	287	398	485
SK	91	104	526	339

Conclusion

The hypothesis is rejected. Low levels of participation and activity are found in specific EU-13 Member States and not in the entire region. CY, EE, LV, MT, and SI participate at EU-15 levels. Only CZ, PL, and SK have relatively low numbers of active organisations. Some EU-15 Member States also have below-average levels of participation and activity. It is perhaps better to distinguish between those Member States oriented towards the European FP funding landscape and those that are not rather than to distinguish between the EU-13 and the EU-15 Member States.

5.1.2. Hypothesis 2: EU-13 organisations are less active in the Framework Programme than EU-15 organisations

Low participation of EU-13 Member States may have its origins in low submission activity. We will examine the number of participations in submitted proposals relative to population, number of researchers, and gross expenditure on R&D in the EU-13 and the EU-15.

Methods and data

The main indicator of submission activity is the number of participations in submitted proposals in relation to population size, size of the researcher population, GERD, and the number of active organisations. We calculate proposal activity based on FP7 data on submissions taken from the E-CORDA database.

Results

Table 18 indicates that on aggregate the EU-13 have lower participations in FP proposal submissions per million population, per FTE researchers and per active organisation. Only the level of participations in submissions per million euros of GERD is much higher, which is possibly related to much lower levels of spending.

Table 18. Participations in proposal submission in FP7 for EU-13 and EU-15 Member States.
Source: E-CORDA database.

				Participations in eligible proposals per			
country	Participations in proposals submitted	Share of participations in ineligible proposals	Participations in eligible proposals	Million population	Thousand FTE researchers	Million euros of GERD	Active organisation
EU-15	**478,449**	**1.9%**	**469,209**	**1,184**	**334**	**1.94**	**22**
AT	15,482	1.6%	15,229	1,822	419	1.87	20
BE	22,183	1.7%	21,798	2,005	532	2.80	19
DE	73,944	1.6%	72,742	894	223	1.02	20
DK	11,388	1.7%	11,196	2,024	302	1.59	19
EL	22,312	2.3%	21,791	1,968	908	15.29	36
ES	57,760	2.2%	56,495	1,223	438	4.04	22
FI	12,674	1.9%	12,435	2,324	309	1.83	25
FR	49,051	1.7%	48,228	746	198	1.10	20
IE	9,070	2.3%	8,863	1,962	599	3.33	21
IT	64,022	2.4%	62,509	1,058	602	3.19	26
LU	1,087	1.9%	1,066	2,114	435	1.76	15
NL	31,447	1.4%	31,007	1,871	525	2.73	21
PT	12,646	3.1%	12,254	1,162	313	4.98	22
SE	19,365	2.7%	18,843	2,018	372	1.50	22
UK	76,018	1.7%	74,753	1,196	292	2.30	26
EU-13	**59,827**	**3.3%**	**57,846**	**546**	**299**	**6.24**	**18**
BG	4,379	5.3%	4,146	559	358	20.06	15
CY	3,062	3.3%	2,960	3,624	3,421	36.42	25
CZ	7,026	2.3%	6,862	658	225	2.96	18
EE	2,505	3.2%	2,425	1,820	574	8.92	15
HR	2,376	2.7%	2,312	538	345	6.45	14
HU	7,690	2.9%	7,468	747	350	6.45	19
LT	2,133	2.4%	2,081	668	247	7.89	14
LV	1,506	3.3%	1,456	687	370	11.48	15
MT	995	2.3%	972	2,352	1,508	22.56	19
PL	12,150	2.5%	11,848	311	184	4.52	20
RO	7,533	6.3%	7,058	346	380	11.10	19
SI	5,731	2.5%	5,589	2,743	714	7.41	22
SK	2,741	2.6%	2,669	495	189	6.35	14

There were 334 participations in proposal submissions for every thousand FTE researchers in the EU-15 as against 299 for the EU-13. The average active EU-15 organisation in FP7 participated in 22 proposals compared to 18 for the average active EU-13 organisation. Only in CY, PL and SI did the average active organisation participate in numbers of proposals comparable those of active organisations in the EU-15. CY, EE, MT, and SI had high levels of participation in proposal submission per million population, per FTE researchers, and per million euros of GERD. Remarkably, Germany, France, and the UK had levels of participation in proposal submission far below the EU-15 average.

Conclusion

The hypothesis is tentatively confirmed. On average, the EU-13 Member States have lower levels of participation in proposal submission than the EU-15 Member States. Some countries are far more active – notably CY, EE, MT, PL and SI – while the big three Member States – DE, FR, UK – were much less active.

5.1.3. Hypothesis 3: The quality of proposals involving participants from the EU-13 is lower than that of proposals not involving participants from the EU-13

Low participation of the EU-13 may originate in a low success rate. EU-13 organisations may be just as active in the Framework Programme as EU-15 organisations but participate in proposals of lower quality, resulting in lower success rates and, consequently, lower participation in FP projects.

Methods and data

The quality of proposals is evaluated using three indicators:

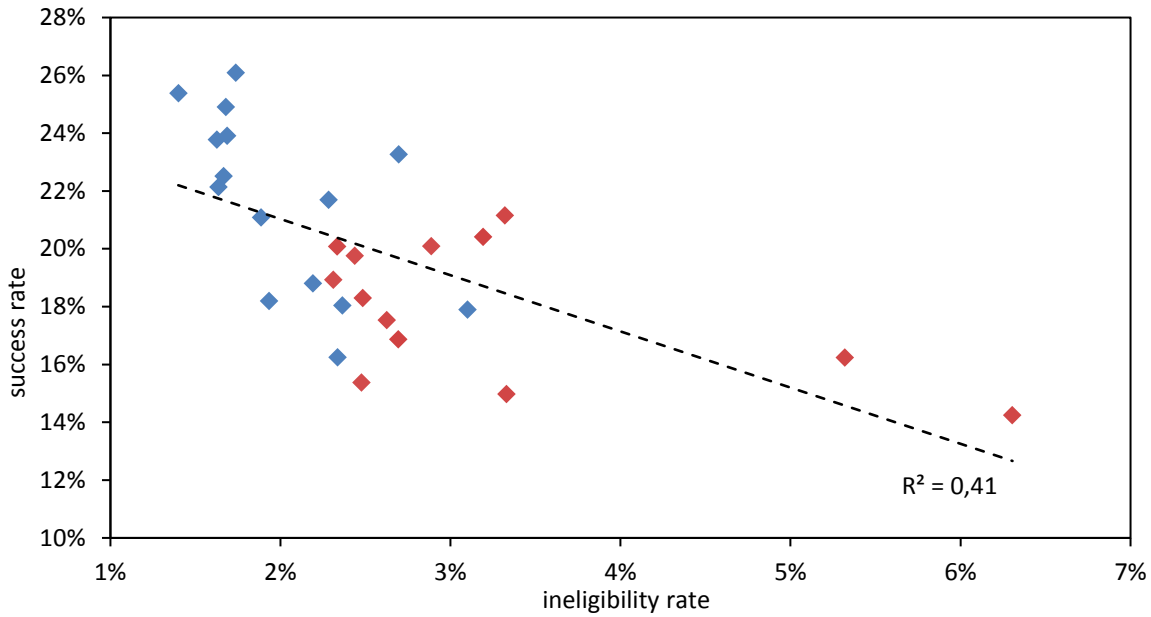
- The ineligibility rate, which is the ratio between the total number of participations in submitted proposals and the number that did not enter into the evaluation process due to serious formal errors;
- the participation success rate, which is equal to the proportion of participations in submitted proposals that were successful; and
- the financial success rate, which is equal to the ratio between the sum total of support requested by all submitted proposals and the total requested support of successful proposals.

We will separately evaluate the success rate of the project coordinators and project participants.
The necessary data are taken from the E-CORDA database of DG RTD, Eurostat

Results

Table 18 indicates the lower ability of the EU-13 to write, compile and submit an eligible project proposal to FP7. The number of participations in proposals that were found ineligible – which means they did not enter into the evaluation process due to serious formal errors – was higher for proposals involving EU-13 organisations (3.3 per cent) than for proposals involving EU-15 organisations (1.9 per cent). The table also illustrates the diversity of the EU Member States. It is clear that according to 'participations in eligible proposals per 1000 FTE' CY and MT are outliers in the EU-13, see the sixth column of the Table 18. The same holds good for EL in the EU-15. Ineligibility is more important than the low percentage shares suggest. Without the outliers CY, MT, and EL, there is no correlation between the activity of project proposers and the success rate of the submitted projects. There is, however, a strong negative correlation between the rate of participations in ineligible proposals and the participation success rate, see Figure 3.

Figure 3. Member State success rate compared to ineligibility rate in FP7
Note: Red diamonds indicate EU-13 Member States. Blue diamonds indicate EU-15 Member States.
Source: E-CORDA database, version November 2015.



What the figure shows is that:

- The ineligibility rates of EU-13 and EU-15 proposal participations differ about 1.5 per cent, while their success rates differ about 4 per cent.
- Most EU-15 Member States combine low ineligibility rates with high success rates. IT, EL, ES, and LU have lower success rates; PT had the ineligibility rate and he success rate comparable to the EU-13.
- Most EU-13 Member States combine high ineligibility rates with lower success rates. BG and RO have very high ineligibility rates (over 5 per cent). CZ, LT, MT, and PL have levels comparable to ES and IT.

Organisations from the EU-13 Member States clearly have lower skills in writing and compiling R&I project proposals.

The success rate of participations in eligible proposals in FP7 was four percentage points higher for the EU-15 than for the EU-13 (see Table 19). This is after taking into account the skill differences that produce ineligible proposals. Five EU-13 Member States approach the EU-15 average: CZ, EE, HU, LT, and LV. Five EU-15 Member States have success rates similar to the EU-13 level: EL, ES, IT, LU, and PT. In terms of success rates, the two regions of the EU are not homogeneous.

Differences between the EU-13 and EU-15 are more pronounced in terms of the number of successful participations in proposals per unique organisation active in FP7. The average EU-15 organisation had 4.9 proposals accepted compared to 3.2 proposals of EU-13 organisations. With the exception of LU all EU-15 Member States had higher averages than all EU-13 Member States.

Table 19. Success rate of participations in submitted proposals by EU-13 and EU-15 organisations in FP7
Source: E-CORDA database, version November 2015.

	Number of participations in submitted proposals	Of which ineligible	Share of participations in ineligible proposals	Eligible	rejected	Reserve	Successful participations (mainlist)	Successful proposal participations per active organisation
EU-15	**478,449**	**9,240**	**1.9%**	**469,209**	**70%**	**8%**	**21.8%**	**4.9**
AT	15,482	253	1.6%	15,229	70%	8%	22.1%	4.5
BE	22,183	385	1.7%	21,798	64%	10%	26.1%	4.9
DE	73,944	1,202	1.6%	72,742	68%	8%	23.8%	4.8
DK	11,388	192	1.7%	11,196	66%	10%	23.9%	4.5
EL	22,312	521	2.3%	21,791	77%	7%	16.2%	5.8
ES	57,760	1,265	2.2%	56,495	73%	8%	18.8%	4.1
FI	12,674	239	1.9%	12,435	70%	9%	21.1%	5.2
FR	49,051	823	1.7%	48,228	66%	9%	24.9%	5.0
IE	9,070	207	2.3%	8,863	70%	9%	21.7%	4.5
IT	64,022	1,513	2.4%	62,509	75%	7%	18.0%	4.6
LU	1,087	21	1.9%	1,066	75%	6%	18.2%	2.8
NL	31,447	440	1.4%	31,007	65%	9%	25.4%	5.3
PT	12,646	392	3.1%	12,254	74%	8%	17.9%	4.0
SE	19,365	522	2.7%	18,843	68%	8%	23.3%	5.1
UK	76,018	1,265	1.7%	74,753	70%	8%	22.5%	5.9
EU-13	**59,827**	**1,981**	**3.3%**	**57,846**	**75%**	**7%**	**17.8%**	**3.2**
BG	4,379	233	5.3%	4,146	77%	7%	16.2%	2.5
CY	3,062	102	3.3%	2,960	79%	6%	15.0%	3.7
CZ	7,026	164	2.3%	6,862	71%	8%	20.1%	3.6
EE	2,505	80	3.2%	2,425	72%	7%	20.4%	3.1
HR	2,376	64	2.7%	2,312	76%	7%	16.9%	2.3
HU	7,690	222	2.9%	7,468	72%	8%	20.1%	3.8
LT	2,133	52	2.4%	2,081	74%	6%	19.8%	2.9
LV	1,506	50	3.3%	1,456	72%	7%	21.2%	3.2
MT	995	23	2.3%	972	74%	7%	18.9%	3.7
PL	12,150	302	2.5%	11,848	75%	7%	18.3%	3.6
RO	7,533	475	6.3%	7,058	79%	6%	14.2%	2.7
SI	5,731	142	2.5%	5,589	78%	7%	15.4%	3.3
SK	2,741	72	2.6%	2,669	75%	8%	17.5%	2.5

The differences between EU-13 and EU-15 in 'rejection rates' and 'success rates' might seem to be small, however, they are systematic: The EU-13 have statistically significantly higher rejection rate than the EU-15 (the t-statistics for testing this difference amounts to 3,77, which is a value significant at 1 per cent). Similarly, the EU-13 have statistically smaller success rate than the EU-15 ($t = 3{,}51$, $p < 5$ per cent).

There is a clear difference in success rates between proposals in which EU-13 organisations participated and proposals coordinated by EU-13 organisations. Table 20 compares the aggregate success rates of proposals involving EU-13 and EU-15 partners as participants or as coordinators. Table 21 shows the same indicators for individual EU-13 countries.

The difference between the success rates of EU-13 and EU-15 coordinators is highly statistically significant ($p<0{,}0001$). The success rate of coordinators is quite crucial: any coordinator's failure means rejection of the whole project proposal thus a rejection of the team of participants who prepared the proposal. The difference between success rates of participants (who did not coordinate a project) is not so dramatic, but it is still highly statistically significant ($p < 0{,}0001$). Let us remark that participation success rate in project proposals prepared solely by EU-13 participants was only 15.3 per cent in the FP7.

Table 20. Success rates of participations in proposals of EU-13 and EU-15 organisations as coordinators and participants in FP7
Source: E-CORDA database of DG RTD and EUROSTAT.

Role	Ineligible	Rejected	Reserve	Mainlist	Eligible participations	Success rate	EU-15 =100	Financial success rate	EU-15 =100
EU-13									
Coordinator	509	7,445	293	1,027	8,765	11.7%	64	6.1%	45
Participant	1,472	35,988	3,839	9,254	49,081	18.9%	82	15.6%	68
Total	1,981	43,433	4,132	10,281	57,846	17.8%	81	11.4%	62
EU-15									
Coordinator	2,526	89,424	6,818	21,508	117,750	18.3%	100	13.7%	100
Participant	6,714	238,509	31,942	81,008	351,459	23.0%	100	23.1%	100
Total	9,240	327,933	38,760	102,516	469,209	21.8%	100	18.5%	100

Table 21. Success rates of proposals of EU-13 Member States as coordinators and participants in FP7
Source: E-CORDA database of DG RTD and EUROSTAT.

	Role	Ineligible	Rejected	Reser-ve	Main-list	Participation success rate	EU-15=100	Financial success rate	EU-15=100
BG	Coordinator	47	436	13	48	9.7%	54	5.2%	38
	Participant	186	2741	283	625	17.1%	76	13.8%	60
	Total	233	3177	296	673	16.2%	76	9.9%	54
CY	Coordinator	23	492	22	79	13.3%	74	6.1%	44
	Participant	79	1851	152	364	15.4%	68	11.9%	52
	Total	102	2343	174	443	15.0%	70	9.4%	51
CZ	Coordinator	31	818	41	118	12.1%	67	5.6%	41
	Participant	133	4083	542	1260	21.4%	95	19.4%	84
	Total	164	4901	583	1378	20.1%	94	14.0%	76
EE	Coordinator	23	264	14	56	16.8%	94	13.8%	101
	Participant	57	1492	160	439	21.0%	93	17.2%	75
	Total	80	1756	174	495	20.4%	95	15.9%	86
HR	Coordinator	11	317	22	40	10.6%	59	6.8%	49
	Participant	53	1447	136	350	18.1%	80	16.0%	69
	Total	64	1764	158	390	16.9%	79	11.0%	59
HU	Coordinator	36	941	49	213	17.7%	99	10.9%	79
	Participant	186	4441	537	1287	20.5%	91	16.8%	73
	Total	222	5382	586	1500	20.1%	94	14.3%	78
LT	Coordinator	4	173	1	30	14.7%	82	10.8%	79
	Participant	48	1364	132	381	20.3%	90	15.1%	65
	Total	52	1537	133	411	19.8%	92	13.7%	74
LV	Coordinator	10	176	7	26	12.4%	69	5.3%	39
	Participant	40	876	89	282	22.6%	100	16.8%	73
	Total	50	1052	96	308	21.2%	99	11.1%	60
MT	Coordinator	1	89	8	21	17.8%	99	3.6%	26
	Participant	22	629	62	163	19.1%	84	12.5%	54
	Total	23	718	70	184	18.9%	88	10.6%	57
PL	Coordinator	81	1823	61	229	10.8%	61	5.3%	39
	Participant	221	7023	774	1938	19.9%	88	16.7%	72
	Total	302	8846	835	2167	18.3%	85	11.0%	59
RO	Coordinator	203	879	14	70	7.3%	41	3.4%	25
	Participant	272	4716	444	935	15.3%	68	12.1%	52
	Total	475	5595	458	1005	14.2%	67	8.1%	44
SI	Coordinator	24	724	27	58	7.2%	40	5.3%	39
	Participant	118	3638	341	801	16.8%	74	13.8%	60
	Total	142	4362	368	859	15.4%	72	10.3%	55
SK	Coordinator	15	313	14	39	10.7%	60	3.0%	22
	Participant	57	1687	187	429	18.6%	82	15.6%	68
	Total	72	2000	201	468	17.5%	82	10.3%	56

While the differences between the EU-13 and EU-15 participation success rates are not so big, differences between the success rate of coordinators are enormous. EU-13 coordinators submitted 509 ineligible proposals and only twice as many (1,027) proposals had the quality necessary for gaining the EC support (i.e. to be on the mainlist). EU-15 coordinators submitted nine times as many successful proposals (21,508) as ineligible proposals (2,526).

The financial success rate of EU-13 coordinators was only 6 per cent, which is lower than one half of the financial success rate of the EU-15, which amounted to 13.7 per cent. The financial success rate of coordinators is low in several EU-13 countries. In ten of the EU-13 countries (BG, CY, CZ, HR, LV, MT, PL, RO, SI, SK) it is less than half the average financial success rate of EU-15.

Detailed analysis reveals that due to ineligibility of proposals EU-13 coordinators lost 1,086 million euros in requested support and gained in successful proposals only 420 million euros. The same numbers for EU-15 coordinators are 5,511 million euros lost and gained 13,010 million euros gained in support for successful proposals. The ratio between gains and losses was 0.4 in the EU-13 and 2.4 in the EU-15.

The statistics point towards an enormous gap in quality. Poor performance by a coordinator always harms the entire consortium. The quality gap of coordinators aggravates low EU-13 participation in the FP.

The quality of the project proposals depends on the quality of consortia that compile and submit the proposals. Table 23 provides evidence that if the teams from the most prestigious European institutions do participate in preparing project proposals then such proposals have much higher chance to be successful than other proposals.

The TOP15 FP7 institutions, i.e. institutions to which the European Commission allocated the highest total support for their participation in the FP7 are listed in the following Table 22.

Table 22. The 15 organisations with the highest number of participations in FP7 (the TOP15)
Source: E-CORDA database, version November 2015.

TOP15	country	participations	support (M€)
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE (CNRS)	FR	1524	793
FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V. (FhG)	DE	1205	568
THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF OXFORD (Oxford)	UK	719	437
THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF CAMBRIDGE (Cambridge)	UK	737	424
COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES (CEA)	FR	745	423
MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V. (MPG)	DE	665	412
UNIVERSITY COLLEGE LONDON (UCL)	UK	600	351
EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH (ETHZ)	CH	562	337
IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE (ICSTM)	UK	657	325
ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE (EPFL)	CH	508	305
INSTITUT NATIONAL DE LA SANTE ET DE LA RECHERCHE MEDICALE (INSERM)	FR	430	295
KATHOLIEKE UNIVERSITEIT LEUVEN (KUL)	BE	549	263
AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS (AECSIC)	ES	709	260
THE UNIVERSITY OF EDINBURGH (UE)	UK	414	234
CONSIGLIO NAZIONALE DELLE RICERCHE (CNR)	IT	694	230

It should be emphasized that these 15 institutions, further referred to as TOP15, participate in solving FP7 projects to which the European Commission allocated 51 per cent of the whole FP7 budget distributed among the FP7 participants. Thus, the TOP15 are not important because they received the highest support, but because are the smallest group of organisations which participate in projects that bring into effect more than one half of the (distributed) FP7 budget.

Table 23 brings basic statistics characterizing collaboration of the individual EU Member States with TOP15. This table shows four things:

- The TOP15 organisations are the most active and experienced organisations in the European Framework Programmes.
- Proposals written by consortia that involve at least one TOP15 organisation are more successful than other consortia. The average participation success rate in proposals prepared jointly with TOP15 is 24.6 per cent while without TOP15 only 17.7 per cent. The average increase of the success rate amounts to 6.8 per cent, which is highly statistically significant ($p < 0,01$ for the paired T-test). Remark that the average EU-13 increase of the success rate due to collaboration with TOP15 was 7.4 per cent while 6.3 per cent for EU-15.
- The average participation success rate in proposals prepared **without** collaboration with TOP15 was statistically significantly higher for EU-15 (19.3 per cent) than with EU-13 (16.2 per cent) for EU-13. However, this statistical difference disappears with proposals prepared jointly (with at least one team of) TOP15. The average participation success rate of EU-15 in proposals prepared jointly with TOP15 was 25.6 per cent for EU-15 while for EU-13 it amounted to 23.4 per cent. The difference between these two values is not statistically significant (double-sided t statistics = 1.71, which is not significant neither at 5 per cent significance level). Thus preparing proposals jointly with TOP15 equalizes the participation success rates of EU-13 and EU-15.
- EU-13 organisations collaborate less frequently with TOP15 organisations than EU-15 organisations.

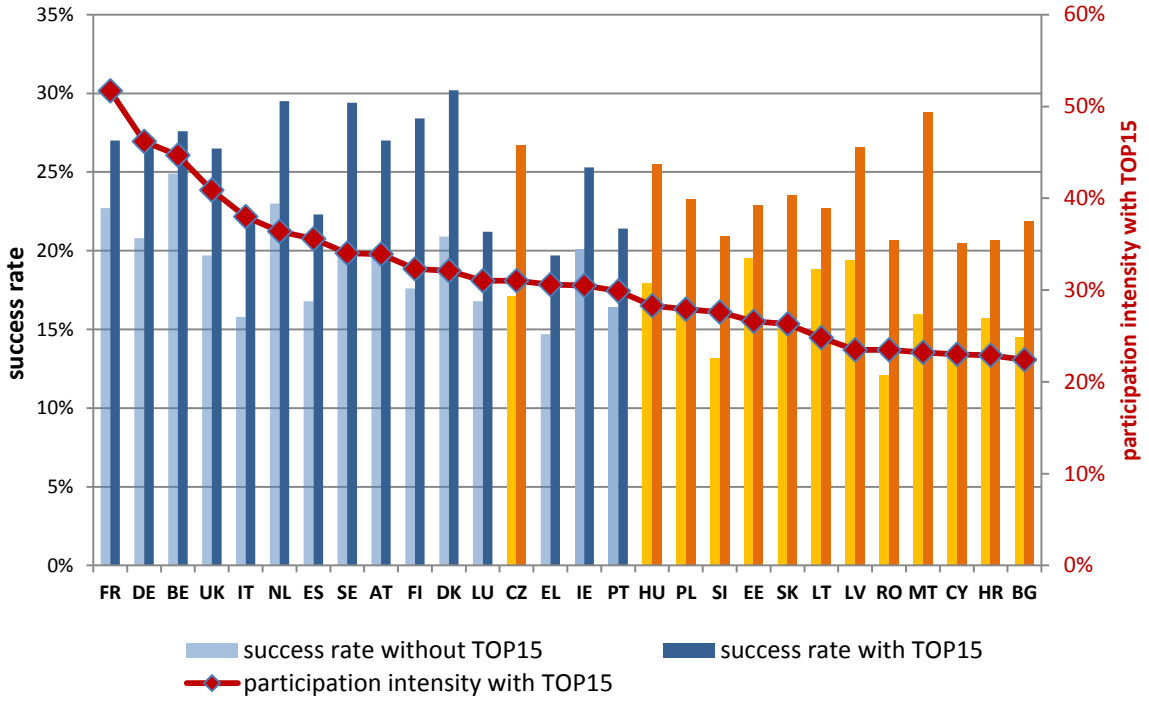
Table 23. Characteristics of individual EU-28 countries collaboration with TOP15
Note: The 'participation intensity with TOP15' is the ratio of all (i.e. sum of ineligible and eligible) participations in proposals prepared in collaboration with at least one team of the TOP15 toward participations in all submitted project proposals. Source: E-CORDA database, version November 2015.

	INELIGIBLE		REJECTED		RESERVE		MAINLIST		participation	success rate	
country	without TOP15	with TOP15	without TOP15	with TOP15	without TOP15	with TOP15	without TOP15	with TOP15	intensity with TOP15	without TOP15	with TOP15
EU-15											
AT	206	47	7285	3327	769	476	1967	1405	33.9%	19.6%	27.0%
BE	281	104	7900	6117	1102	990	2977	2712	44.7%	24.9%	27.6%
DE	845	357	27825	21533	2979	3106	8112	9187	46.2%	20.8%	27.2%
DK	156	36	5245	2110	742	422	1584	1093	32.1%	20.9%	30.2%
EL	419	102	11884	4842	958	567	2216	1324	30.6%	14.7%	19.7%
ES	1000	265	27526	13783	2592	1967	6097	4530	35.6%	16.8%	22.3%
FI	196	43	6295	2406	615	497	1472	1150	32.3%	17.6%	28.4%
FR	504	319	15901	16064	2047	2203	5261	6752	51.7%	22.7%	27.0%
IE	179	28	4412	1770	484	274	1230	693	30.5%	20.1%	25.3%
IT	1092	421	30012	16589	2525	2102	6083	5198	38.0%	15.8%	21.8%
LU	14	7	564	239	48	21	124	70	31.0%	16.8%	21.2%
NL	349	91	13388	6802	1752	1192	4523	3350	36.4%	23.0%	29.5%
PT	311	81	6533	2514	614	400	1401	792	29.9%	16.4%	21.4%
SE	439	83	8910	3952	959	638	2476	1908	34.0%	20.1%	29.4%
UK	877	388	32222	19983	3111	2608	8694	8135	40.9%	19.7%	26.5%
EU-13											
BG	217	16	2531	646	187	109	461	212	22.4%	14.5%	21.9%
CY	89	13	1842	501	125	49	301	142	23.0%	13.3%	20.5%
CZ	137	27	3559	1342	351	232	804	574	31.0%	17.1%	26.7%
EE	71	9	1301	455	122	52	344	151	26.6%	19.5%	22.9%
HR	56	8	1392	372	104	54	279	111	22.9%	15.7%	20.7%
HU	193	29	3974	1408	392	194	953	547	28.3%	17.9%	25.5%
LT	47	5	1170	367	94	39	292	119	24.8%	18.8%	22.7%
LV	45	5	831	221	61	35	215	93	23.5%	19.4%	26.6%
MT	18	5	579	139	48	22	119	65	23.2%	16.0%	28.8%
PL	269	33	6581	2265	529	306	1385	782	27.9%	16.3%	23.3%
RO	448	27	4379	1216	291	167	643	362	23.5%	12.1%	20.7%
SI	111	31	3264	1098	240	128	535	324	27.6%	13.2%	20.9%
SK	64	8	1529	471	127	74	301	167	26.3%	15.4%	23.5%

While the participation intensity with TOP15 of the EU-15 is always higher than 30 per cent (with the exception of PT), the EU-13's participation intensity with the TOP15 is always lower than 30 per cent (with the exception of CZ). The participation intensity is, of course, highest in FR, DE, UK, IT and BE, which is where the TOP15 are mainly located.

Figure 4 presents the participation success rates in proposals prepared in collaboration with or without the TOP15 as well as the participation intensity with TOP15. Member States are arranged in decreasing order of participation intensity, which is a very good discriminator of EU-13 and EU-15.

Figure 4. Success rates with and without the TOP15 in relation to participation intensity with the TOP15
Note: The red dots with the scale on the right-hand side of the graph indicate participation intensity. The dark blue columns show EU-15 success rates in proposals prepared jointly with TOP15 teams. The light blue columns show EU-15 success rate in proposals prepared without TOP15 teams. The light and dark yellow columns indicate the same for the EU-13.



For every EU-28 project proposals prepared in collaboration with the TOP15 have a much higher success rate than proposals prepared without collaboration with the TOP15. The average increment in the success rate is 6.3 per cent in the EU-15 and 7.4 per cent in the EU-13.

Increasing the collaboration with TOP15 in preparing project proposals might not only considerably improve the participation success rates of the EU-13 but also improve performing the project activities. Thus, collaboration with the TOP15 might be considered a form of spreading excellence in the EU-13.

Conclusion

The hypothesis is confirmed. Yet, it has two dimensions: administrative quality determines eligibility and substantive quality determines the success rate. Proposals involving EU-13 organisations are more likely to be ineligible and where they are eligible, they are less likely to be successful. The gap between the EU-13 and EU-15 is concentrated in proposals coordinated by EU-13 organisations. Coordination requires special skills that are rare among EU-13 organisations.

5.1.4. Hypothesis 4: Prospective participants from the EU-13 are not good enough relative to the EU-15

Quality is one of the most important and most controversial concepts in science policy. Quality is a marker attached to individuals (e.g. talent, excellent researchers), to institutions (e.g. universities in the top of worldwide rankings), and to publications (e.g. papers in high-impact journals or that have received a large number of citations). Definitions of quality vary by scientific discipline, by type of institution, and by the nation. The social sciences and humanities have different ideas about the quality of output than the natural sciences; universities of applied science and technical universities tend to attach higher value to applied results than general universities; and some nations allocate core funding based on quality assessments (notably the UK) where other nations rely mainly on block grants.

We use three indicators to approximate the quality of prospective participants:

- average citation impact of scientific output per Member State;
- publications resulting from the FP7 projects; and
- the position of national universities in the CWTS Leiden Ranking.

All indicators are incomplete and controversial. They are, however, also generally accepted as a good proxy in the absence of more comprehensive and reliable statistics.

5.1.4.1 Aggregate output quality

Citation impact is one of the most pervasive indicators of quality in science. Two things must be considered when calculating the citation impact of scientific output.

- The sources for such calculations are biased towards the natural and medical sciences and away from the social sciences and humanities.
- The number of citations per publication is a good indicator within scientific specialisations. However, each discipline and specialisation have developed its own specific 'citation culture' (Wouters, 1999). Calculating citation impact for the entire scientific output of a nation requires that we normalise for such field-specific differences.

We use Scopus data, extracted from the Scimago website, to calculate a weighted average Field-Normalised Citation Score (FNCS) for the total scientific output of the EU-13 and EU-15. This FNCS gives an indication of the relative quality of each science systems relative to the other EU nations.

Methods and data

Aggregate national output quality is calculated based on data extracted from the Scimago Journal & Country Rank (www.scimagojr.com). Scimago presents aggregated data drawn from Elsevier's Scopus bibliographic index. It provides data on the number of documents, citable documents, citations, self-citations, and citations per document per country for each of the 309 Scopus subject categories from 1996 until 2016. We focus on the years 2013, 2014 and 2015.

First, for each country and for each of the 309 Scopus subject categories we have calculated a citation score. This score is defined as the average number of citations per paper in one particular subject category in one particular EU nation divided by the average number of citations per paper in the same subject category in the United States of America. The USA is our benchmark. Self-citations are excluded.

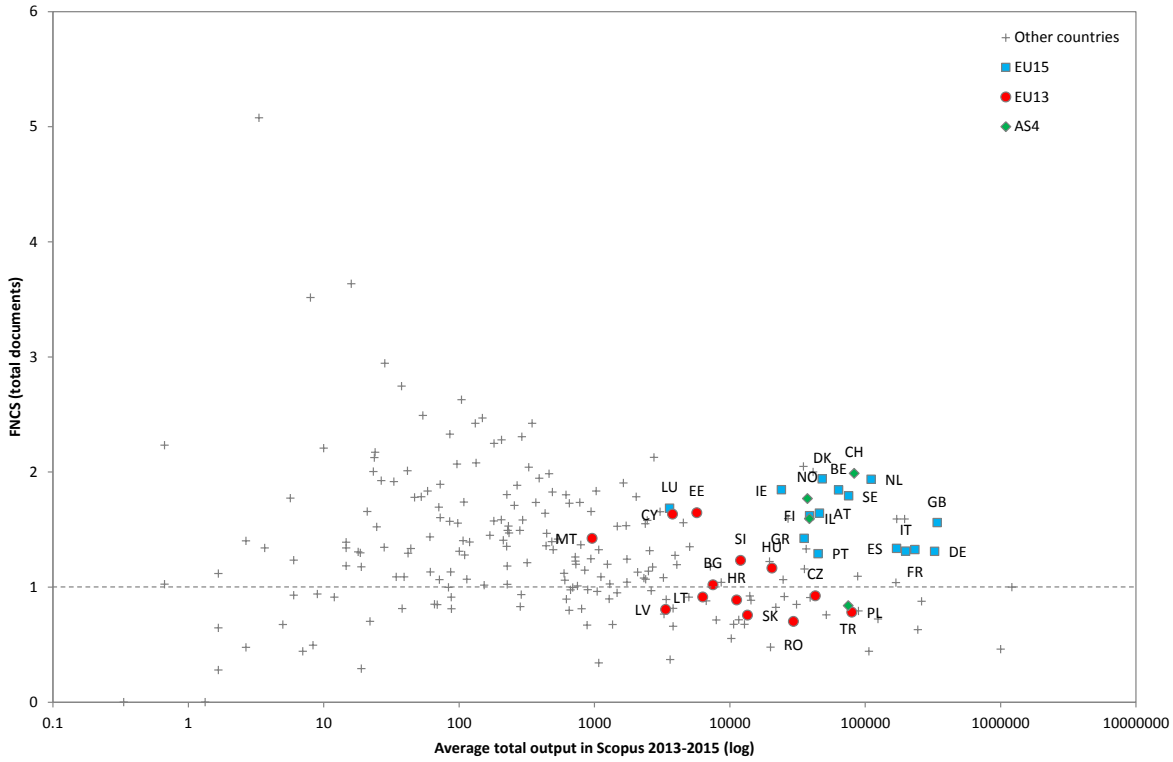
Next, we have calculated a weighted average citation score per country using national output per subject category as the weight. The resulting number is the national Field-Normalised Citation Score (FNCS).

Results

Figure 5 presents the FNCS for all the world's nations and dependencies in the Scopus database as aggregated on the Scimago website in relation to their total scientific output. The EU-13 Member States are shown in red, the EU-15 Member States in blue. The FNCS of the USA equals 1.

- The EU-15 Member States as well as the associated states of Switzerland, Norway and Israel generally produce more scientific output and have a relative high FNCS for their output size.
- The EU-13 Member States as well as Turkey generally produce fewer scientific publications and have lower average FNCS than the EU-15.
- Some EU-13 Member States achieve an average FNCS as high as or near to the level of the EU-15. This concerns Cyprus, Estonia, Malta, Slovenia, and Hungary.
- Some EU-15 Member States produce scientific output with a lower average FNCS. Italy, Portugal, Spain, France, Greece, and Germany have an FNCS similar to Slovenia and Hungary and lower than the rest of the EU-15.

Figure 5. Field-normalised citation scores of national output for 237 countries and dependencies in Scopus, 2013-2015 (USA=1)
Source: Scimago Journal Ranking (www.scimagojr.com)
Note: Citations per citable document, excluding self-citations.



5.1.4.2 Quality of FP7-related output

In order to assess whether the EU-13 countries are useful and equal members of the FP7 project consortia and produce comparable results as the EU-15 countries (i.e. have enough skills to participate) and whether the participation in the FP7 is beneficial for their research systems (i.e. have sufficient motivation to participate), we have analysed publications resulting from the FP7 projects.
Because we were not able to analyse results of all EU countries, we have analysed the results of 4 representatives of the EU-13 countries and 3 representatives of the EU-15 countries. Only the middle sized or small countries were selected and we took care to include the countries with relatively high and low GERD in both groups. We have compared the publications of the selected EU-13 and EU-15 countries resulting from FP7 mutually and also with their total national publication outputs.

Methods and data

We have analysed the publications assigned to the FP7 projects with the Austrian, Finnish, Portuguese, Czech, Hungarian, Slovenian and Slovakian participants published from 2008 to 2015. The numbers, acronyms and the starting dates of the FP7 projects with participants from the above named countries were retrieved from the database E-CORDA. Publications referring to these grant numbers and/or to their acronyms were extracted from the Core Collection of the Web of Science (WoS) of Thomson Reuters. All publications having at least one co-author with affiliation in the analysed country have been assigned in full to the given country.

The bibliometric data of the publications assigned to the FP7 projects were compared with the total publication output of the named countries (i.e. the national standards). The data for the national standards have been retrieved from the InCites of Thomson Reuters. Comparisons were done namely in the intensity of international collaboration and citation impact of the publications. International collaboration has been calculated as the percentage share of the international papers in the evaluated set of publications. All publications with co-author affiliations to at-least 2 different countries were considered as international. Citation impact of publications has been analysed using open citation window (i.e. counting all citations received since the time of publication) and normalization of the citation counts according to citation standards. Category normalized citation impact (CNCI) assigned to each set of publication in the InCites has been used. The CNCI value greater than 1 indicates that the publications are more cited than the world standards. Full counting was used in all cases.

Results

Analysis of participation of the 7 selected EU countries and it results

Each of the three EU-15 countries was participating in more FP7 projects than any of the analysed EU-13 country (Table 24). In all countries, the highest project numbers belong to the FP7-Cooperation programme; however, in the EU-15 countries, the FP7-Cooperation represented in average about 69 per cent of all FP7 projects while in the EU-13 countries only about 60 per cent. Considerably lower relative participation had EU-13 countries in the FP7-Ideas programme. On the contrary, they had higher relative participation in the FP7-Capacities and FP7-Euratom programmes.

We have retrieved the publications which have acknowledged the grant number(s) with participants from each of the analysed countries (Table 25). Majority of the resulting publications had authors from other countries than the analysed country, which is not surprising given the multinational research consortia of the FP7 projects. Only about 9 per cent to 18 per cent of the publications had the co-authors with the affiliation in the analysed country; the highest, 17.6 per cent in case of the Portugal and the lowest, 9.1 in case of Slovenia (Table 25). In case of the projects with recipients from the analysed EU-13 countries, the percentage of the publications with the co-authors from the same country (i.e. domestic co-authors) was considerably lower than in the case of the projects with recipients from the analysed EU-15 countries (average 11.1 per cent in EU-13 and 17.1 per cent in EU-15, see Table 25). This finding indicates that project participants from the EU-15 countries have higher publication activity than participants from EU-13 countries.

Consequently, also the percentage of the projects with participants from one of the analysed EU-13 countries which have produced publication(s) with co-authors from the same country (i.e. domestic co-authors) is smaller than in the case of the analysed EU-15 countries (compare averages 30.5 per cent in EU-13 and 35.6 per cent in EU-15, Table 25 and Figure 6). Publication activity is thus somewhat lower in the analysed EU-13 than in EU-15 countries. The highest yields of the FP7 projects producing publications with co-authors from the same country as the grant recipients were signed in 2009-2010; 40 to 50 per cent of these projects had publications with the domestic co-authors (Figure 6). The grants signed in later years had lower publication activity, but they also had less time to publish (and they may still publish in later years). From all grants signed 2007 - 2014, only about one third has produced

publications with co-authors from the same country as the grant recipients (i.e. with the domestic co-authors).

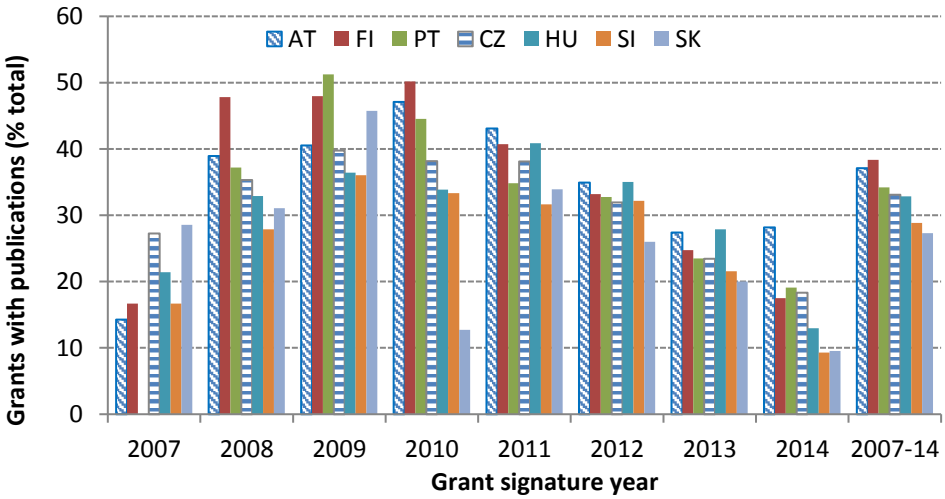
Table 24. Numbers and yields of the FP7 projects resulting from the projects with participants affiliated in each of the 7 analysed countries.

Country	AT	FI	PT	CZ	HU	SI	SK	Avg AT-FI-PT	Avg CZ-HU-SI-SK
FP7 projects (number)	2443	1785	1676	1139	1197	717	388	1968	860
Cooperation (% total)	71.2	72.3	63.3	62.0	52.6	66.4	58.9	68.9	60.0
Ideas (% total)	3.6	2.7	1.9	1.1	2.8	0.3	0.2	2.8	1.1
People (% total)	12.5	8.5	15.9	13.6	17.5	9.7	13.8	12.3	13.6
Capacities (% total)	12.4	13.3	17.8	17.4	22.9	20.1	21.5	14.5	20.5
Euratom (% total)	0.3	3.2	1.1	6.0	4.3	3.4	5.5	1.5	4.8

Table 25. Publications resulting from the FP7 projects with participants affiliated in each of the 7 analysed countries. Numbers of all publications (all authors) resulting from the FP7 projects with participants from the given country as well as of the publications with co-authors from the same country as the grant recipients (domestic co-authors only) are shown.

Grant recipients from:	AT	FI	PT	CZ	HU	SI	SK	Avg AT-FI-PT	Avg CZ-HU-SI-SK
All authors	26497	22074	18087	14678	15701	8909	4536	22219	10956
Domestic co-author(s)	4251	3863	3181	1970	1974	814	424	3765	1296
Domestic co-author(s)	16.4%	17.5%	17.6%	13.4%	12.6%	9.1%	9.3%	17.1%	11.1%

Figure 6. Yields of the FP7 projects producing publications with co-authors from the same country as the grant recipients (i.e. participants of the project consortia). The data are shown as a percentage of all grants contracted to each country in the given year.



EU-13 countries have a lower total number of publications resulting from the FP7 projects because they have a lower number of the projects (Table 26 and Figure 7 top). The highest percentage of the publications resulted from the FP7-Cooperation programme, the lowest from the FP7-Euratom (Table 26). However, there were differences among individual countries. On average, the analysed EU-13 countries had a much lower yield of publications resulting from the FP7-Ideas and somewhat lower yield of publications resulting from the FP7-Cooperation than the analysed EU-15 countries. On the other hand, the EU-13 countries had higher yields of publications from FP7-Capacities and FP7-Euratom.

Although the EU-13 countries produce a lower number of the FP7 publications, when numbers of publications per project are calculated, the analysed EU 13 countries are only slightly less productive the analysed EU-15 countries (Figure 7 middle part). Moreover, when numbers of publications per million

Euro project costs are calculated, the EU 13 countries are doing even better than the EU-15 countries (Figure 7 bottom part). The analysed EU 13 countries are thus somewhat less productive members of the project consortia but they are also less expensive.

There are also considerable differences in the publication activity among individual types of the FP7 programmes. When numbers of publications per project are compared, the most productive is the FP7-Ideas programme. However, when numbers of publications per million Euro project costs are compared, the FP7-People is even more productive than the FP7-Ideas programme. Quite exceptional is a very high number of the Austrian and Portuguese publications per million euro funding in the FP7-Euratom (Figure 7 bottom part).

Figure 7. Publications resulting from the FP7 projects with both participant(s) and co-author(s) affiliated in one of the 7 analysed countries. Top: numbers of publications in individual FP7 programmes; middle: publications per projects; bottom: publications per project cost. The data were retrieved from WoS based on citation of the grant numbers in the funding acknowledgement.

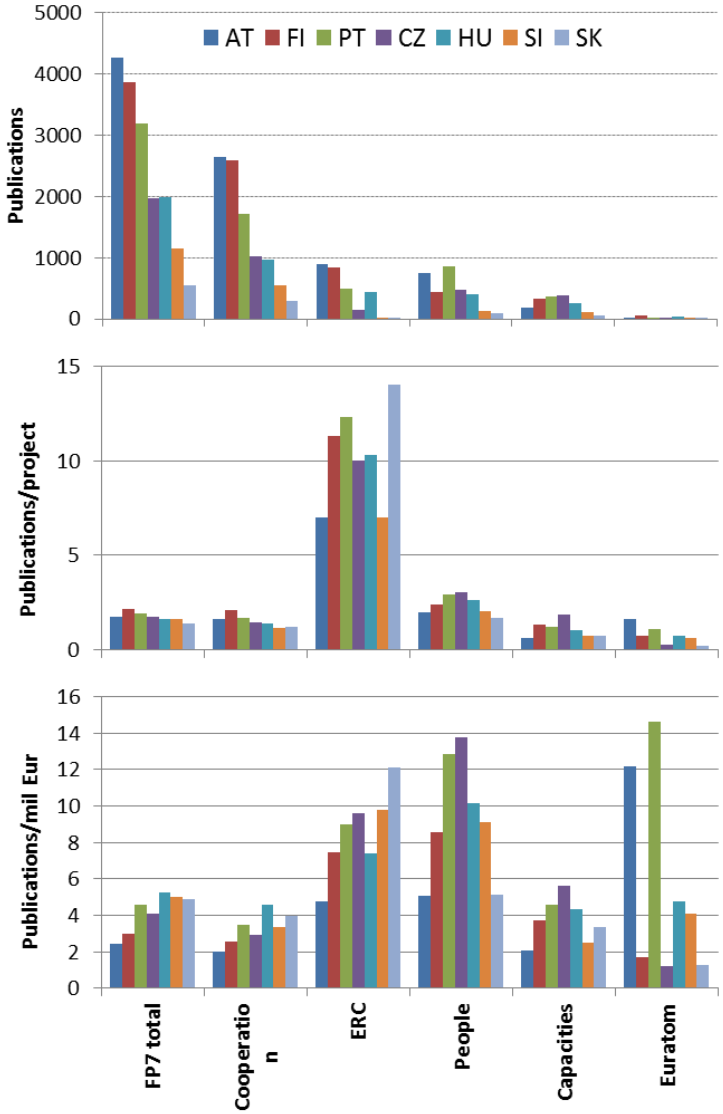


Table 26. Publications resulting from the FP7 projects with both participant(s) of the project(s) and co-author(s) of the publication(s) affiliated in one of the 7 analysed countries. Numbers of publications in individual FP7 projects as well as in the whole FP7 are shown; some publications have acknowledged more than 1 project number for funding, therefore the sum of publications in an individual programme may be higher than FP7 total.

Country	AT	FI	PT	CZ	HU	SI	SK	Avg AT-FI-PT	Avg CZ-HU-SI-SK	Avg AT-FI-PT (%)	Avg CZ-HU-SI-SK (%)
FP7 total	4251	3863	3181	1970	1974	814	424	3765	1296	100.0	100.0
Cooperation	2635	2589	1703	1023	970	552	284	2309	707	61.3	54.6
Ideas	887	838	493	150	434	21	14	739	155	19.6	12.0
People	741	439	859	476	404	135	82	680	274	18.1	21.1
Capacities	189	328	365	389	251	114	63	294	204	7.8	15.7
Euratom	16	46	20	18	32	14	4	27	17	0.7	1.3

Bibliometric analysis of all FP7 results with co-authors from the 7 selected countries

Using the grant numbers, we were not able to retrieve all publications funded from the FP7. Some of the authors did not quote the project numbers in their funding acknowledgements but only the project acronyms, the calls, specific programmes or even some modification of the FP7 only. Therefore, we have used several variations of the FP7, its individual programmes and calls, as well as of the project acronyms to retrieve additional publications from WOS. The following analysis was performed on these extended sets of the FP7 publications, which represented about 3-6 per cent of the whole-country publication outputs in the 7 analysed countries. FP7 papers represented the highest yield of the country papers in Finland and the lowest in Slovakia.

The number of the retrieved FP7 publications was about 2 times higher compared to the amounts retrieved using the grant numbers only (compare Figures 7 and 8). The biggest increase in publication number occurred in the FP7-People and FP7-Ideas programmes. Part of the increase is due to the author inconsistencies and variabilities in the funding acknowledgements. However, some of these additional publications cite different FP7 grant numbers than those having participants from the 7 countries included in our analysis. Therefore some co-authors of these publications that had affiliation in the analysed country were not the participants of the cited FP7 project. Therefore it seems useless to analyse on this sets of publications which of the FP7 projects were the most productive and which produced publications for the lowest funding. However, because these extended sets of publications are resulting from the FP7 projects and have co-authors from the analysed countries, it is correct to perform bibliometric analysis on them.

There are considerable differences in the international collaboration rate among the analysed countries (Figure 9 lower part). The highest collaboration rates have Austrian papers, reaching about 55 per cent in average and absolutely the lowest rate had the Czech papers with collaboration rate lower than 40 per cent. In general, the analysed EU-13 countries had somewhat lower collaboration rates than the analysed EU-15 countries. Hungarian papers had the highest collaboration from the EU-13 countries and Portugal had the lowest collaboration rates from the EU-15 countries. In the publications resulting from the FP7, the national differences almost disappeared and the average international collaboration rate was much higher – about 80 per cent (Figure 9 upper part). Participation in the FP7 thus increases international collaboration rate and the highest increase, in comparison with the whole-country publications outputs, occurs in the analysed EU-13 countries.

Figure 8. Numbers of publications produced by the FP7 projects. Publications were retrieved from WoS based on citation of the grant numbers and/or call acronyms in the funding acknowledgement.

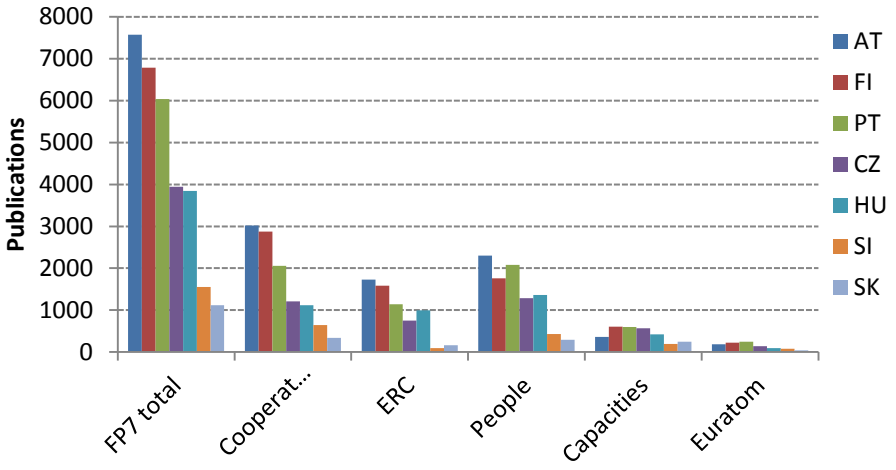
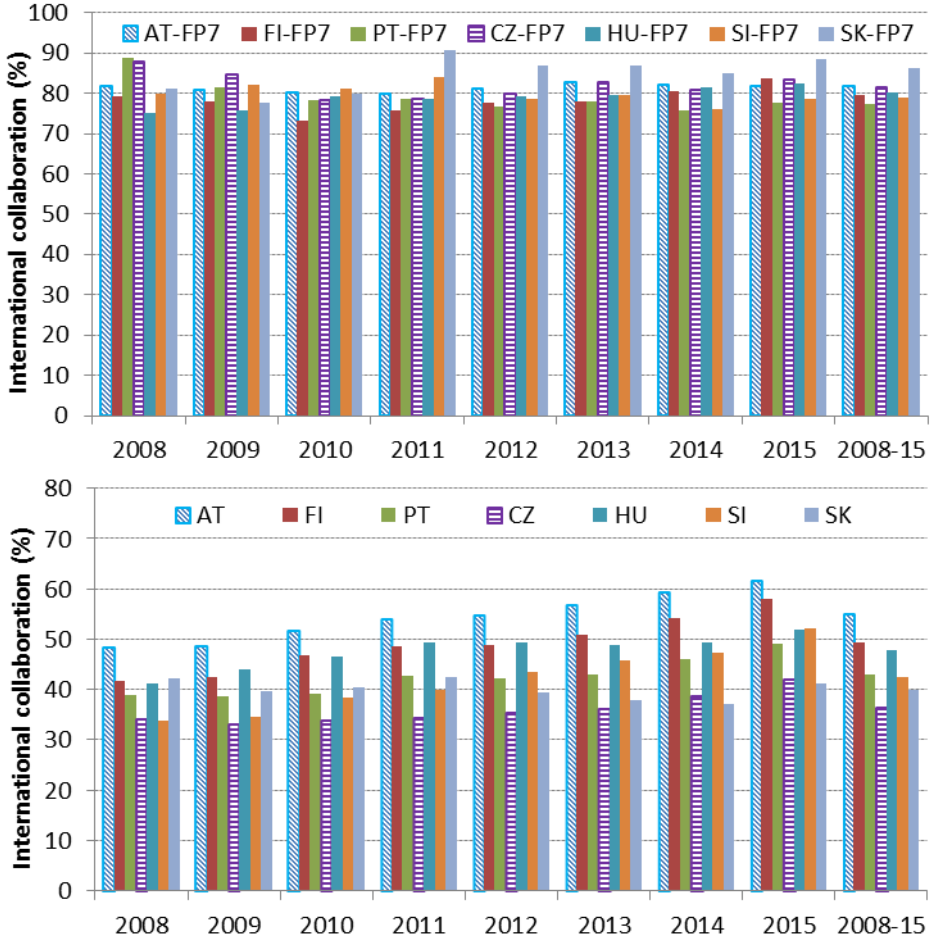


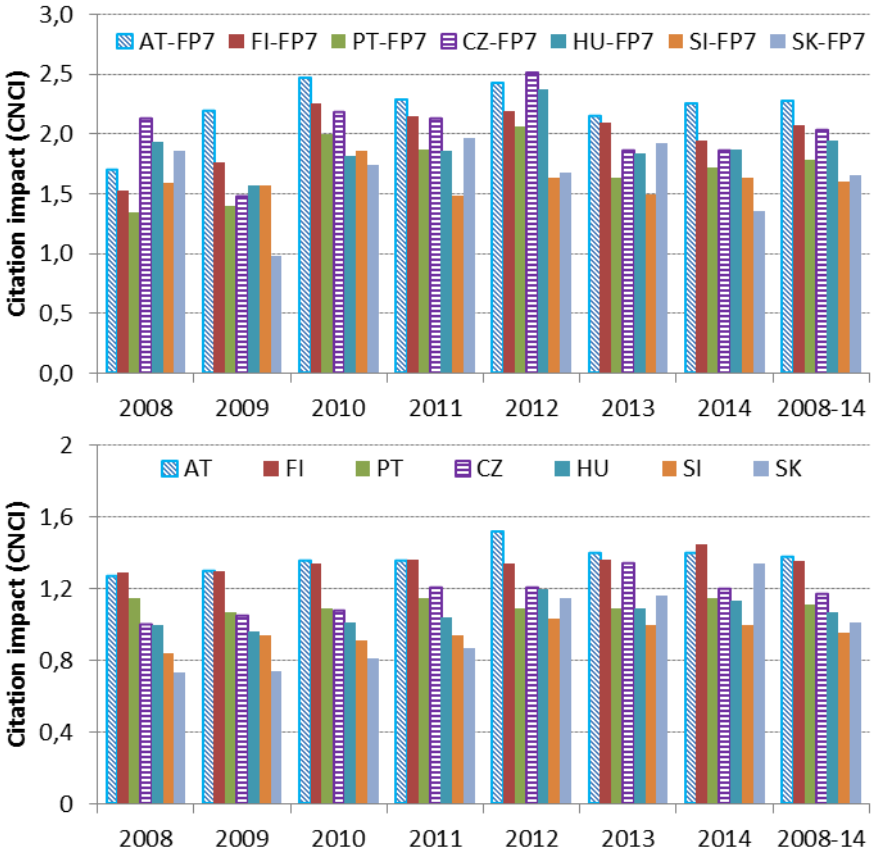
Figure 9. Comparison of the international collaboration rate in the publications resulting from the FP7 projects (upper part) and in the total country output (lower part). All publications having co-authors from at least 2 different countries were considered as international. International collaboration rate is a percentage of international publications in the evaluated set of papers. See the legend to figure 3 for the details.



There are considerable differences in the citation impact among the analysed countries (Figure 10 lower part). The highest impacts have Austrian and Finnish papers, which have CNCI about 1.4. The lowest impacts had the Slovenian papers. In general, the analysed EU-13 countries had considerably lower citation impacts than the analysed EU-15 countries, but Portuguese papers had an impact even lower than the Czech publications, whose impact was the highest from the EU-13 countries. In the publications

resulting from the FP7, the citation impacts were much higher but there were still considerable national differences although somewhat diminished (Figure 10 upper part).

Figure 10. Comparison of the category normalized citation impact (CNCI) of the publications resulting from the FP7 projects (upper part) and in the total country output (lower part).



Conclusions

Total number of publications resulting from the FP7 projects is lower in the analysed EU-13 countries, participants of the FP7 projects from the EU-13 countries had lower publication activity than participants from the analysed EU-15 countries

The analysed EU-13 countries have a slightly lower number of publications per project but higher number publications per 1 million euro project costs than the analysed EU-15 countries.

International collaboration rate in whole-country publications was somewhat higher in the analysed EU-15 than in the analysed EU-13 countries. International collaboration rate in FP7 publications was much higher and almost identical in all countries. Participation in FP7 thus increased collaboration rate and the highest increase occurred in the EU-13 countries.

Citation impact (CNCI) was lower in the analysed EU-13, both in total and in FP7 publications. Participation in FP7 increased citation impact and the highest increase occurred in the EU-13 countries.

EU-13 countries are thus quite good research partners and members of research consortia, producing about the same number of publications of the sufficient quality as EU-15 members. Moreover, participation in FP7 projects is very beneficial for EU-13 countries, because it increases international collaboration rate and citation impact of the resulting publications. The EU-13 countries thus should have enough motivation and expertise to participate in the Framework Programmes.

5.1.4.3 Institutional quality and reputation

University rankings are highly popular among university boards, policy-makers and politicians. Science policy researchers tend to be more sceptical. Rankings are not always transparent about their methods and data; different rankings produce different results for the same universities; and when rankings of individual universities are traced over time, the results can be inconsistent. In this section, we use two rankings to provide an overall comparison of institutional quality and reputation. We focus not on precise rankings or comparisons over time. We merely count the number of universities in ranking brackets.

Methods and data

Institutional quality and reputation are measured as the position of national universities of the EU-28 nations and 4 main Associated States in the CWTS Leiden Ranking (2016) and the Times Higher Education ranking (2017). The THE ranking is a hybrid ranking in that it measures various dimensions of university performance and characteristics. The CWTS Leiden Ranking is based entirely on scientific output as recorded in Thomson Reuters Web of Science.

Results

Tables 27 and 28 show the number of universities of each EU Member State in the top-10, top-50, top-100 and top-200 of the Times Higher Education University Ranking 2017 and the CWTS Leiden Ranking 2016-2017 (See also Schuch, 2014; European Commission, 2016b).

Table 27. Number of universities in the top-200 of the Times Higher Education University Ranking 2017

Country	top-10	11-50	51-100	101-200	200-1000
EU-13	**-**	**-**	**-**	**-**	**47**
Bulgaria	-	-	-	-	1
Croatia	-	-	-	-	1
Cyprus	-	-	-	-	3
Czech Republic	-	-	-	-	12
Estonia	-	-	-	-	2
Hungary	-	-	-	-	7
Latvia	-	-	-	-	2
Lithuania	-	-	-	-	2
Malta					
Poland	-	-	-	-	9
Romania	-	-	-	-	4
Slovakia	-	-	-	-	2
Slovenia	-	-	-	-	2
EU-15	**3**	**9**	**24**	**54**	**211**
Austria	-	-	-	1	5
Belgium	-	1	-	2	5
Denmark	-	-	1	2	4
Finland	-	-	1	-	8
France	-	-	1	3	23
Germany	-	3	6	13	19
Greece	-	-	-	-	6
Ireland	-	-	-	-	8
Italy	-	-	-	2	36
Luxembourg	-	-	-	1	-
Netherlands	-	-	8	5	-
Portugal	-	-	-	-	8
Spain	-	-	-	2	25
Sweden	-	1	2	3	5
United Kingdom	3	4	5	20	59
EU-28	**3**	**9**	**24**	**54**	**258**

Table 28. Number of universities in the top-200 of the CWTS Leiden Ranking 2016-2017

Country	top-10	11-50	51-100	101-200	200-900
EU-13	**-**	**-**	**-**	**-**	**28**
Croatia	-	-	-	-	1
Czech Republic	-	-	-	-	4
Estonia	-	-	-	-	1
Hungary	-	-	-	-	5
Lithuania	-	-	-	-	1
Poland	-	-	-	-	13
Romania	-	-	-	-	1
Slovakia	-	-	-	-	1
Slovenia	-	-	-	-	1
EU-15	**1**	**9**	**26**	**49**	**175**
Austria	-	-	-	1	8
Belgium	-	-	1	3	3
Denmark	-	-	1	1	3
Finland	-	-	-	1	7
France	-	-	4	3	17
Germany	-	-	2	18	29
Greece	-	-	-	-	7
Ireland	-	-	-	1	5
Italy	-	-	-	1	36
Netherlands	-	-	4	4	5
Portugal	-	-	-	-	6
Spain	-	-	1	1	30
Sweden	-	-	2	2	6
United Kingdom	1	9	11	13	13
EU-28	**1**	**9**	**26**	**49**	**203**

The main observations are:

- There are no universities from the EU-13 Member States among the top-200 universities in either ranking. There are no universities from Bulgaria, Cyprus, Latvia, Malta in the CWTS Leiden Ranking.
- Some EU-15 Member States do not do too well either. Greece and Portugal also have no university in the top-200 of either ranking, while Ireland, Italy have at most one. Only two Spanish universities (of the 27 Spanish universities in the THE ranking and 32 in the CWTS Leiden Ranking) are in the top-200 (Pompeu Fabra University in both rankings; University of Cantabria in the CWTS Leiden Ranking, Autonomous University of Barcelona in the THE ranking).

Conclusion

The hypothesis is tentatively accepted. The quality of EU-13 science is lower than that of the EU-15, based on the average citation impact per publication and the presence of national universities in two global university rankings. Both indicators are a mix between absolute quality (reflecting the capabilities of scientists working in each nation) and relative quality (the reputation awarded to national scientists by peers, students, firms and other stakeholders worldwide). However, on a global scale, many EU-13 Member States (particularly CY, EE, MT, SI, and HU) achieved high average quality, higher than or near the level of the EU-15. The FP7-related output of the EU-13 is equal to that of the EU-15, provided they collaborated with EU-15 co-authors. Moreover, participation in FP7 projects is very beneficial for EU-13 countries, because it increases international collaboration rate and citation impact of the resulting publications. There are no EU-13 universities in the top-200 of some of the main university rankings, but quite a few EU-15 Member States had few if any universities in the top-200 either.

5.2. Collaboration and networks

5.2.1. Hypothesis 5: Prospective participants from the EU-13 have weaker connections to the collaboration network in FPs than participants from the EU-15 who have more connections and are more central to the network

Collaboration is a key aspect of the framework programmes and its importance has increased over time (witness, for example, the emergence of networks of excellence as an instrument). Patterns of collaboration are driven by (a) proximity and (b) past connections. Proximity relates to the distance among entities (e.g. partners in different countries) in geographical, social, organisational, institutional, and cognitive terms (Heringa et al., 2014). Evidence suggests that collaboration patterns in the EU framework programmes primarily depend on social proximity (prior acquaintance), thematic proximity, and geographical proximity (Paier & Scherngell, 2011). Furthermore, technological proximity has a stronger effect than geographic proximity (Scherngell & Barber, 2009).

The FP network is dominated by core organisations that are consistently successful in applying for FP funding and that have higher than average numbers of projects and a more central position in the collaboration network. Until FP6 the only core organisations in the EU-13 were found in Cyprus, Poland and Hungary (Heller-Schuh, 2011). Using the CORDIS databases for FP7 and Horizon 2020, we will compare the position in the collaboration network of organisations from the EU-13 with the position of organisations from the EU-15. We focus in particular on three aspects of collaboration:

1. *Network position of organisations*: Using Social Network Analysis (SNA) metrics, we compare the position of EU-13 organisations to that of EU-15 organisations. How central are EU-13 organisations compared to EU-15 organisations? What is the network position of different types of organisation, particularly higher education institutions, industry, and research organisations?
2. *Clustering of organisations in the network*: We identify clusters in the collaboration networks of FP7 and Horizon 2020 using the Louvain clustering algorithm (Blondel et al., 2008). A cluster is a group of organisations that collaborate in projects more often with each other than with other organisations elsewhere in the network. How are EU-13 participants distributed among clusters compared to EU-15 participants?
3. *Connections to top participants*: For each EU Member State we analyse the ability of participants to collaborate with the most significant R&D European institutions in the FP. The analysis will focus on collaboration with the Top-15 higher education institutions and research organisations in H2020 according to the Horizon 2020 Monitoring Report 2014.

Methods and data

The network position of organisations in the collaboration networks of FP7 and Horizon 2020 is evaluated using metrics for social network analysis. Our focus is on the position of individual organisations in the network – particularly the position of EU-13 organisations relative to that of EU-15 organisations – and not on the structure of the network as a whole.

Metrics for social network analysis help us identify different types of organisations within the network. We analyse three types of organisation.

- *Isolates* have no connections to other organisations in the network. This includes ERC and MSCA grants awarded to individuals. Isolates will be excluded from the estimates of network position.
- *Brokers* are organisations that connect different parts of the network. They occupy a strategic position in the collaboration network and thus control the flow of information through the network from one part to the other. Brokers have a betweenness centrality higher than zero.
- *Hubs* are brokers with many connections. They combine high betweenness centrality with high degree centrality. Here we apply the definition of Cassi et al. (2008) who define hubs as

belonging in the top 2 per cent of a synthetic ranking of organisations in terms of betweenness centrality and degree centrality (Cassi et al., 2008).

Eigenvector centrality is a variant on degree centrality. It is a metric that takes into account the quality of the connections to other organisations. Organisations connected to other organisations with high prestige have better access to information in the network than organisations with an equal number of connections to lower-prestige organisations (Arif, 2015). We examine average eigenvector centrality per organisation to examine the strength of the network position of organisations per Member State.

Clustering is a key property of social networks. Clusters are groups of organisations that collaborate more with each other than with other organisations in the network. When the partners of an organisation also collaborate with each other, cliques emerge. We examine the composition of clusters in the network to determine if organisations from the EU-13 and EU-15 co-occur and if there are regions in the network where EU-13 organisations dominate.

Results

There is no significant difference in the relative importance of *brokers* among the active participants from EU-13 and the EU-15 Member States. In FP7 about 38 per cent of EU-15 organisations and 39 per cent of EU-13 organisations was a broker; in Horizon 2020 the percentage shares were 31 per cent and 28 per cent respectively.

There is, however, a significant difference in the relative importance of *hubs*. Table 29 shows the number of organisations that have been identified as hubs in the FP7 and Horizon 2020 collaboration networks. In FP7 and Horizon 2020 two per cent of all EU-15 organisations was a hub. The relative importance of hubs among EU-13 organisations was less than half that of EU-15 organisations: 0.9 per cent in FP7 and 0.7 per cent in Horizon 2020.

Table 29. Hubs in the collaboration networks of FP7 and Horizon 2020
Notes: Hubs are organisations that belong in the top 2 per cent in terms of betweenness centrality and degree centrality. Isolates have been excluded.
Source: CORDIS. Cassi et al. (2009).

	Total number of connected organisations	'Hubs'	Percentage share of 'Hubs'	Total number of connected organisations	'Hubs'	Percentage share of 'Hubs'
EU-15	**20784**	**407**	**2.0%**	**9422**	**191**	**2.0%**
AT	750	18	2.4%	350	6	1.7%
BE	1147	17	1.5%	565	11	1.9%
DE	3584	67	1.9%	1555	27	1.7%
DK	593	8	1.3%	234	5	2.1%
EL	608	18	3.0%	309	10	3.2%
ES	2575	44	1.7%	1217	18	1.5%
FI	499	12	2.4%	222	8	3.6%
FR	2371	41	1.7%	1051	10	1.0%
IE	428	8	1.9%	177	5	2.8%
IT	2431	52	2.1%	1189	25	2.1%
LU	70	0	0.0%	56	1	1.8%
NL	1486	29	2.0%	721	18	2.5%
PT	549	11	2.0%	296	7	2.4%
SE	863	17	2.0%	313	10	3.2%
UK	2830	65	2.3%	1167	30	2.6%
EU-13	**3190**	**29**	**0.9%**	**1522**	**10**	**0.7%**
BG	266	1	0.4%	128	0	0.0%
CY	119	1	0.8%	60	1	1.7%
CZ	388	4	1.0%	154	1	0.6%
EE	158	2	1.3%	72	2	2.8%
HR	162	0	0.0%	90	0	0.0%
HU	392	4	1.0%	157	0	0.0%
LT	143	2	1.4%	60	0	0.0%

LV	96	1	1.0%	53	0	0.0%
MT	50	2	4.0%	28	1	3.6%
PL	592	7	1.2%	288	3	1.0%
RO	375	3	0.8%	198	0	0.0%
SI	259	2	0.8%	138	2	1.4%
SK	190	0	0.0%	96	0	0.0%
EU-28	**23974**	**436**	**1.8%**	**10944**	**201**	**1.8%**

Since the absolute number of participants from the EU-13 is much lower, only a handful of organisations qualifies as a hub. These organisations are listed in Table 30. The hubs in Horizon 2020 are also among the hubs in FP7.

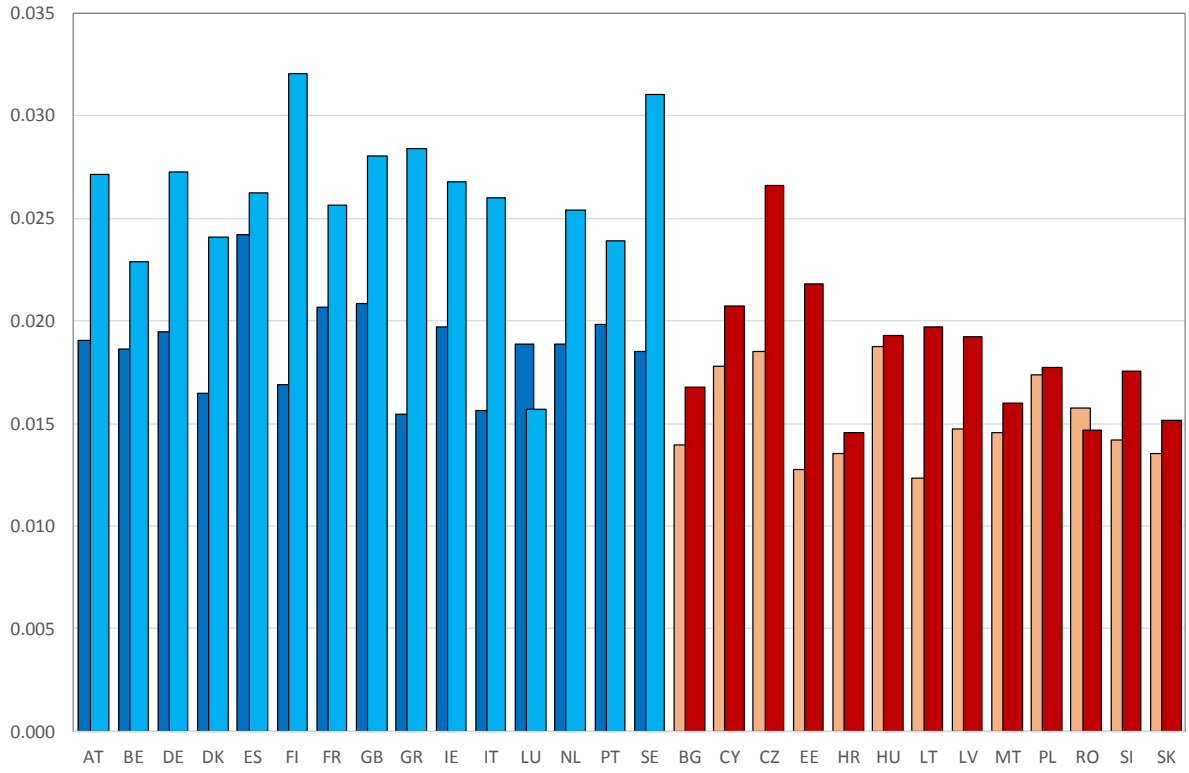
Table 30. EU-13 Hubs in FP7 and Horizon 2020

Name	Activity type	Country	Number of projects
FP7			
UNIVERZA V LJUBLJANI	HES	SI	160
INSTITUT JOZEF STEFAN	REC	SI	158
UNIVERSITY OF CYPRUS	HES	CY	117
UNIVERZITA KARLOVA V PRAZE	HES	CZ	117
BUDAPESTI MUSZAKI ES GAZDASAGTUDOMANYI EGYETEM	HES	HU	117
UNIWERSYTET WARSZAWSKI	HES	PL	102
TARTU ULIKOOL	HES	EE	102
CESKE VYSOKE UCENI TECHNICKE V PRAZE	HES	CZ	87
POLITECHNIKA WARSZAWSKA	HES	PL	78
UNIWERSYTET JAGIELLONSKI	HES	PL	65
MASARYKOVA UNIVERZITA	HES	CZ	64
INSTYTUT CHEMII BIOORGANICZNEJ POLSKIEJ AKADEMII NAUK	REC	PL	56
INSTYTUT PODSTAWOWYCH PROBLEMOW TECHNIKI POLSKIEJ AKADEMII NAUK	REC	PL	53
KAUNO TECHNOLOGIJOS UNIVERSITETAS	HES	LT	51
AKADEMIA GORNICZO-HUTNICZA IM. STANISLAWA STASZICA W KRAKOWIE	HES	PL	50
EOTVOS LORAND TUDOMANYEGYETEM	HES	HU	50
DEBRECENI EGYETEM	HES	HU	49
POLITECHNIKA WROCLAWSKA	HES	PL	49
SOFIISKI UNIVERSITET SVETI KLIMENT OHRIDSKI	HES	BG	49
UNIVERSITA TA MALTA	HES	MT	47
TALLINNA TEHNIKAULIKOOL	HES	EE	46
UNIVERSITATEA POLITEHNICA DIN BUCURESTI	HES	RO	45
VYSOKE UCENI TECHNICKE V BRNE	HES	CZ	44
OFFICE OF THE PRIME MINISTER	PUB	MT	42
VILNIAUS UNIVERSITETAS	HES	LT	42
MAGYAR TUDOMANYOS AKADEMIA SZAMITASTECHNIKAI ES AUTOMATIZALASI KUTATO INTEZET	REC	HU	42
RIGAS TEHNISKA UNIVERSITATE	HES	LV	37
UNIVERSITATEA DIN BUCURESTI	HES	RO	35
UNIVERSITATEA TEHNICA CLUJ-NAPOCA	HES	RO	35
Horizon 2020			
TARTU ULIKOOL	HES	EE	42
UNIWERSYTET WARSZAWSKI	HES	PL	21
INSTITUT JOZEF STEFAN	REC	SI	45
UNIVERZA V LJUBLJANI	HES	SI	34
CESKE VYSOKE UCENI TECHNICKE V PRAZE	HES	CZ	26
UNIVERSITY OF CYPRUS	HES	CY	35
UNIVERSITA TA MALTA	HES	MT	15
AKADEMIA GORNICZO-HUTNICZA IM. STANISLAWA STASZICA W KRAKOWIE	HES	PL	12
TALLINNA TEHNIKAULIKOOL	HES	EE	16
INSTYTUT CHEMII BIOORGANICZNEJ POLSKIEJ AKADEMII NAUK	OTH	PL	19

Figure 11 shows average eigenvector centrality of organisations from each Member State in FP7 and Horizon 2020.

- In FP7 the network position of organisations from Cyprus, Czech Republic, Hungary, and Poland was about as strong as that of organisations from most EU-15 Member States.
- In Horizon 2020 the network position of EU-15 organisations has vastly improved, with the exception of Luxembourg. Among the EU-13 Member States, only organisations from the Czech Republic and – to a lesser extent – Estonia and Cyprus can match the network position of the EU-15. Organisations from Lithuania and Latvia have also significantly improved their network position.
- In FP7 the network position of the average EU-13 organisation was 16 per cent weaker than that of the average EU-15 organisation. In the first two years of Horizon 2020 this gap had increased to 31 per cent.

Figure 11. Average eigencentrality of organisations per Member State in Horizon 2020
Source: CORDIS.



The Horizon 2020 collaboration network breaks down into 1,674 clusters of which 1,479 are isolates (organisations not collaborating with other organisations) and 195 clusters of collaborating organisations. The FP7 network has 272 clusters with 212 isolates and 60 clusters of collaborating organisations. FP7 covered a longer period for repeated interaction among organisations to form a dense network; Horizon 2020 has only just begun.

The largest clusters that define the collaboration networks of FP7 and Horizon 2020 are dominated by EU-15 organisations. Where EU-13 and EU-15 organisations are part of the same cluster, the network position of EU-15 organisations is generally better. They have more connections and a stronger network.

The FP7 network is dominated by 14 clusters, containing 28,629 organisations of 29,055 or 98.5 per cent of all organisations active in FP7. In Horizon 2020, the 20 largest clusters form the core of the network. They contain 11,846 organisations, equal to 86 per cent of all 13,799 organisations active in Horizon 2020 and 96 per cent of the 12,320 collaborating organisations. They also contain virtually every 'broker' and 'hub'. On average, EU-15 organisations comprise 76 per cent of the organisations in the 20 largest

Horizon 2020 clusters, and EU-13 organisations 12 per cent. The two largest clusters contain over 4,000 organisations, including the TOP15 organisations that participated in the most projects in FP7. EU-13 organisations are relatively overrepresented in five of the 20 largest clusters where they account for about 20 per cent of all organisations.

As indicated above, preparation of project proposals in collaboration with TOP15 institutions of the FP7 considerably increases the participation success rate. Thus collaboration with TOP15 in the FP7 projects might be considered as a 'soft form' of spreading excellence. Given country we propose to measure its collaboration with the TOP15 by the '**intensity of collaboration with TOP15**' ratio (Albrecht 2013a, 2013b):

$$\frac{sum\ of\ eligible\ cost\ invested\ to\ participate\ in\ projects\ with\ TOP15}{total\ eligible\ cost\ to\ participate\ in\ the\ FP7}$$

The TOP15 is the smallest group of institutions whose teams participated in FP7 projects to which 51 per cent of the FP7 budget was allocated by the European Commission. The list of TOP15 is in Table 22. The smallest group of institutions whose teams participate in the Horizon 2020 projects to which the EC allocated 51 per cent of the H2020 budget is given in Table 31.

Table 31. TOP20 institutions that participate in Horizon 2020 projects to which the EC allocated 51 per cent of the so far distributed budget of this programme
Source: E-CORDA database, version February 2017.

Institution	Country	Participations
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	FR	569
FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.	DE	455
THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF CAMBRIDGE	UK	317
THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF OXFORD	UK	294
COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	FR	291
AGENCIA ESTATAL CONSEJO SUPERIOR DEINVESTIGACIONES CIENTIFICAS	ES	286
UNIVERSITY COLLEGE LONDON	UK	283
CONSIGLIO NAZIONALE DELLE RICERCHE	IT	281
KOBENHAVNS UNIVERSITET	DK	261
MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV	DE	257
IMPERIAL COLLEGE OF SCIENCE TECHNOLOGY AND MEDICINE	UK	235
KATHOLIEKE UNIVERSITEIT LEUVEN	BE	214
TECHNISCHE UNIVERSITEIT DELFT	NL	191
DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAHRT EV	DE	191
THE UNIVERSITY OF EDINBURGH	UK	172
Teknologian tutkimuskeskus VTT Oy	FI	159
EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH	CH	159
ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE	CH	158
POLITECNICO DI MILANO	IT	151
DANMARKS TEKNISKE UNIVERSITET	DK	146

The FP7 TOP15 institutions are among the TOP20 of Horizon 2020, the twenty organisations to which the EC wants to allocate the same percentage share of its budget (51 per cent) that was allocated to the TOP15 in FP7. The significant role and stability of the TOP15 in performing the FP7 and H2020 projects is evident. Table 32 gives the intensities of the collaboration of organisations from EU-13 and EU-15 Member States with the TOP15 of FP7 and the TOP20 of Horizon 2020.

Table 32. Intensity of collaboration with the TOP15 of FP7 and the TOP20 of Horizon 2020 of organisations from the EU-13 and the EU-15 Member States
Source: E-CORDA database, versions November 2015 and February 2017.

	FP7		Horizon 2020	
Country	Participations in projects with TOP15	Intensity of collaboration with TOP15	Participations in projects with TOP20	Intensity of collaboration with TOP20
EU-15				
AT	1632	48.6%	780	49.8%
BE	2760	55.8%	1324	53.5%
DE	10372	57.3%	4174	63.5%
DK	1196	40.9%	837	55.5%
EL	1512	43.1%	756	50.3%
ES	5190	46.2%	2643	43.5%
FI	1325	45.6%	712	52.1%
FR	7683	68.1%	3021	61.8%
IE	741	38.3%	421	37.0%
IT	5947	52.1%	2727	57.6%
LU	99	34.4%	77	43.0%
NL	3801	50.3%	1826	50.1%
PT	951	39.6%	562	41.6%
SE	2095	49.4%	872	46.2%
UK	9262	56.7%	3824	50.7%
EU-13				
BG	233	31.0%	98	60.1%
CY	157	36.9%	93	40.9%
CZ	650	47.7%	330	49.3%
EE	184	29.7%	94	23.1%
HR	132	28.4%	111	47.6%
HU	635	36.2%	227	41.2%
LT	135	34.9%	80	45.0%
LV	101	36.5%	65	28.2%
MT	75	59.8%	28	27.4%
PL	863	38.2%	418	44.8%
RO	418	38.3%	184	34.3%
SI	368	39.1%	201	40.7%
SK	191	39.5%	127	75.5%

In the next two figures (Figure 12 and Figure 13) the values from the Table 32 are depicted, the Member States are ranked according to their decreasing intensity of collaboration with the respective TOP institutions. It is immediately clear that the number of EU-13 collaborations with the TOP15 and TOP20 organisations is much lower than that of the EU-15. For example, BE and SE together have more collaborations with the TOP15 and TOP20 than all EU-13 Member States put together. The intensity of collaboration with TOP organisations is quite unstable; it can fluctuate quite dramatically, particularly for small countries. In FP7, MT had the highest intensity of collaboration with the TOP15, whereas in Horizon 2020 MT has the second lowest index of collaboration with the TOP20.

Figure 12. Intensity of collaboration with TIP15 in the FP7
Note: Blue bars indicate the EU-15. Yellow bars indicate the EU-13.
Source: E-CORDA, version November 2015.

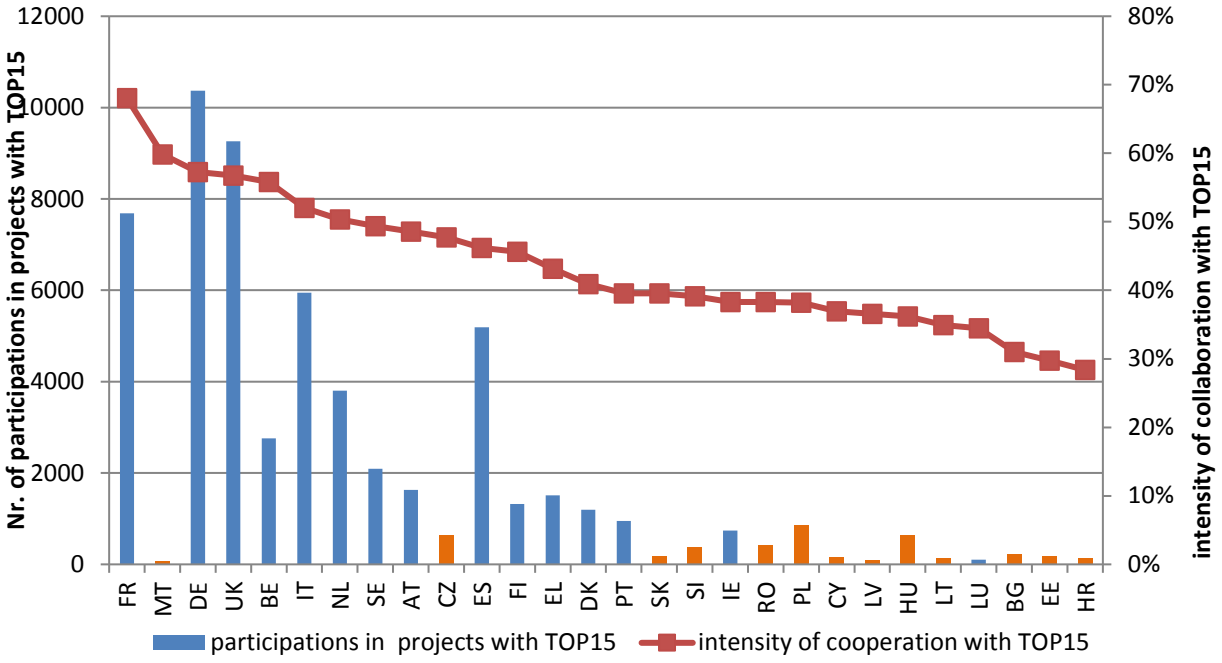
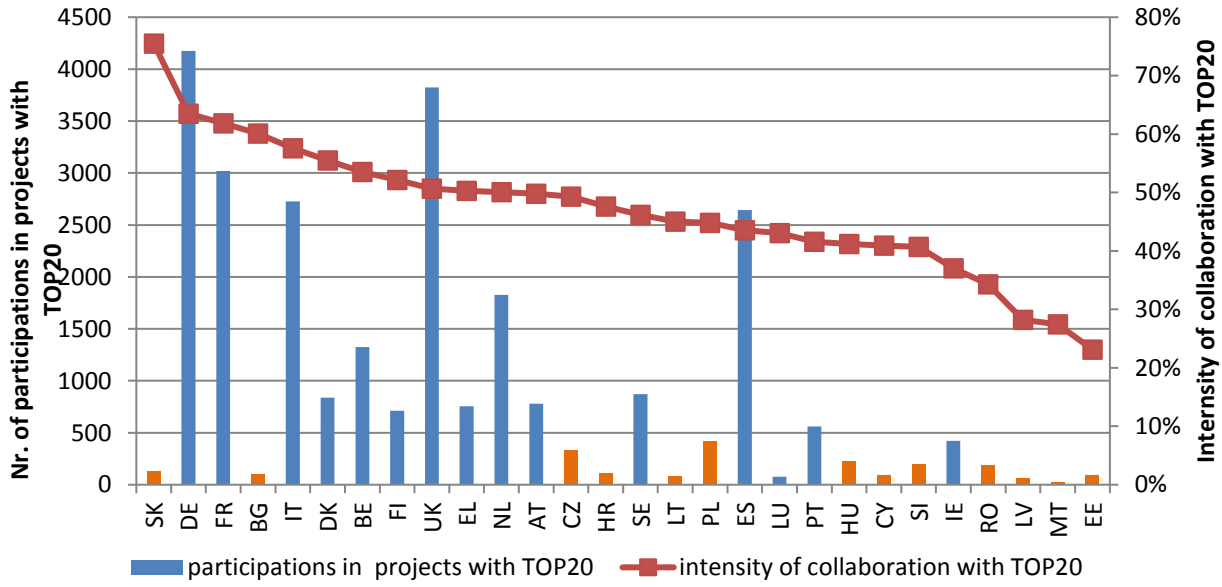


Figure 13. Intensity of collaboration with TOP20 in the H2020
Note: Blue bars indicate the EU-15. Yellow bars indicate the EU-13.
Source: E-CORDA, version February 2017



Horizon 2020 has introduced specific measures for spreading excellence and widening participation. These measures are targeted at the low-performing Member States in terms of research and innovation, and they will be implemented by the Member States most in need of the new Cohesion policy for the 2014-2020 programming period. The 'Teaming and Twinning' actions are aimed at increasing the collaboration between the low-performing countries and the excellent R&D institutions and at creating new scientific networks. Thus, the intensity of collaboration with the TOP20 might considerably increase if the country succeeds in the activity 'spreading of excellence and widening participation' jointly

performed in collaboration with some TOP20 institution. This is the case in BG, which has higher collaborative intensity with TOP20 than the majority of the EU-13 due to success in the Teaming action.

The 'Spreading of excellence and widening participation' projects are very rare; they pertain only to several small institutions. They likely increase excellence only in small numbers of EU-15 institutions. However, the 'soft' increase of excellence via joint participation of EU-13 organisations in projects with the TOP institutions applies to hundreds of EU-13 teams.

Conclusion

The hypothesis is confirmed. The FP network is dominated by EU-15 organisations, in particular by a small group (the TOP15 organisations) that form the 'oligarchic core' of the network. Only a handful of EU-13 organisations qualify as hubs, giving them a strong position in the FP collaboration network. The average network position of EU-13 organisations is weaker than that of EU-15 organisations; in Horizon 2020 this position is weaker than in FP7. EU-13 organisations have a much lower intensity of collaboration with the TOP15 and TOP20 organisations than EU-15 organisations.

5.2.2. Hypothesis 6: There is a cognitive distance between the scientific and technological portfolio of prospective participants from the EU-13 and the portfolio of the more successful EU-15

In most of its funding schemes, the European Framework Programmes call for a collaborative approach to problems identified in the FP work programme. Proximity is one of the strongest drivers of research collaboration; different types of proximity have a specific effect on different results (Heringa et al. 2015). For example, Scherngell and Barber (2011) found that in FP5 (including the EU-13) „geographical factors significantly affect patterns of industrial R&D collaboration, while in the public research sector effects of geography are much smaller' and that „technological distance is the most important factor for both industry and public research cooperative activities.' A possible explanation for the low participation of organisations from the EU-13 Member States is that their research portfolio is not sufficiently proximate to (i.e. too different from) that of organisations from the more successful EU-15.

Cognitive distance has two dimensions:

1. There is insufficient space for collaboration between participants from the EU-13 and the EU-15, assuming that collaborating participants need to be technologically proximate as is suggested by the literature.
2. There is a mismatch between the knowledge demands formulated in the FP work programmes and the knowledge supplied by prospective participants from the EU-13.

The possibility of a mismatch between the scientific portfolios of the EU-13 and the knowledge demands of the FP work programmes could not be explored. There is no objective measure for the portfolio of knowledge required by FP7 and Horizon 2020, and the interviews did not provide an answer.

We examine the first possibility by making a comparison of the scientific and technological portfolios of the EU-13 and the EU-15. Are the scientific portfolios of the EU-13 similar to or different from those of the EU-15? Are the scientific portfolios converging or not?

Methods and data

First, we collect data on the scientific and technological portfolio of the individual EU-13 and EU-15. This concerns the distribution of citable documents among Thomson Reuters Web of Science subject categories. This replicates an earlier analysis based on a factor analysis of the scientific output portfolios of the world's nations in 1993, 2000, and 2008 (Horlings & Van den Besselaar, 2011). This study found that after the falling apart of the Soviet Union and the Warsaw Pact, the scientific output of the New

Member States shifted from a portfolio similar to that of the former Soviet Republics to a portfolio similar to that of the emerging economies in South East Asia and very different from that of the EU-15.

Results

Factor analysis on the distribution of scientific output of the EU-28 among the 256 Web of Science categories in Thomson Reuters Web of Science shows that the portfolios of the EU-15 and EU-13 was significantly different in 2004-2006 (before the start of FP7). The results confirm the findings of Horlings & Van den Besselaar (2011) for the period 1993-2008 that the EU-13 and EU-15 have distinctly different scientific portfolios. Between 1993 and 2008 former East European nations converged on the scientific portfolio of emerging economies in South East Asia between 1993 and 2008 and not on the portfolio of the EU-15.

Table 33. Clustering EU Member States and four Associated States based on factor analysis of national scientific portfolios in 2004-2006 and 2014-2016
Sources: Thomson Reuters Web of Science. Horlings & Van den Besselaar (2011).
Note: Rotated component matrix, only showing loadings greater than 0.4. Factor analysis using Principal Component Analysis, orthogonal rotation (Varimax) with Kaiser Normalization, solution constrained to two factors after parallel analysis. Countries in descending order of factor loading.

2004-2006	2014-2016
Factor 1 (20 countries)	**Factor 1 (23 countries)**
Netherlands	Netherlands
Denmark	Denmark
United Kingdom	United Kingdom
Norway	Sweden
Sweden	Switzerland
Finland	Belgium
Austria	Austria
Belgium	Italy
Italy	Israel
Switzerland	Ireland
Israel	Germany
Luxembourg	Norway
Greece	Finland
Ireland	France
Spain	Spain
Germany	Hungary
Turkey	Greece
France	Portugal
Malta	Estonia
Croatia	Malta
	Turkey
	Bulgaria
	Luxembourg
Factor 2 (12 countries)	**Factor 2 (9 countries)**
Romania	Romania
Bulgaria	Slovakia
Poland	Latvia
Lithuania	Czech Republic
Czech Republic	Lithuania
Latvia	Slovenia
Slovenia	Poland
Slovakia	Croatia
Portugal	Cyprus
Hungary	
Estonia	
Cyprus	

There is some convergence in portfolios between 2004-2006 and 2014-2016 (see results in Table 33). Cross-correlation between factors increased. Bulgaria, Hungary and Estonia moved from the EU-13 group (factor 2) in 2004-2006 to the EU-15 group (factor 1) in 2014-2016. Malta had a portfolio more similar to that of EU-15 countries than of EU-13 countries. The other nine EU-13 countries still have a discrete pattern of scientific specialisation, distinctively different from that of the EU-15.

Conclusion

The hypothesis is tentatively confirmed. The results of the comparison of scientific output portfolios suggests that the odds of finding a cognitive overlap – that is, two organisations have the same or similar thematic interests and specialisations – is much higher within the EU-15 and within the EU-13 than between the two regions.

5.3. Environmental conditions

5.3.1. Hypothesis 7: Low rates of participation in the FP are a reflection of the relative weakness of the R&I systems of the EU-13 compared to the EU-15

Low rates of participation in the European FPs and the lag in scientific quality compared to the EU-15 may be symptoms of a more fundamental problem. It is possible that the development of the knowledge economy in the EU-13 lags behind that of the EU-15 and that this lag weakens the research and innovation systems of the EU-13 Member States. We examine indicators for the development of the knowledge economy, namely R&D capacity, rates of economic growth, and relative innovation performance.

Methods and data

R&D capacity is compared based on several indicators: the level of R&D expenditure (public, private and total) as a percentage of GDP, the number of researchers per million population, the share of persons with tertiary education and employed in science and technology in active population, and the employment in knowledge intensive activities (KIA). Economic growth is defined as the compound average growth rate of per capita Gross Domestic Product at constant prices. We use the Total Economy Database of the Conference Board, which is one of the best sources of data for global comparisons of macroeconomic developments. Innovation performance is compared using the European Innovation Scoreboard, which tracks innovation in the EU-28 using indicators on eight dimensions of innovation performance. These dimensions are:

1. Human resources
2. Open, excellent and attractive research systems
3. Finance and support
4. Firm investments
5. Linkages & entrepreneurship
6. Intellectual assets
7. Innovators
8. Economic effects

The analysis is complemented by relevant conclusions of the Research and Innovation Observatory (RIO) country reports coordinated by the Joint Research Centre (https://rio.jrc.ec.europa.eu/) and country reports produced in the Stairway to Excellence (S2E) project launched in 2014 within the Smart Specialization Platform (http://s3platform.jrc.ec.europa.eu/stairway-to-excellence) that provide deeper insight into the national R&I systems in the context of socio-economic development.

Results

Figures 14 and 15 show the development of R&D expenditure as a percentage of GDP in EU-13 and the EU-15 Member States since around 1995.

- Levels are generally higher in the EU-15 than in the EU-13.
- Slovenia, Estonia and the Czech Republic approach or exceed the average level for the EU-28.
- Levels of R&D spending in Greece, Italy, Portugal, Spain, Ireland, the UK and Luxembourg are comparable to those in most EU-13 Member States.
- R&D expenditure is higher and growing in Austria, Denmark, Germany, and Belgium in the EU-15, and in the Czech Republic, Slovenia, Estonia and Hungary in the EU-13. In Slovenia, Estonia, and the Czech Republic levels of GERD and researchers are rapidly approaching those of most EU-15 Member States.
- Levels are low and unchanging in Cyprus, Romania, Croatia, and Latvia. In Hungary, levels are higher but remained unchanged.

It is perhaps better to distinguish between nations that invest more in R&D (and are becoming more knowledge-intensive) and those that invest less in R&D (and are not becoming more knowledge-intensive).

The share of persons with tertiary education employed in science and technology in active population is below the EU-28 average in most of the EU-13 countries (Figure 15a). Only the countries, such as Cyprus, Estonia, Lithuania and Slovenia, are above or approach the EU-28 average. The number of persons with tertiary education employed in science and technology has been growing in all of the EU-13 countries and the rate of growth is similar to that in the EU-28 average.

The sector of knowledge intensive activities (KIA) in the EU-13 is still relatively undeveloped (Figure 15b). The share of employees in this sector in the total number of employees is below the EU-28 average in most of the EU-13 countries (except for very small countries, such as Malta and Cyprus). Even though the share of employment in KIA in the EU-13 Member States has been growing in recent years the convergence to the EU average is slower than in R&D expenditures (see Figure 15). The only countries that have been approaching the EU average are Hungary and Slovenia.

Figure 14. Gross domestic expenditure on R&D as a percentage of GDP in the EU-13, 1990-2015 (per cent)
Source: Eurostat
(http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=t2020_20)

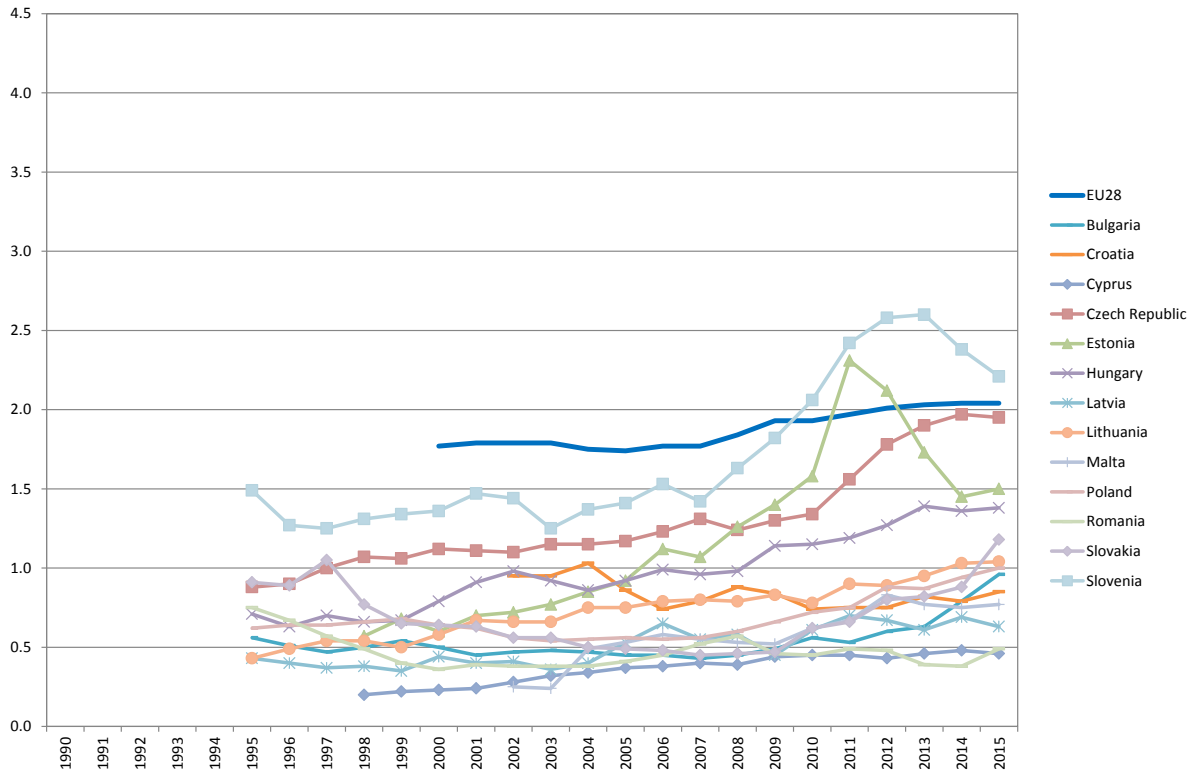


Figure 15. Gross domestic expenditure on R&D as a percentage of GDP in the EU-15, 1990-2015 (per cent)
Source: Eurostat
(http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=t2020_20)

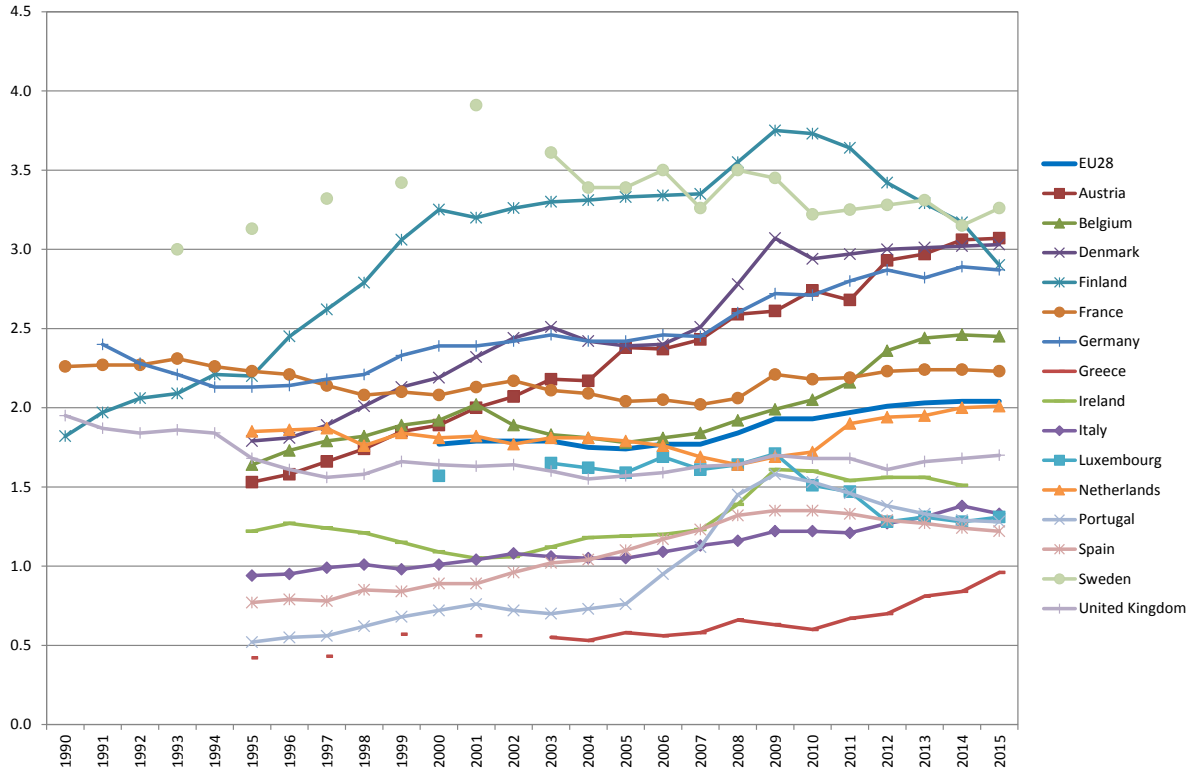


Figure 15a. Persons with tertiary education (ISCED) and employed in science and technology as a percentage of active population from 25 to 64 years in the EU-13, 1996-2015
Source: Eurostat
(http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=hrst_st_ncat&lang=en)

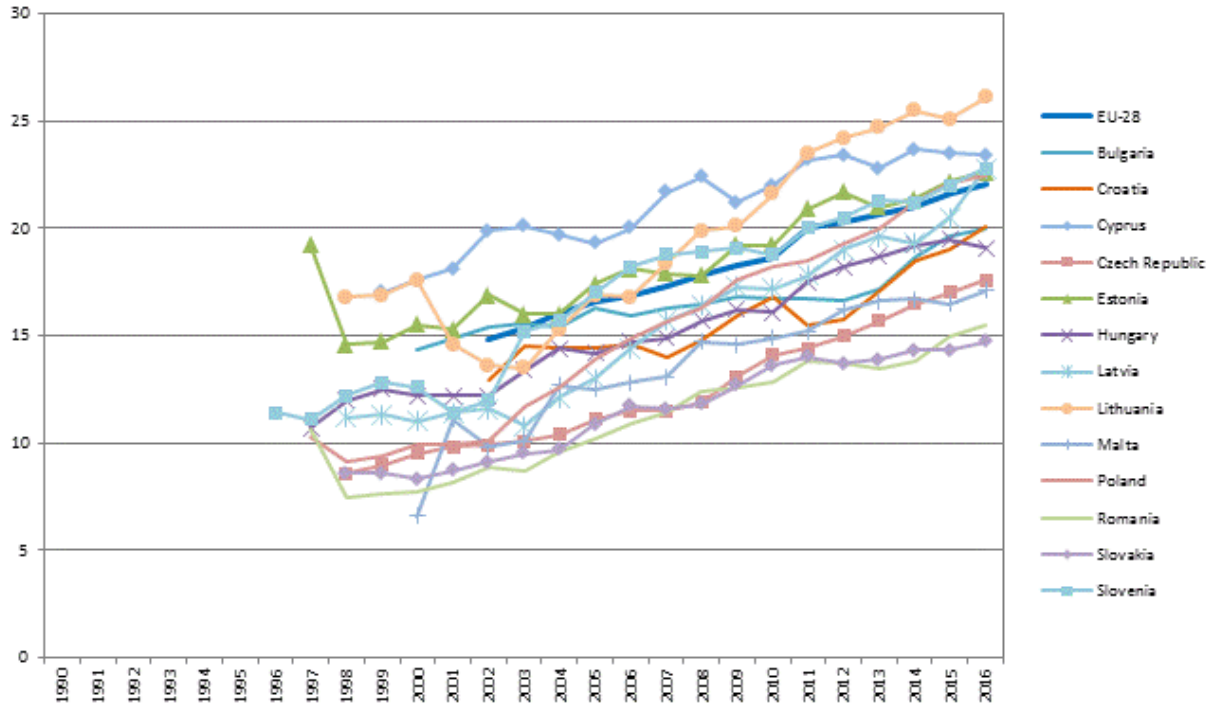
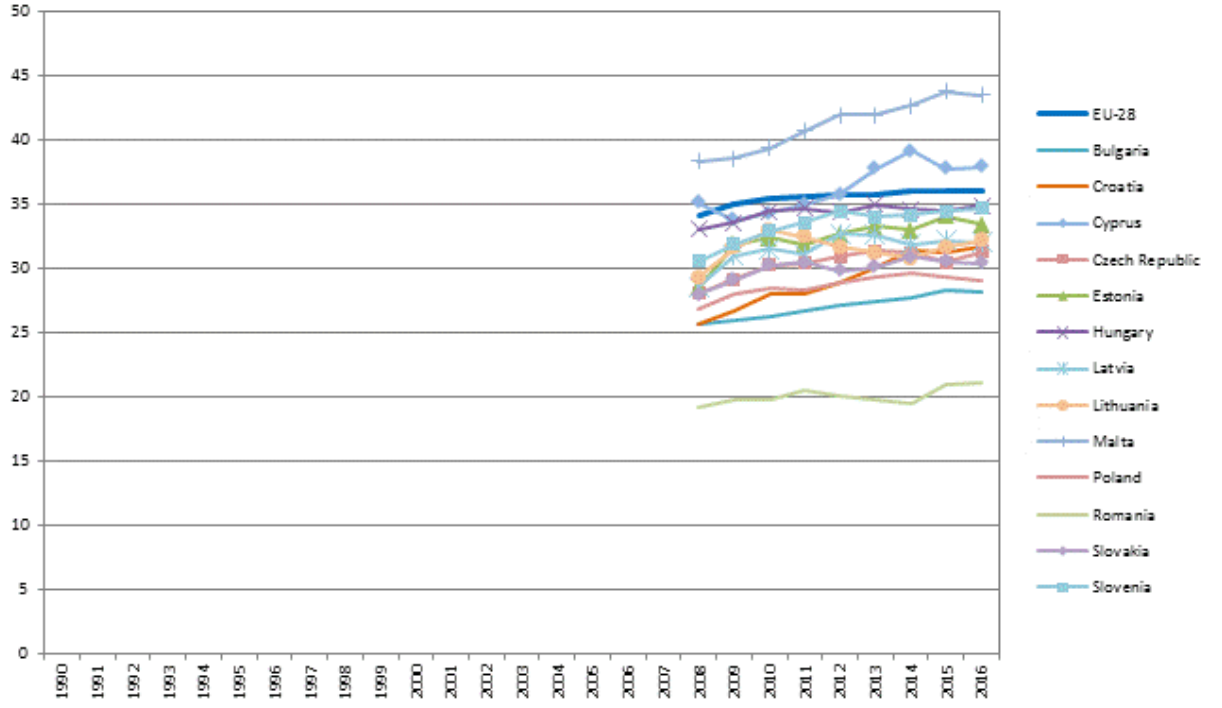


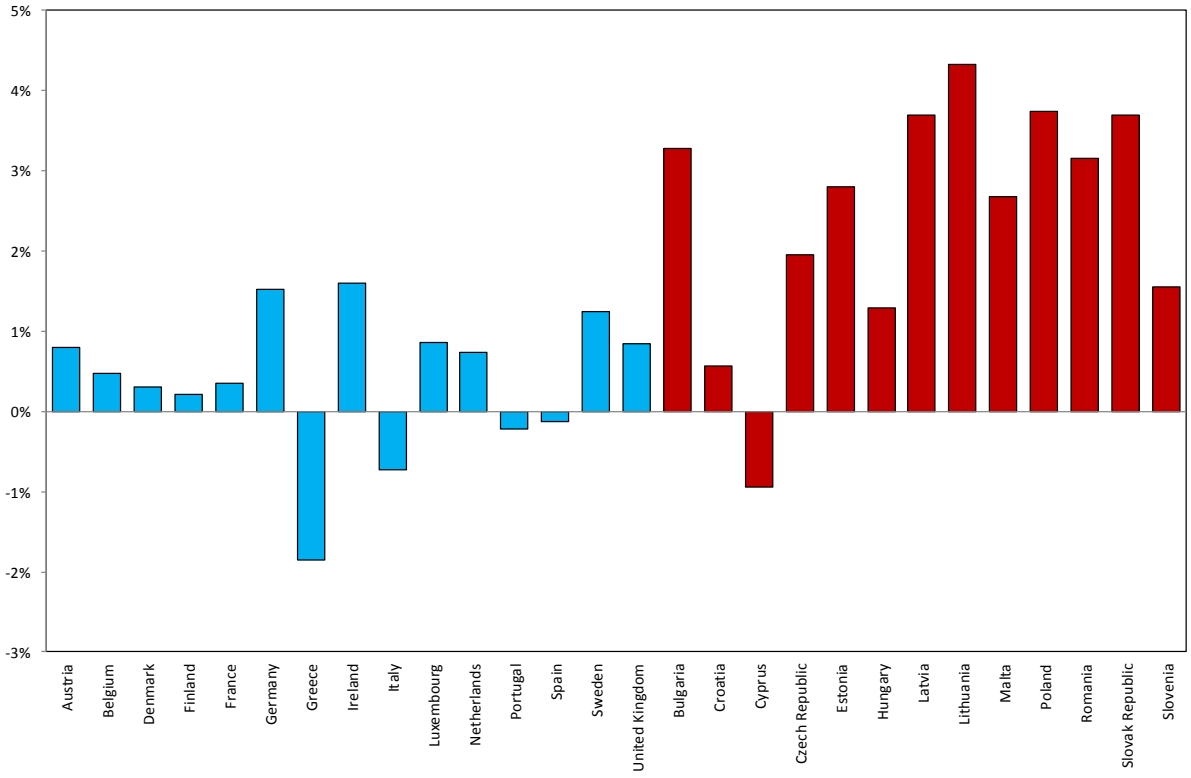
Figure 15b. Employment in knowledge-intensive activities as a percentage of total employment in the EU-13, 2005-2015
Source: Eurostat (http://ec.europa.eu/eurostat/data/database?node_code=htec_kia_emp2)



From an economic perspective, the EU-13 has outperformed the EU-15. Data on the growth rate of per capita GDP (Figure 16) show that economic growth has been much higher in the EU-13 than in the EU-15. Between 2004 and 2016 most EU-15 Member States have experienced growth rates below 1 per cent; Greece, Italy, Portugal, and Spain have witnessed a decline in per capita GDP. In most EU-13 Member States per capita GDP has grown by about 3 to 4 per cent per year. Growth was slower in Hungary, Croatia, Slovakia and the Czech Republic. Only in Cyprus did per capita GDP decline.

Levels of per capita GDP remain generally higher in the EU-15. In 2016, the per capita GDP of Malta is comparable with that of France. The per capita GDP of Spain, Portugal, and Greece is comparable with that of Poland and Hungary.

Figure 16. Compound average growth rate of per capita GDP between 2004 and 2016 (per cent)
Source: Conference Board, Total Economy Database, November 2016 release.
Note: GDP per capita in 2015 US$ (converted to 2015 price level with updated 2011 Purchasing Power Parities).



Innovation is the most important source of economic growth. Data from the European Innovation Scoreboard suggest that the EU-13 lags behind the EU-15. Table 34 gives rise to a number of observations, some of which are worrisome.

- In 2008 the Innovation Index of the EU-13 was almost 40 per cent lower than that of the EU-15. In 2015, after having participated in FP7, the gap remained the same. The EU-13 does not appear to be catching up with the EU-15.
- The EU-13 score particularly low in 'Open, excellent and attractive research systems'. Here the gap with EU-15 performance is 65 per cent. The number of international scientific co-publications is increasing rapidly, but the number of scientific publications among the top 10 per cent most cited publications is declining and the number of non-EU doctorate students is very low.

- EU-13 performance in 'Linkages & entrepreneurship' is declining rapidly. The percentage of SMEs innovating in-house, the percentage of innovative SMEs collaborating with others, and the number of public-private co-publications are all going down.
- Performance in the 'Innovators' dimension is stable. This is, however, the result of an increase in employment in fast-growing enterprises and a sharp decline in the percentage of SMEs that introduces innovations. Sales of new to the market and new to firm innovations (in the 'Economic effects' dimension) are also rapidly declining.

Table 34. EU-13 and EU-15 performance on European Innovation Scoreboard indicators and composite scores, 2008-2015

Source: European Innovation Scoreboard 2016.
Note: EU-13 and EU-15 aggregate scores represent the unweighted averages of Member State scores.

	EU-13 performance (EU-15=100)		CAGR 2008-2015	
	2008	2015	EU-15	EU-13
Summary Innovation Index	**61**	**62**	**0.6%**	**0.8%**
Human resources	**79**	**89**	**2.7%**	**4.4%**
New doctorate graduates per 1000 population aged 25-34	42	58	2.7%	7.7%
Percentage population aged 30-34 having completed tertiary education	59	83	2.7%	7.8%
Percentage youth aged 20-24 having attained at least upper secondary level education	143	129	2.6%	1.1%
Open, excellent and attractive research systems	**35**	**35**	**3.9%**	**4.0%**
International scientific co-publications per million population	36	43	8.4%	11.0%
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	51	43	2.1%	-0.5%
Non-EU doctorate students as a % of all doctorate students	12	17	2.2%	6.5%
Finance and support	**48**	**62**	**-1.9%**	**1.7%**
Public R&D expenditures as % of GDP	52	58	2.4%	4.0%
Venture capital investments as % of GDP	44	69	-7.5%	-1.3%
Firm investments	**95**	**90**	**-0.8%**	**-1.6%**
Business R&D expenditures as % of GDP	32	43	0.7%	5.2%
Non-R&D innovation expenditures as % of turnover	193	187	-3.4%	-3.8%
Linkages & entrepreneurship	**57**	**45**	**-0.4%**	**-3.8%**
SMEs innovating in-house as % of SMEs	50	38	-1.2%	-4.8%
Innovative SMEs collaborating with others as % of SMEs	76	57	0.2%	-3.9%
Public-private co-publications per million population	49	41	0.0%	-2.5%
Intellectual assets	**48**	**63**	**0.3%**	**4.4%**
PCT patents applications per billion GDP (in PPS€)	45	47	-0.6%	0.0%
PCT patent applications in societal challenges per billion GDP (in PPS€)	49	45	0.3%	-0.8%
Community trademarks per billion GDP (in PPS€)	68	90	2.0%	6.1%
Community designs per billion GDP (in PPS€)	29	73	-0.7%	13.2%
Innovators	**58**	**56**	**-0.9%**	**-1.5%**
SMEs introducing product or process innovations as % of SMEs	49	37	-1.7%	-5.5%
SMEs introducing marketing or organisational innovations as % of SMEs	62	50	-1.4%	-4.5%
Employment in fast-growing enterprises (average innovativeness scores)	64	79	0.4%	3.3%
Economic effects	**72**	**65**	**0.7%**	**-0.8%**
Employment in knowledge-intensive activities	56	65	1.1%	3.3%
Medium and high tech product exports	95	98	0.1%	0.6%
Knowledge-intensive services exports	44	44	-0.1%	-0.1%
Sales of new to market and new to firm innovations	103	67	-1.6%	-7.6%
Licence and patent revenues from abroad	68	52	4.7%	0.7%

Figures 17 and 18 compare the scores of individual Member States for two dimensions of the European Innovation Scoreboard in 2008 and 2015, namely 'Open, excellent and attractive research systems' and 'Linkages & entrepreneurship'. The first figure illustrates that the research systems of the EU-13 are much less open, excellent and attractive than those of the EU-15. The top performing countries (CY, CZ, EE, and SI) barely reach the lowest performing countries of the EU-15. Between 2008 and 2015 most EU Member States made progress, but most of the EU-13 lagged behind the EU-15 (apart from CY, CZ, EE, and SI). With respect to 'Linkages & entrepreneurship' most EU Member States had lower performance in 2015 than in 2008. Notable exceptions were NL, UK, DK, and BE. CY, CZ, EE, and SI were the top EU-13 performers in this dimension as well, although EE and CY also underwent the strongest decline.

Figure 17. Scores of EU-13 and EU-15 Member States on the European Innovation Scoreboard dimension 'Open, excellent and attractive research systems' in 2008 and 2015
Source: European Innovation Scoreboard 2016.

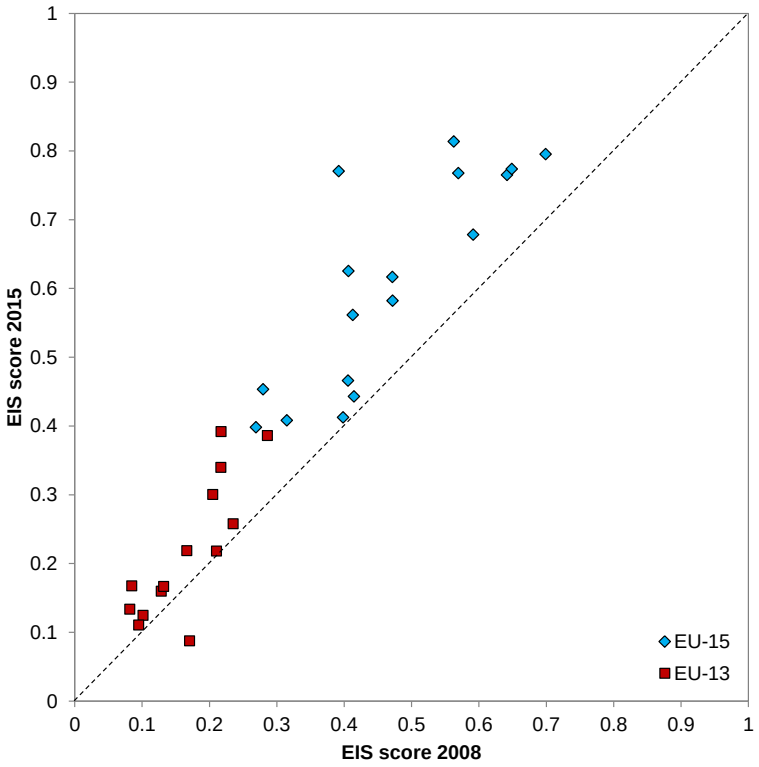
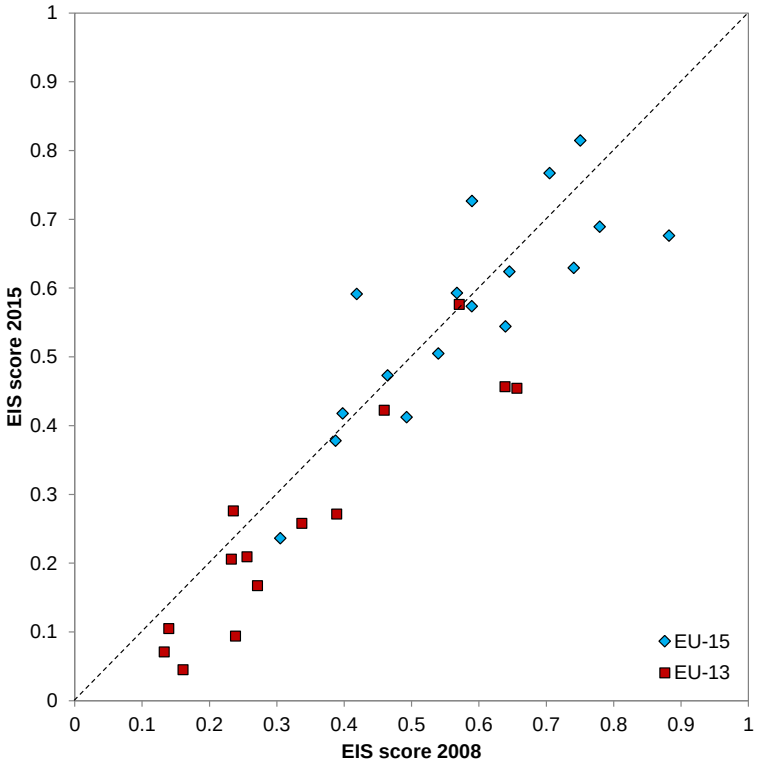


Figure 18. Scores of EU-13 and EU-15 Member States on the European Innovation Scoreboard dimension 'Linkages & entrepreneurship' in 2008 and 2015
Source: European Innovation Scoreboard 2016.



The difference in innovation performance between the EU-13 and EU-15 is also visible at a lower regional level. Cecere and Corrocher (2011) have classified NUTS-2 regions in the EU-27. Their classification is based on the intensity of participation in the IST programme for Research and Technology Development in FP6 and FP7 as well as on the presence of network hubs to indicate strategic positioning, given that a high number of participants does not mean that a region is well-connected. Cecere and Corrocher classify 209 NUTS-2 regions into four categories:

1. *Core members*: high frequency of participation and strategic positioning
2. *Followers*: high frequency of participation but a small connecting role
3. *Peripheral participants*: low frequency of participation and a small connecting role
4. *Selective players*: low frequency of participation but strategic positioning

Table 35 shows that only 10 per cent of EU-13 NUTS-2 regions has a high frequency of participation and strategic positioning ('core members') compared to 25 per cent of EU-15 NUTS-2 regions. In the EU-13 78 per cent of NUTS-2 regions has a low frequency of participation and a small connecting role ('peripheral participants') as against 51 per cent in the EU-15.

Table 35. Classification of NUTS-2 regions in the EU-27 based on participation in the IST programme for Research and Technology Development in FP6 and FP7
Source: Cecere and Corrocher (2011).

Country	Core	Selective	Follower	Peripheral	Total
EU-15	**40**	**16**	**21**	**81**	**158**
	(25%)	**(10%)**	**(13%)**	**(51%)**	**(100%)**
DE	9	2	7	14	32
UK	6	8	1	12	27
IT	6		1	10	17
NL	3	1	1	5	10
SE	3	1		2	6
ES	3		2	9	14
AT	2	1	2	2	7
FR	2		2	12	16
BE	2		2	4	8
GR	1	3		6	10
FI	1		1	1	3
DK	1				1
IE	1				1
PT			1	4	5
LU					
			1		1
EU-13	**5**	**2**	**4**	**40**	**51**
	(10%)	**(4%)**	**(8%)**	**(78%)**	**(100%)**
PL	1	1		11	13
HU	1			6	7
CZ	1			5	6
CY	1				1
SI	1				1
RO		1	1	7	9
BG			1	7	8
EE			1		1
LT			1		1
SK				3	3
LV				1	1
Total	45	18	25	121	209

The country reports produced in the framework of the Research and Innovation Observatory (RIO) and the Stairway to Excellence (S2E) project enable to assess weakness of the R&I systems in the EU-13 that might result in a lower participation of research teams from these countries in the European Framework Programmes. The R&D intensity in 2015 was below EU-28 average in all EU-13 countries (with exception of Slovenia) and also the number of researchers in EU-13 is smaller compared to EU-15, both in nominal terms and in percentage of the total population (21 per cent in EU-13 vs. 27 per cent in EU-15 in 2015).

The reports confirm that the EU-13 group of countries is rather heterogeneous in terms of population number, level of economic development, number of researchers, intensity of R&I both in terms of public and private funding, and scientific output. On one side there are some rather economically well developed countries that invest moderately into R&D, mainly Slovenia, Czech Republic, and to some extent also Estonia. These countries also show relatively high participation rate in FP among the EU-13 countries. On the other side, there are countries with the national research and innovation system that is significantly underfunded, in particular Romania and Cyprus (with R&I intensity below 0.5 in 2015). The underfunding of R&D also results in lower quality of research infrastructures in some of the EU-13 countries.

The overall funding in the business sector is insufficient - BERD in none of the EU-13 countries is close to the 2 per cent target value. Path-breaking innovation is rare; access to venture capital is limited. Linkages between public and private R&D sector and knowledge transfer remain weak in the EU-13 countries. In some EU-13 countries, there is a strict distinction between basic and applied research with little willingness for closer collaboration. High concentration of R&D activities in large multinational companies is typical for some countries (Hungary, Czech Republic, Slovenia). Almost all EU-13 countries include strengthening the linkages between public R&D sector and industry among their innovation challenges (see e.g. RIO country reports, 2016).

In some EU-15 countries (e.g. DE or FR), RTOs play a significant role in bridging the gap between academia and industry and they are considered a significant element of the R&I system that contributes to the exploitation of research results. In this respect, underdevelopment of the segment of RTOs in EU-13 might induce an insufficient exploitation of FP research results that lead to the lower motivation to participation in FPs. However, as mentioned in the chapter 4.1.3, structures of national R&I systems and labour division in R&I are country dependent and there is no one size fits all institutional model for bridging the gap between academia and industry. Therefore, the role of RTOs and other institutions helping to effective exploitation of research results needs to be thoroughly investigated in a future research.

There are still shortcomings in the governance of the R&I systems in most of the EU-13 countries. The public R&D systems in the EU-13 countries are often fragmented consisting of a large number of both public and private universities, institutes of the Academy of Sciences, and other public research institutions. Some of the EU-13 countries suffer from insufficient coordination of national R&I system. Although many of the EU-13 countries have made substantial changes in their R&I systems many deficiencies in R&D governance still remain (see e.g. RIO country reports, 2016).

Shortcomings in the governance of the public research sector result in an inefficient allocation of public research funding. Majority of EU-13 countries suffer from missing priorities and a common vision for the R&I system. There is also a need to adopt a more targeted approach in several EU-13 countries. Higher education reform has also been an issue in several EU-13 countries (e.g. Czech Republic, Hungary) but the progress has so far been insufficient. There is still an insufficient evaluation culture in most of the EU-13 countries and the revision of evaluation methodologies is needed to be capable of steering the R&I system and/or informing the performance-based funding.

Many EU-13 countries have made use of the ESIF funds to support their R&I system. Public R&D expenditure is in some countries made of a large percentage of public R&D investment from abroad, especially from ESIF. Some countries admit that availability of ESIF funds allocated to R&D, and in some countries also availability of national R&D funds, is limiting the willingness of scientists to compete for FP funding where the competition on the international scale is harder than on the local national scale (see e.g. Stairway to Excellence country reports, 2015).

Analyses produced in the framework of the S2E project and the RIO initiative confirm that internationalization in the public sector remains low in the EU-13 countries. This is a problem inherent to many EU-13 countries. In addition, some of them suffer from a massive brain drain. Therefore most of the EU-13 countries take policy instruments and measures to facilitate the participation in the European Framework Programmes and other international R&D activities (see e.g. Stairway to Excellence country reports, 2015).

Conclusion

The hypothesis is confirmed. As a group, the EU-13 has lower R&D expenditure and lower innovation performance. They have, however, achieved much stronger growth of per capita GDP and are consequently catching up economically with the EU-15. Some EU-13 Member States – specifically CY, CZ, EE, and SI – have much better performance than the rest of the EU-13. As the innovation performance of most of the EU-13 countries lags behind that in the most of the EU-15 countries the

stronger growth of GDP in the EU-13 compared to the EU-15 may be attributed to the growth of factor productivity, but not necessarily as a result of innovation.

5.3.2. Hypothesis 8: Prospective participants in the EU-13 have alternative and more easily accessible funding opportunities that are less easily available in the EU-15

The European Framework Programme allocates R&D funding on a competitive basis. Funding is distributed using a range of different instruments (funding schemes), each of which has its own eligibility criteria, consortium criteria, and quality criteria. In some areas, particularly the ERC, competition is particularly fierce and requires levels of excellence that the EU-13 may not (yet) have. Where EU-13 organisations have easy access to alternative funding, they may opt not to submit to the FPs and instead rely on these alternate sources, thus lowering actual participation. Rauch & Sommer-Ulrich (2012) found that the more national funding programmes are available as a part of GERD, the easier it is for researchers and developers to access them.

5.3.2.1 Willingness-to-submit

Methods and data

We will examine two indicators:

1. the number of proposals submitted per million researchers for individual grants (ERC, MSCA) and collaborative instruments (CSA and RIA) to measure willingness-to-submit; and
2. the relative size of the budget of European Structural Funds, which are increasingly used for investments in the knowledge economy.

There is currently insufficient information on expenditure on core funding versus competitive funding.

Results

The 'willingness to submit' can be measured by the number of participations in preparing project proposals. For the sake of international comparability, it is necessary to normalize these numbers for population size or the number of FTE researchers. The corresponding indexes can be found in Table 18; they have been visualized in Figure 19. We immediately see that the highest number of teams participating in the preparation of FP7 proposals have CY, SI and MT and EE. The other EU-13 (RO, LV, BG, HU, HR, LT, CZ, SK and PL) form a more or less homogeneous group with less than 750 participations in submitted proposals.

The same applies if the numbers of participations in project preparations are related to the number of FTE researchers. The EU-15 is clearly divided into two groups: the 'big five' (DE, FR, UK, IT and ES) have less than 1,200 participations per one million population, while the rest of the EU-15 have more than 1,800 participations. In both regions of the EU, the smaller Member States have higher willingness-to-submit FP projects.

Relative to R&D expenditure, the willingness-to-submit of the EU-13 is generally higher than that of the EU-15. Figure 20 shows that all EU-13 Member States except for CZ have more than 0.5 participations in submitted proposals per million euros of GERD. A possible explanation is that EU-13 organisations try to overcome the lack of domestic R&D funding by participating in preparing and submitting many FP project proposals.

Figure 19. Participations in submitted project proposals in FP7, normalized per one million inhabitants (light coloured columns) and per thousand FTE researchers (dark coloured columns)
Source: Table 18.

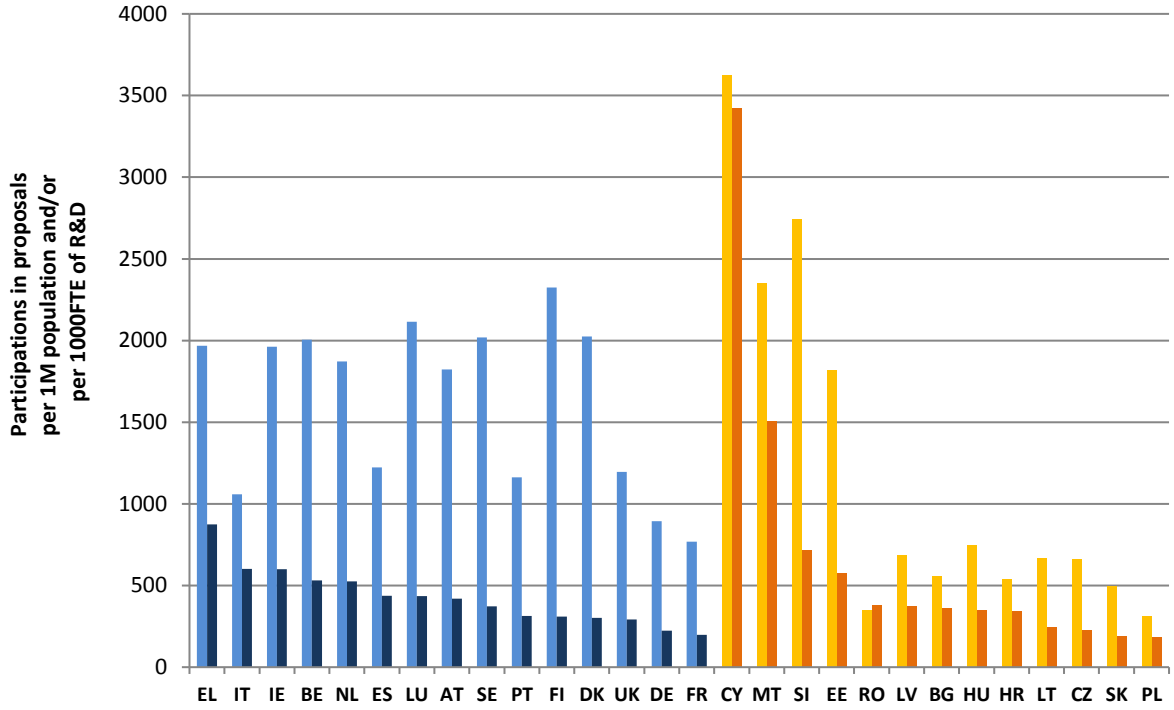
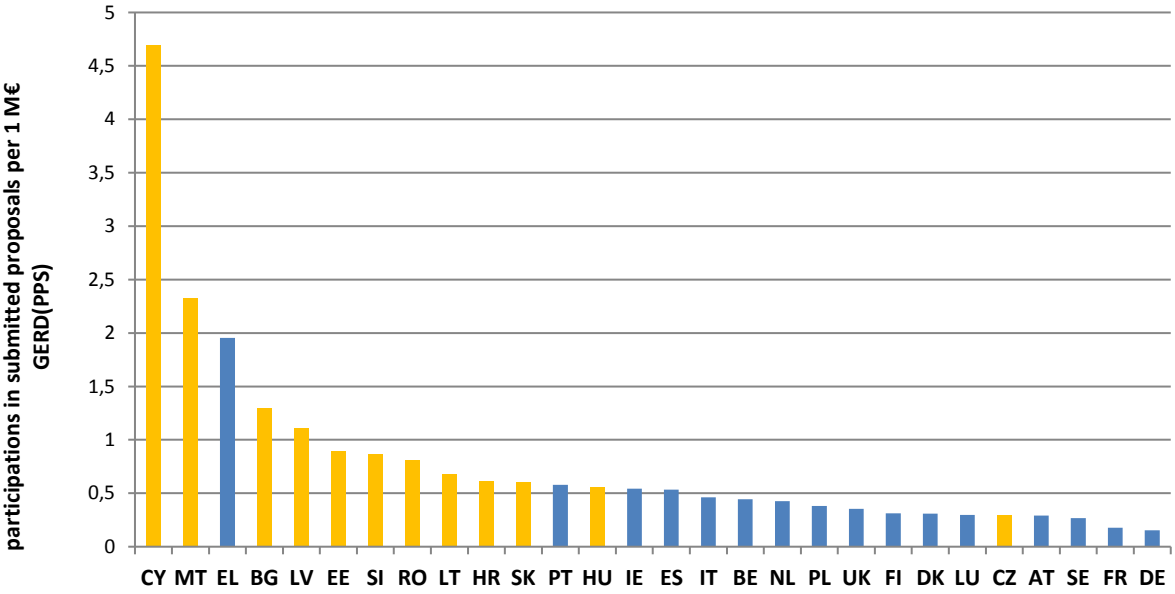


Figure 20. Participations in submitted project proposals in FP7, normalized per million GERD
Source: Table 18.



5.3.2.2 European Structural Funds

Methods and data

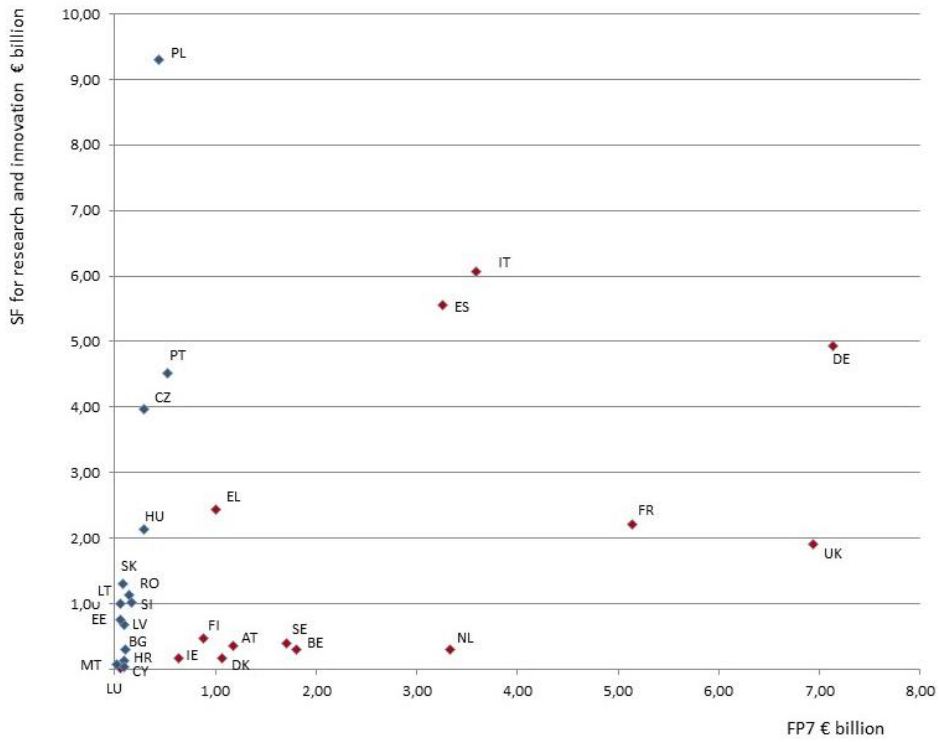
Data for the measurement of willingness-to-submit is taken from the E-CORDA database. ESIF expenditure per EU Member State was taken from a report by the UK Royal Society.

Results

Some EU Member States use the European Structural and Investment Funds (ESIF) to invest in R&D. Good access to national supplies of ESIF funding may lower the incentive for organisations to compete for FP funding. In Figure 21 we compare the amount of funding received from FP7 and the ESIF for the EU-28.

- Total funding from FP7 was much lower in the EU-13 Member States than in every EU-15 Member State with the exception of Luxembourg.
- In nine EU-13 Member States, the ESIF accounted for over 80 per cent of European R&D funding. In Malta and Bulgaria, the ESIF share was just below 80 per cent (78 and 75 per cent respectively).
- When ESIF funding is included, total EU funding for R&D in the Czech Republic was higher than that in Ireland, Finland, Greece, Denmark, Austria, Sweden, Belgium, and the Netherlands. Hungary received more EU R&D funding than Ireland, Finland, Denmark, Austria, Sweden, and Belgium. Poland received more EU R&D funding than all EU-15 Member States with the exception of Germany.

Figure 21. Distribution of EU expenditure on research, development and innovation among the EU-28 in 2007-2013 from FP7 and the European structural and investment funds (million euros)
Source: The Royal Society (2015). UK Research and the European Union. The role of the EU in funding UK research. December 2015, DES3891.



Conclusion

The hypothesis is rejected. The EU-13 organisations have easy access to a large alternative funding source, the European Structural and Investment Funds. Yet, the essence of the hypothesis was that EU-13 organisations would submit fewer proposals because easily accessible alternative funding sources were available. However, contrary to the expectations formulated as part of this hypothesis willingness-to-

submit is higher among the EU-13 Member States. This is a reflection of their smaller size: small Member States tend to submit more proposals (per million population) than large Member States.

5.4. Time

5.4.1. Hypothesis 9: It is too soon to expect a raise in participation rates as EU-13 R&I actors still have to prove their capabilities

This hypothesis might be considered an expression of the cautionary principle. We will examine this possibility by measuring the development of the participation rates of Spain and Portugal – countries that acceded in 1986, during FP1, but that were long considered peripheral – and of Austria, Sweden, and Finland – countries that acceded in 1995, during FP4, but are considered strong STI performers. Also, some differences between the EU-13 and the EU-15 may have their origins before FP7.

Methods and data

The analysis is based on CORDIS data available on EU Open Data Portal, showing participations in EU FP projects from FP1 until Horizon 2020. Country codes have been harmonised as much as possible.

The data for FP4 are not consistent with those of the other FPs; it would require significant effort to address this issue. Horizon 2020 has only just begun. This is why we have restricted our analysis to FP1, FP3, FP5, FP7 and Horizon 2020. Spain and Portugal joined the EU in 1986, during FP1. Finland, Sweden, and Austria joined in 1995, at the start of FP4. The EU-13 joined in 2004, 2007 (Romania and Bulgaria) and 2013 (Croatia).

We have calculated the share of organisations from the EU-13 and the EU-15 Member States in the total number of participations. The aim is to establish whether an increase in FP participation was associated with membership. Was there an increase and did it occur before or after accession?

Results

Spain and Portugal joined the EU during FP1. By FP3 their rate of participation had doubled. Between FP1 and FP3 the number of participations in Spain and Portugal increased at more than twice as much as that of the EU-10. Their relative share in total FP participations has remained stable since FP3. Yet, to this day they remain at the lower end of many participation statistics (see Table 36).

Finland, Sweden, and Austria joined during FP4. Their rate of participation began to increase much earlier, but after they had joined, it remained steady. Between FP3 and FP5 their rate of participation grew about four times as much as the EU-10 rate of participation. Since FP5 their number of participations grew only slightly more than that of the EU-10. Their relative share in total FP participations has remained stable since FP5.

The participation of EU-13 organisations began to increase long before they joined the EU. Their expansion began already in FP5. Between FP5 and FP7 the EU-13 number of participations more than doubled. It increased twice as much as that of the EU-10. In relative terms, the EU-13 share in FP participations has increased little since FP5, growing from 7 per cent in FP5 to 9 per cent in FP7 and 10 per cent in Horizon 2020.

Many EU-13 Member States have increased their attractiveness in FP7 in comparison with FP6, including BG, EE, and SI. It showed that a number of the smaller countries—former Yugoslav countries as well as some EU Member States located in Central and Eastern Europe—became more integrated into the co-participation network under FP7 than under FP6 (European Commission, 2015b).

Table 36. Participations per EU Member State in FP1, FP3, FP5, FP7, and Horizon 2020

	FP1 1984-1987	FP3 1990-1994	FP5 1998-2002	FP7 2007-2013	H2020 2014-2020
Total number of participations	7,811	29,953	74,580	116,578	33,439
ES, PT	499	3,208	7,594	13,576	4,605
FI, SE, AT	55	1,230	6,730	10,560	2,843
EU-10	7,257	25,489	55,060	81,752	22,798
EU-13	0	26	5,196	10,690	3,193
ES, PT	6%	11%	10%	12%	14%
FI, SE, AT	1%	4%	9%	9%	9%
EU-10	93%	85%	74%	70%	68%
EU-13	0%	0%	7%	9%	10%

Conclusion

The hypothesis is rejected. For the hypothesis to be confirmed, we would expect the FP participation of Spain, Portugal, Sweden, Finland, and Austria to show a continued increase at high rates long after their accession to the EU. We do see an increase in numbers of participation, but in relative terms – the number of participations per Member State as a percentage of total FP participations – we see stability.

5.5. The Framework Programme

5.5.1. Hypothesis 10: The problem of FP participation is specific to certain instruments in FP7 and Horizon 2020

Part of the explanation may lie in the design, governance and politics of the Framework Programme. We will examine the composition of successful participants per MS in different parts of the FP, comparing the EU-13 with the EU-15, and focusing specifically on (a) instruments that target (excellent) individuals (ERC, MSCA) and (b) collaborative instruments (CSA and RIA in the Grand Challenges, LEIT, and FET).

Methods and data

We examine participation per funding scheme normalised for the size of the researcher population and for investments in R&D. Funding schemes in FP7 and Horizon 2020 are fairly comparable, but some occur only in FP7 or in Horizon 2020, not in both. In our comparison, we focus on five specific funding schemes that are comparable across the two FPs (Table 37).

Table 37. Comparable funding schemes in FP7 and Horizon 2020

Funding scheme	Objective	FP7	Horizon 2020
ERC	scientific excellence, frontier research	European Research Council (ERC)	European Research Council (ERC)
MSCA	support for training and career development	Marie Skłodowska-Curie Actions (MSCA)	Marie Skłodowska-Curie Actions (MSCA)
CP (IP and FP), IA/RIA	development of new knowledge or a new technology; closer-to-the-market activities with the aim at producing new or improved products or services	Collaborative projects (CP), Large-scale integrating project (CP – IP), Small or medium-scale focused research project (STREP), Small/medium-scale focused research project for specific cooperation actions (STREP)	Research and innovation actions (RIA), Innovation actions (IA)
CSA	coordination and networking of research and	Coordination and support actions (CSA), Coordination	Coordination and support actions (CSA)

	innovation projects, programmes and policies; research is covered elsewhere	(or networking) actions (CSA-CA), Support actions (CSA-SA)	
Benefit of specific groups (SMEs, CSOs)	support for highly innovative SMEs with the ambition to develop their growth potential	Research for the benefit of specific groups in particular SMEs as well as SME associations and groupings	SME Instrument

Results

In the analysis of participation in chapter 4, we observed that EU-13 participation was particularly low in funding schemes that focus on individual researcher excellence and on innovation. EU-13 organisations account for 2 per cent of participations in the ERC, 5 per cent in the MSCA, and 7 per cent in innovative projects (Integrating Projects, Focused Projects, Innovation Actions, Research and Innovation Actions). In these funding schemes performance in Horizon 2020 is the same as in FP7.

In two other types of funding scheme – Coordination and Support Actions, and projects for the Benefit of Specific Groups – EU-participation is higher as well as improving. In FP7 EU-13 organisations accounted for 14 per cent of CSA participations; in Horizon 2020 this has increased to 18 per cent. In BSG projects, these percentage shares are 6 and 10 per cent respectively. In other, non-comparable funding schemes, performance is also higher than average. For example, EU-13 organisations account for 12 per cent of participations in Networks of Excellence in FP7 and for 17 per cent of Cofund participations in Horizon 2020.

In Table 38 we have expressed the number of EU-13 participations relative to the number of EU-15 participations per comparable funding scheme in FP7 and Horizon 2020, normalised for the number of researchers and for R&D expenditure. After normalisation, it is clearly visible that participation in ERC, MSCA, and CP projects is relatively and declining. The EU-13 generally outperforms the EU-15 in participations per million GERD, but in the ERC EU-13 performance went from 65 to 51 per cent of EU-15 participation per million GERD. EU-13 organisations only excel in CSA projects.

Table 38. Number of participants per type of funding scheme from the EU-15 and EU-13 in FP7 and Horizon 2020, per researcher (FTE) and per million GERD (EU-15=100)
Source: CORDIS.

	participations per FTE researcher		participations per million GERD	
	FP7	Horizon 2020	FP7	Horizon 2020
ERC	18	16	65	51
MSCA	47	35	168	112
CP (IP and FP), IA/RIA	59	60	212	191
CSA	145	165	523	528
BSG	48	83	173	265
Total	73	72	264	231

Table 39. Participation per researcher (FTE) comparing FP7 with Horizon 2020, per funding scheme (EU-15=100) Source: CORDIS.

	ERC		MSCA		CP (IP and FP), IA/RIA		CSA		BSG	
country	FP7	H2020	FP7	H2020	FP7	H2020	FP7	H2020	FP7	H2020
EU-15	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
AT	105	101	107	107	127	133	145	157	89	71
BE	128	110	128	113	183	158	265	267	139	42
DE	74	82	60	62	80	76	62	61	57	37
DK	80	104	109	151	97	88	93	92	109	169
EL	52	16	154	117	202	202	260	198	307	50
ES	71	93	114	132	112	164	105	155	202	294
FI	57	78	49	69	90	107	107	114	75	142
FR	83	76	70	63	69	61	74	63	39	37
IE	91	119	221	190	153	142	192	146	273	233
IT	104	96	102	103	162	154	158	163	152	261
LU	13	94	82	158	113	232	280	436	93	105
NL	232	227	176	169	181	155	180	144	118	111
PT	34	60	78	83	72	107	107	166	125	87
SE	110	73	102	75	122	82	123	68	99	103
UK	150	136	146	142	77	75	68	62	101	81
EU-13	**18**	**16**	**47**	**35**	**59**	**60**	**145**	**165**	**115**	**83**
BG	11	0	36	18	56	51	194	272	149	28
CY	361	495	582	1102	453	921	1337	1841	1758	441
CZ	15	28	47	37	58	53	90	86	75	18
EE	44	20	82	102	112	169	378	515	457	815
HR	14	14	44	55	59	83	151	466	200	62
HU	63	44	73	35	73	60	199	128	136	138
LT	0	0	28	43	45	53	154	183	151	134
LV	8	0	44	51	65	94	372	456	104	105
MT	145	108	99	39	182	280	1221	1239	845	120
PL	10	4	37	20	39	30	77	74	55	45
RO	2	15	33	26	64	85	162	273	125	5
SI	12	11	77	79	149	194	265	366	232	445
SK	2	6	28	21	36	46	103	160	42	53

When we look at differences among the individual Member States (Table 39), it appears that there is a considerable gap between the two regions in the ERC and MSCA funding schemes, but more overlap in participation in innovative projects, CSA projects and BSG projects. Strong performers are Malta, Cyprus, Estonia, and Slovenia.

- In the ERC there is a very clear and deep gap between the EU-13 and EU-15. Malta and Cyprus do perform extremely well. The participation of Hungary is close to the low performers of the EU-15 (Portugal and Greece).
- The same gap exists in the MSCA, even though the differences between the EU-13 and the EU-15 Member States are smaller. Slovenia and Estonia perform close to the EU-15 average. Cyprus participates at levels 5 to 11 times higher than the EU-15 average.
- There is more overlap between the EU-13 and the EU-15 Member States in participation in innovative projects. Malta, Cyprus, Estonia and Slovenia participation is well above the EU-15 average. French participation, on the other hand, is on the level of the EU-13 average.
- EU-13 Member States excel in CSA projects. Only the Czech Republic and Poland have fewer participations per thousand researcher FTEs than the EU-15. The largest EU-15 Member States – Germany, France, the UK – also participate below EU-15 average.
- Patterns of participation in BSG projects are comparable to those in CSA projects. The number of projects is lower and there are bigger differences between FP7 and Horizon 2020. The Czech Republic, Slovakia, and Poland have fewer participations per thousand researcher FTEs than the EU-15 in both FPs.

Conclusion

The hypothesis is confirmed. The participation of EU-13 organisations in FPs is relatively low and declining in funding schemes aimed at excellence and innovation. It is relatively high in areas where existing knowledge is used for specific purposed, particularly in the Coordination and Support Actions.

5.5.2. Hypothesis 11: The EU-13 has insufficient influence on the work programme of the FP

The work programmes of the FPs create a thematic opportunity space for participation. Member States with more influence on the formulation of the work programme and on the implementation of the peer review process may have better opportunities for participation than the Member States with less influence.

Methods and data

The involvement of EU-13 countries in programme design and governance can be quantitatively assessed by exploring the composition of advisory groups to the European Commission in the area of research and innovation. Based on the data from the Register of Commission expert groups 73 active or on-hold advisory groups for R&I policy have been identified in February 2017. Out of these 73 advisory groups, 9 groups did not have any members evidenced in the Register, so the composition of remaining 64 advisory groups was further analysed.

The 64 advisory groups for research and innovation (AG for R&I) consist of 1,121 members (Table 40). On average there are 17.5 members per advisory group, ranging from 3 to 72 members. Based on the EC's categorisation the members are of five types related to the nature of their appointment and representation:

- Type A - Individual expert appointed in his/her personal capacity
- Type B - Individual expert appointed as representative of a common interest
- Type C - Organisation
- Type D - Member State Authority
- Type E - Other public entity

Table 40. Number and share of various types of members in AG for R&I
Source: Register of Commission expert groups (February 2017)

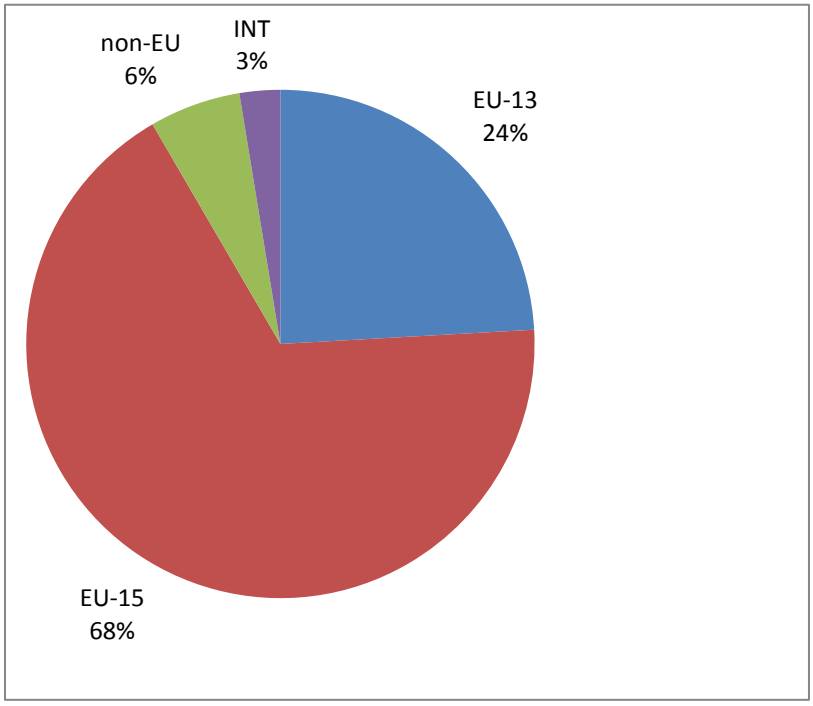
Type of member	Number	Percentage share
Type A - Individual expert appointed in his/her personal capacity	589	53%
Type B - Individual expert appointed as representative of a common interest	213	19%
Type C - Organisation	76	7%
Type D - Member State Authority	242	22%
Type E - Other public entity	1	0%
Total	1,121	100%

Expert groups perform a number functions. In general, they are a forum for discussion on a given subject and provide high-level input from a wide range of sources and stakeholders. Experts assist the Commission with tasks in connection with the Framework Programme for Research and Innovation. As peer reviewers and in the Horizon 2020 Advisory Groups, they assist in the evaluation of proposals and monitoring of actions as well as in the preparation, implementation or evaluation of programmes and design of policies.

Results

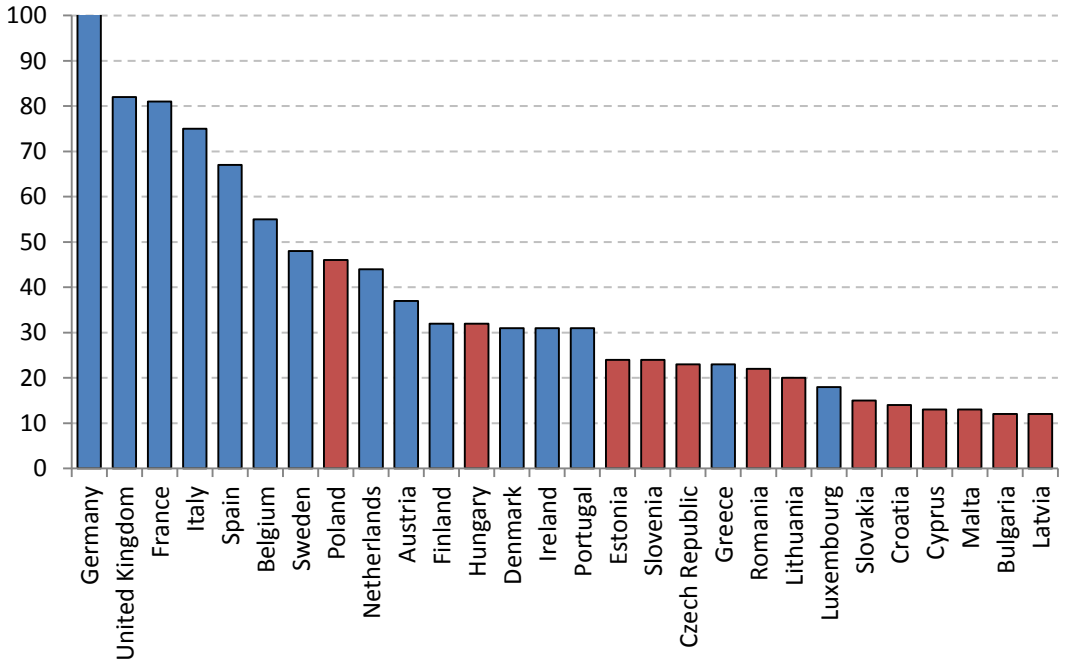
With regard to the Member States and nationalities represented in advisory groups for R&I, the EU-15 countries have the highest share of 68 per cent of all members (See Figure 22). The EU-13 countries assigned 24 per cent of all members and the rest are members from non-EU countries and international organisations.

Figure 22. Structure of members in AG for R&I
Source: Register of Commission expert groups (February 2017).



The Figure 23 shows that Germany provides the largest number of advisory group members, followed by the UK, France, Italy and Spain. This correlates with the size of these countries and the size of their R&I system. The same holds true for Poland, which is the most represented EU-13 country in AG for R&I. If we look at smaller EU countries, the EU-15 countries have rather stronger representation in R&I advisory groups than the EU-13 countries. The only exception is Hungary with an AG representation comparable with Finland or Denmark. On the other side of the ranking Greece and Luxembourg are the two EU-15 countries with an AG representation similar to EU-13 countries.

Figure 23. Number of AG for R&I members from EU-15 and EU-13 countries
Source: Register of Commission expert groups (February 2017).



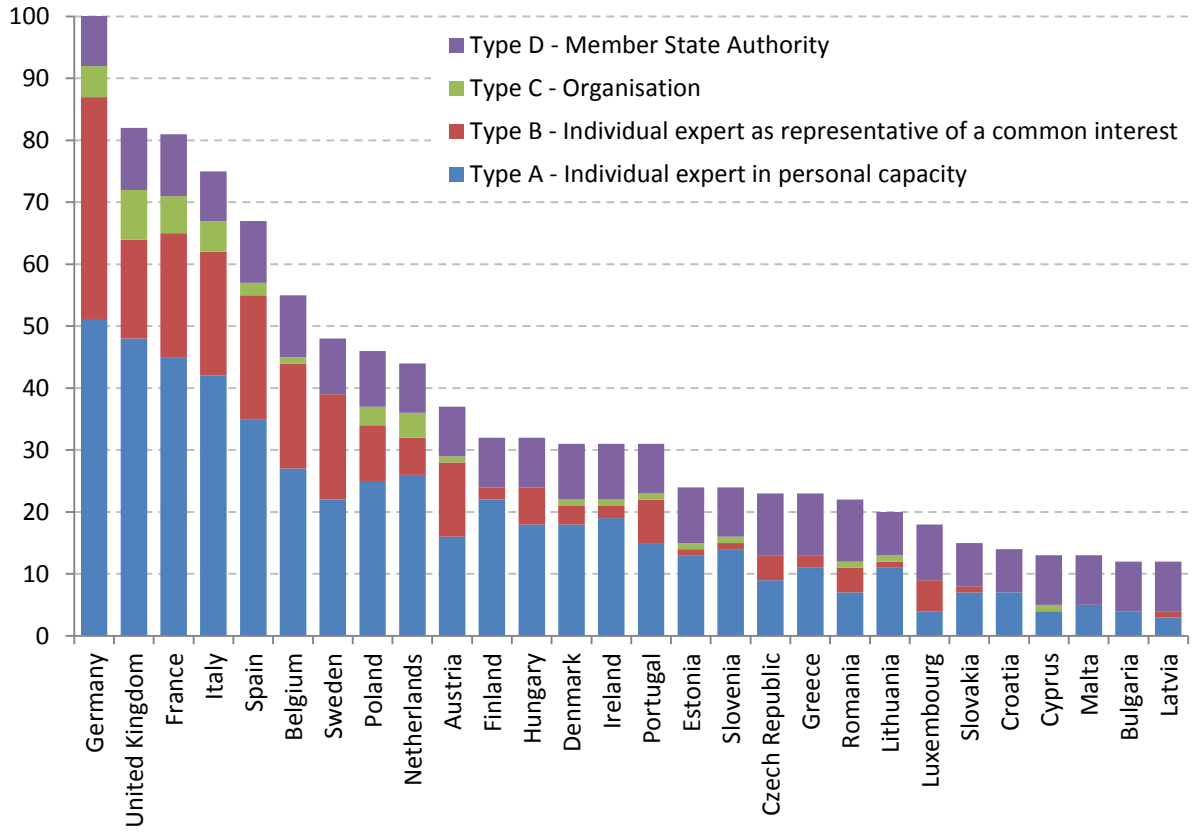
A closer look at the structure of members shows that the main disparities with regard to nationality or country representation are in the two categories of individual experts (see Table 41a). In the category of 'Individual experts appointed in their personal capacity' (Type A) more than 68 per cent of all members come from EU-15 whereas 22 per cent come from EU-13. Even higher representation of members coming from EU-15 is apparent in the category of 'Individual experts appointed as representative of a common interest' (Type B), where 87 per cent of all members come from EU-15 and only 13 per cent from EU-13.

Table 41. Number of members from EU-15 and EU-13 in Advisory Groups for R&I according to type
Source: Register of Commission expert groups (February 2017), Eurostat.

	Type A	Type B	Type C	Type D	Type E	Total
a) absolute numbers						
EU-13	127	28	8	107		270
EU-15	401	185	35	135		756
non-EU	61		4		1	66
INT			29			29
b) per 100.000 researchers						
EU-13	39	9	2	33		83
EU-15	16	8	1	6		31

Based on this comparison we can conclude that EU-13 countries are generally less represented in EC's advisory groups for R&I. However, this difference in representation reflects to a certain extent the different size of R&I systems in the EU-13 compared to the EU-15. If we look at the number of members in advisory groups for R&I relative to the number of researchers (Table 41b), the EU-13 countries have relatively higher representation in all types of advisory groups than EU-15.

Figure 24. Number of AG for R&I members according to their type
Source: Register of Commission expert groups (February 2017).



The emphasis of the EC on a balanced representation of Members States in Advisory Groups for R&I is evident especially in the AGs where members are appointed by or represent individual Member States. Concerning representation of individual experts (either appointed in their personal capacity or as representatives of common interest) the EU-15 countries (with leading role of Germany) significantly outweigh the EU-13 countries (see Figure 24). However, this difference is related mainly to the different size of R&I systems.

Other possible explanations are that EU-15 countries have developed wider and deeper expertise and that individual experts from EU-13 countries have weaker linkages to the EU R&I policy making structures. The latter interpretation has been partly confirmed also during the interviews with policy-makers and policy experts. This problem has its origins in personal willingness and readiness of researchers and experts from EU-13 countries to participate in databases of experts used for the evaluation of FP projects. If individual experts do not participate in evaluation processes, (1) they cannot gain the experience needed for writing competitive proposals, and (2) they have lower chances of being invited to participate in various Advisory Groups for R&I policy making.

Conclusion

The hypothesis is rejected. Although the EU-13 Member States have lower representation in the EC's Advisory Groups for R&I in absolute terms, their representation related to the size of R&I systems is adequate.

6. Perspective of participants in FP7 and H2020

6.1. Methodology

In order to better understand the position of FPs in national R&I systems, motivations for participation in FPs, and perceived barriers to successful participation we have organized an online survey among higher education institutions, public research institutions and private sector organisations from the EU-13 with practical experience with FP projects. The text below represents a summary of the main findings of the questionnaire survey.

The online questionnaire consisted of 14 questions divided into the following six parts:

- Basic information;
- Motives for participation in FP7/H2020 projects;
- Barriers to higher participation in FP7/H2020 projects;
- Services supporting participation in FP7/H2020 projects;
- Recommendations;
- Optional.

The questionnaire is attached to this report in Annex 1. The questionnaire survey was conducted through the LimeSurvey application, which generates and sends a unique questionnaire to each respondent. This simplified and accelerated the completion of questionnaires because the respondents did not have to fill in their identification data.

The respondents had been selected from the E-Corda database. We selected all participants with at least one funded FP7 project and at least 10 project proposals submitted to FP7. Contacts to R&D managers (directors, vice-chancellors, CEOs) of every single organisation were identified based on an internal database of contacts and web search. In total, 389 questionnaires have been sent out via LimeSurvey. Out of those 389 questionnaires, we received 84 completed questionnaires; the response rate was 21.6 per cent. We then linked information from the E-Corda database to the information from the questionnaire survey and created a complete profile of each respondent. This allowed us to analyse the responses acquired from the survey by country of origin, type of organisation, and success rate in the FP7 without the need for asking respondents to provide us with this information.

The survey covered participants from three types of organisations: universities, public and private research institutes, and business enterprises. The research institutes were the most frequent type with 44 per cent share on the number of completed questionnaires, while shares of universities reached 37 per cent and private companies 19 per cent.

As regards to respondents' roles within the FP7/H2020 projects, the majority of respondents (51 per cent) were researchers, while shares of two other roles (administration support 24 per cent and project manager 25 per cent) were almost the same and amounted to about a quarter of all respondents. The typical role of respondents' organisations in FP7/H2020 projects differed significantly. A half of respondents declared that their organisation has been involved in FPs as work package leader, a quarter as team members and only 8 per cent typically coordinated the FP7/H2020 projects.

Regarding the country of origin, the highest number of responses were received from Poland (19 responses, 22.6 per cent), Romania (13 responses, 15.5 per cent) and the Czech Republic (11 responses, 13.1 per cent), while there were only 2 responses from Estonia, Croatia and Latvia.

Response rates in combination with a relatively high similarity in responses show that the survey seems to be representative at the level of types of organisations and respondents' roles, while it is not representative at the level of the EU-13 countries because of a high variety of responses numbers in general and very low number of responses in some countries.

6.2. Results

There can be many motives for participation in FP7/H2020 projects. In our survey, the respondents report as the most important motivations for participation in FP7 and Horizon 2020 (see Figure 25):

- Access to research funding;
- Development and extension of internal knowledge and capabilities;
- Development of new or improved relationships or networks; and
- Addressing scientific, technical or societal challenges.

The least important motivations were:

- Development of new or improved regulations or policies; and
- Compliance with national strategy of participation in H2020.

Figure 25. Importance of motives for participation in FP7/H2020 projects (rating scale: 1=unimportant, 5=extremely important)

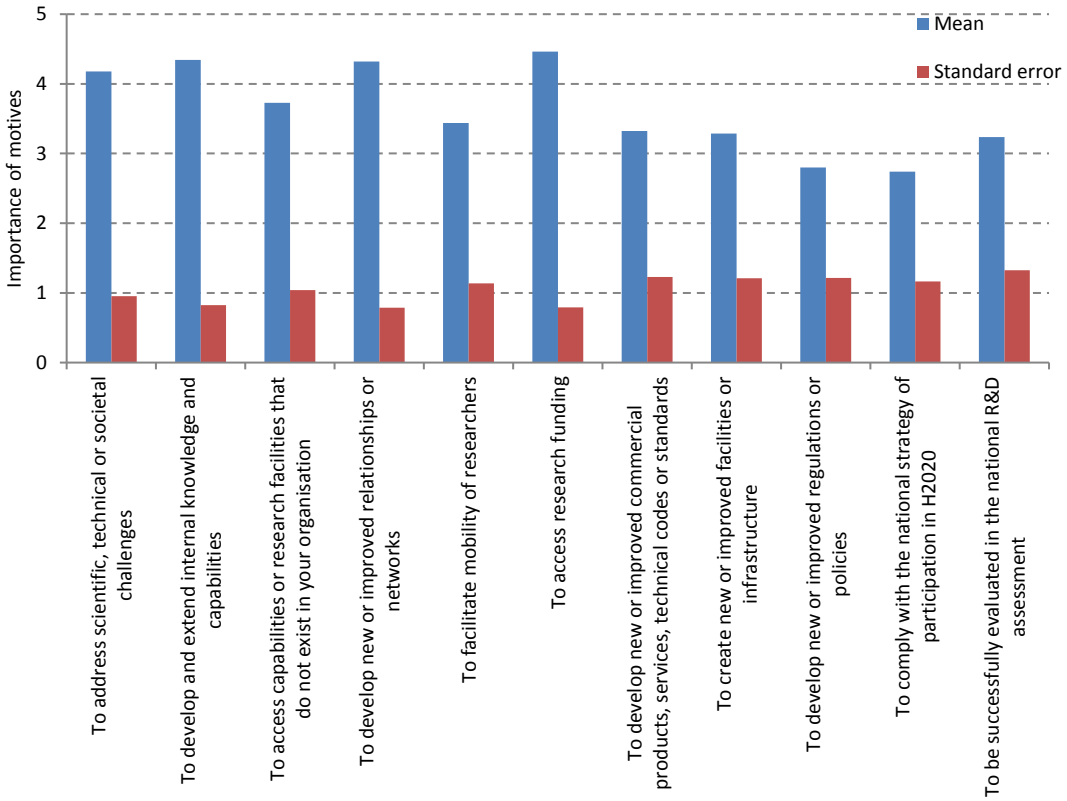
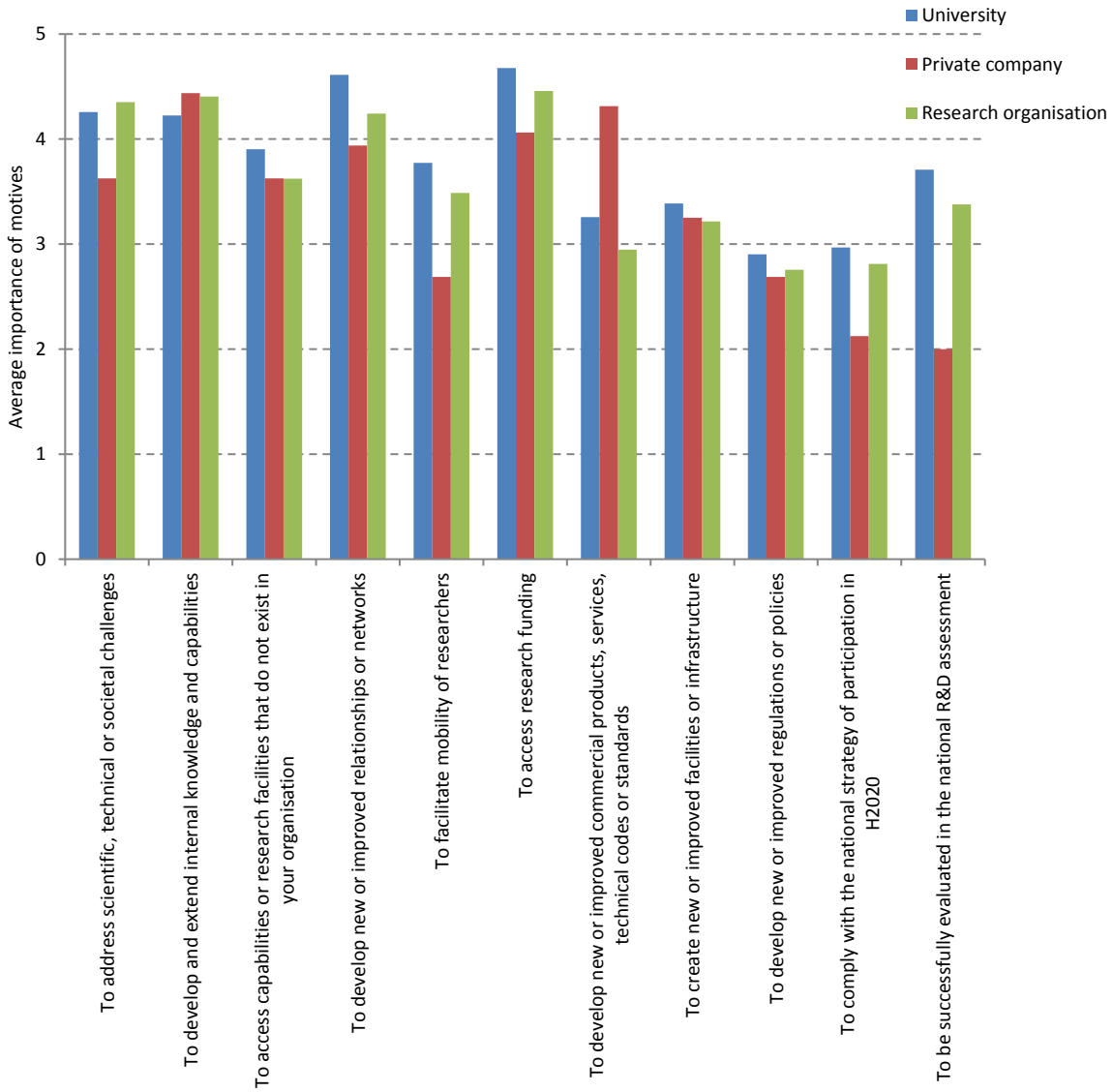


Figure 26 shows how different types of participating institutions considered the motives for participation. Differences between universities and private companies are worth mentioning. High differences are seen in the case of a successful evaluation in the national R&D assessment and a facilitation of mobility of researchers.

Figure 26. Importance of motives for participation in FP7/H2020 projects according to type of participating institutions (rating scale: 1=unimportant, 5=extremely important)



The respondents were also asked to provide answers about additional motivation for their participation. Nevertheless, their responses were mere elaborations or specifications of the above-mentioned motivations.

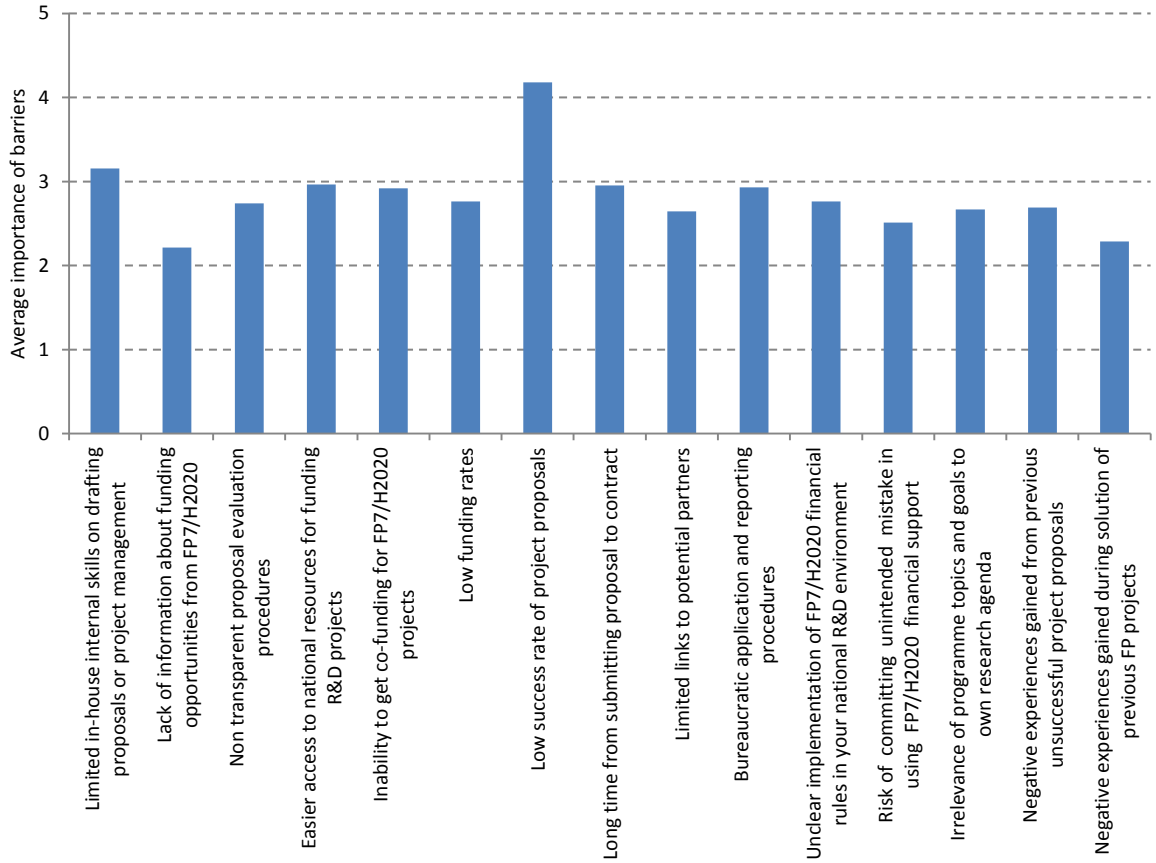
As regards to strategic orientation of FP7/H2020 calls, 94 per cent of respondents reported that the topics of FP7/H2020 calls correspond to the long-term research agenda of their institutions; and therefore it does not pose a problem for higher participation.

Other important question deals with meeting participants' initial expectations. The vast majority of respondents (86 per cent) reported that the benefits of their participation correspond to their initial expectations. There were some differences among the types of respondents' institutions and countries of origins. For instance, 25.8 per cent of universities and 27.3 per cent of respondents from the Czech Republic, 23.1 per cent of respondents from Romania and more than a fifth of respondents from Poland reported that their initial expectations had not been met at all. However, these variations are based on small numbers of respondents.

Another set of questions dealt with barriers to higher participation in FP7/H2020. According to the respondents, the low success rate of project proposals was considered the most important barrier to their participation in FP7 and Horizon 2020 (see Figure 27). Following barriers were of medium importance:

- Limited in-house internal skills on drafting proposals or project management;
- Easier access to national resources for funding R&D projects;
- Long time from submitting proposal to contract;
- Inability to get co-funding for FP7/H2020 projects; and
- Bureaucratic application and reporting procedures.

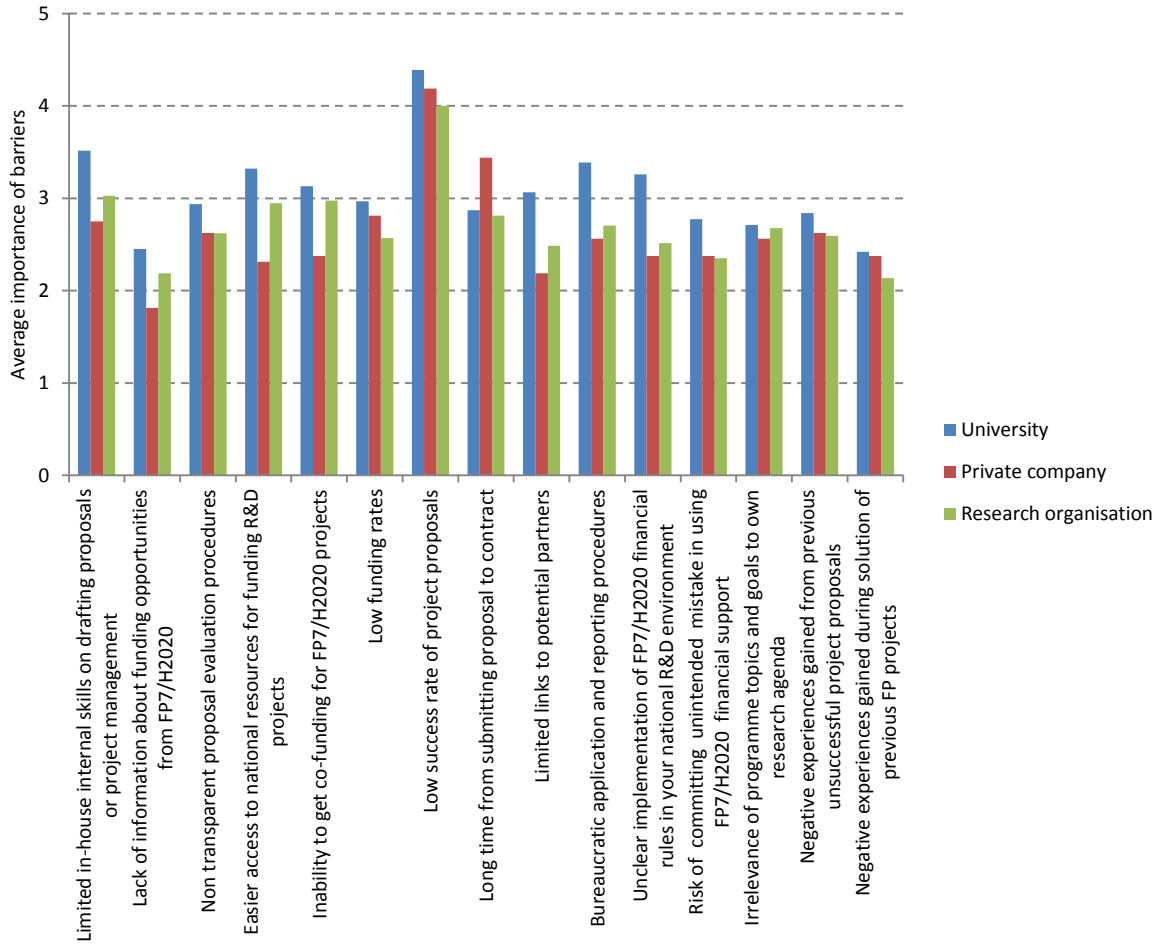
Figure 27. Importance of barriers to participation in FP7/H2020 projects (1=unimportant, 5=extremely important)



As far as the type of participating institution and differences among them are concerned, universities considered nearly all barriers more important than the other two types of institutions (see Figure 28). The survey proves that the position of participants within consortia plays a role in the perception of barriers. We observe a difference between coordinators (possibly more experienced participants) and task leaders and team members (possibly less experienced participants). Compared to the group of less experienced participants coordinators considered following barriers less important: risk of committing an unintended mistake in using FP7/H2020 financial support, unclear implementation of FP7/H2020 financial rules in your national R&D environment, bureaucratic application and reporting procedures, limited links to potential partners and easier access to national resources for funding R&D projects.

However, the low success rate of project proposals is the key barrier for all participants regardless of their role in project consortia.

Figure 28. Importance of barriers to participation in FP7/H2020 projects according to the type of institutions (1=unimportant, 5=extremely important)



Similarly, the low success rate of projects proposals is that the crucial barrier in all EU -13 countries. Surprisingly, there are no significant differences among the EU-13 countries in the importance of the barriers.

The lack of information about funding opportunities from FP7/H2020 is the least important barrier for the majority of respondents. This result indicates relatively high awareness of funding opportunities. Information on FP7/H2020 and the previous Framework programmes has been provided by the National Contact Points, internal supporting services (project offices, project management teams, administration support, etc.) or external consultants.

6.3. Discussion

The respondents regard services provided by their own organisation as more important than National Contact Points services (both are considered of medium importance) and external consultants, which are the least beneficial for all types of organisations and countries. In general, the services of all these three information sources are more beneficial for less experienced team members than they are for task leaders, work package leaders, and coordinators.

The difference in the importance of the National Contact Points services and own internal supporting services can be explained by a different type of provided information and services. While National Contact Points provide rather general information on funding opportunities in FP7/H2020, funding

principles and calls for proposals, the internal supporting services rather focus on more 'practical' issues connected with project proposals elaboration or project management.

In a few cases, participants made comments with respect to other national activities that would be welcome. The most relevant are:

- Systematic support in professional preparations of applications; co-financing of cost of grant preparations (travel costs, consultations, networking);
- Assistance in project drafting;
- More documents should be available in national language, e.g. documents clearly depicting financial rules, ways of employing workers for projects, etc.;
- Practical Training seminars, webinars;
- Mentoring and coaching for SMEs and Start-ups by professionals;
- Financial support to attend Info days and brokerage events organized by EC.

The respondents were asked to indicate what measures might be taken to increase participation in the EU FP. The respondents regarded the following measures as highly relevant:

- Increasing the number of smaller scale projects in H2020/FP9;
- Grants for exploring project feasibility and validation of project ideas;
- Advice and quick checks of project ideas;
- Softening the researchers' remuneration gap between the Member States;
- Representation of national experts in advisory bodies for EU R&I policy and as evaluators of project proposals;
- Promotion of international networking;
- Active science-oriented lobbying for designing H2020 work programmes;
- Provision of training, mentoring and coaching in course of the whole project preparation phase;
- Grants to seek advice from specialized consultants; and
- Support in searching for international partners.

Finally, respondents were asked about their own activity or activities of their country in discussing the new FP9. More than a half of respondents declared that they had no chance to participate in such discussions, but would like to participate in those discussions in the future. Only about 30 per cent of respondents had a chance to give their suggestions. Involvement of national representatives (research organisations, public administration, business, associations, etc.) in the preparatory process of the next EU Framework Programme is considered insufficient by three-quarters of respondents, and nearly 70 per cent of respondents believe that the interests of their country in FPs are not effectively enforced.

6.4. Conclusions

The questionnaire survey addressed three main types of organisations participating in the FP7/H2020 – universities, research organisations and business companies. Since research organisations together with universities are the most numerous participants, they also dominated among responding organisations. Researchers were predominant among the respondents, while administrative staff and project managers each accounted for a quarter of responses. This low share of managers corresponds to findings of Ruttas (2015), Zizalova (2015), Racic (2015), Paliokaite (2015), Klincewicz (2015), Curaj (2015) and Balaz (2015) that point to the lack of experienced project coordinators in the EU-13. The very low share of project coordinators and relatively high proportion of work package leaders within responses is in accordance with participants' roles in project consortia.

Big differences in response rates and their very low numbers in some countries do not allow to draw robust conclusions for individual countries, identify disparities among them according to their level of

economic development, structural characteristics of their research and innovation systems (Rauch&Sommer-Ulrich, 2012; Titarenko&Kovalenko, 2014a), and to explore differences among groups of states defined e.g. by Ferligoj et al. (2011) or the European Commission (2009).

Access to research funding was reported as the main motive for participation in the FP7/H2020, followed by other factors like a development and extension of internal knowledge and capabilities, development of new or improved relationships or networks, and addressing scientific, technical or societal challenges. The least significant motives (development of new or improved regulations or policies, and compliance with national strategy of participation in H2020) relate to elaboration and implementation of research policies of individual countries. It seems that research organisations and private companies are not very interested in their implementation or, rather, their implementation is left to the state bodies.

The survey results show that there are no significant inconsistencies in thematic orientation between the FP7/H2020 and research organisations' long-term research agendas that would discourage EU-13 research teams from their participation in FPs. This might be attributed to the fact that FP7/H2020 calls are usually sufficiently general and broad to allow research organisations to find thematic space in the calls for their research focus.

On the other hand, the low success rate of project proposals was reported by the respondents to be the main reason for low participation in FP7/H2020. Other causes are related to the low experience of participants with the preparation and administration of similar projects (similarly to Schuch, 2014), the time-consuming nature of the assessment of project proposals and administrative requirements. Some barriers are caused by the EU-13 states, e.g. they do not provide co-funding for FP7/H2020 projects, or there is easier access to national resources for funding R&D projects (similarly to European Commission, 2009; Fresco et al., 2015; Annerberg et al., 2010).

The survey proved that the previous experiences with FPs determine how significantly the barriers are perceived by the respondents. More experienced participants – coordinators and task leaders - considered all above mentioned barriers less important.

The lack of information about funding opportunities from FP7/H2020 was reported as the least important barrier for the majority of respondents. This is connected with the relatively long time over which EU-13 countries can participate in the framework programmes and thus awareness of the programmes and the availability of advisory services. The importance of these services is increasing with the lower level of participant's experiences. The participants perceived the services provided by their organisations as more important than the National Contact Points (NCP) services, reflecting a change in the demand for information. It seems that the participant due to their limited staffing capacities would rather need services related to project proposals elaboration or project management.

They would welcome measures taking into account their lesser experiences like for instance increasing the number of smaller scale projects in H2020/FP9, grants for exploring project feasibility and validation of project ideas, advice and quick checks of project ideas, provision of training, mentoring and coaching in course of the whole project preparation phase, and support in searching for international partners.

Another aspect that would be welcome by the respondents is the 'softening of the researchers' remuneration gap between the Member States'. In some EU-13 countries researchers' basic salaries are ten times lower than in some EU-15 countries (nevertheless, purchasing power in EU-13 countries is not so low and varies from 48 per cent of the EU-28 average in the case of Bulgaria to 88 per cent in the Czech Republic). Current rules for remuneration in Horizon 2020 projects do not provide for top-up funding from Horizon 2020. This discourages EU-13 organisations from participating in FP projects in which EU-15 partners are remunerated completely differently for the same amount and quality of work.

Next to that, also a better representation of national experts in advisory bodies for EU R&I policy and as evaluators of project proposals or active science-oriented lobbying for designing H2020 work programmes would be highly welcome by the respondents. The respondents consider that interests of

their country in FPs are not effectively enforced and involvement of national representatives in the preparatory process of the next EU Framework Programme is insufficient. Personally, they are rather sceptical about the chance to participate in such discussions but would like to participate in those discussions in the future.

7. Perspective of policy-makers and policy experts

7.1. Methodology

In order to deepen our understanding of barriers to the participation of EU-13 in FP7/H2020 and to discuss possible policy measures aimed at improving conditions for better integration of EU-13 in ERA, we interviewed policy-makers and policy experts from EU-13 countries as well as from the European Commission and its advisory bodies. The interviews complemented the online survey by providing a different perspective of experts on R&I policy on both national and European levels and helped to validate our findings of the data analysis and online survey.

We interviewed 21 policy experts from national and European state administrations as well as independent analysts and representatives of national support infrastructures for FPs. (for the list of interviewees see Annex 3).

1. Representatives of the state administrations (ministries, agencies) responsible for ERA and international research collaboration in EU-13 countries.
2. Individual policy analysts who have analysed the performance of EU-13 Member States in the Framework Programme.
3. National contact points, liaison offices and other parts of national support infrastructure for the FPs.
4. Representatives of EU bodies responsible for EU R&I policy

In order to identify the right experts for interviews, we created a long list of 95 experts consisting of national representatives in European Research Area and Innovation Committee (ERAC), members of the EU Evaluation Network, participants in recent EU evaluation projects, NCP coordinators and NCPs for Widening Participation and Spreading Excellence programme. Based on this long list we have selected policy-makers and policy experts for interviews so that each of the EU-13 Member States was covered by at least two experts. This short list of interviewees was complemented by representatives of EC and its bodies in order to comprise their point of view.

The interviews were designed as open and semi-structured with a defined set of topics but a degree of flexibility as to exactly which questions will be tackled and in what depth. As to the structure, following 6 topics have been covered by the interviews with slight modifications for the interviews with representatives of the EC (see Annex 2 for the general structure of interviews):

1. Perception of barriers to participation in FP7/H2020
2. Position of FP7/H2020 in the R&D funding system
3. Active participation of national representatives in the FP7/H2020 elaboration process (negotiations) and formulation of calls
4. Experiences with Spreading Excellence and Widening Participation Programme
5. Synergies of FPs and EU Structural Funds
6. Measures encouraging the participation of researchers from your country in FPs

All the interviews were accomplished by phone or Skype and their length ranged from 30 – 60 minutes.

7.2. Results

Perception of barriers to participation in FP7/H2020

The interviews proved that the participation of EU-13 countries is generally perceived inadequate both in absolute terms as well as in relation to the size and quality of R&D systems. This opinion is apparent in all interviewed countries despite the level of R&D intensity and size of the R&D system in terms of a relative number of researchers. The attitude concerning FP7/H2020 programmes at research organisations is miscellaneous and depends mainly on the readiness of management at individual research organisations. Some research organisations aim to increase their internationalization and

introduce measures for increasing their participation in FPs, on the other hand, other research organisations are more nationally oriented.

Several issues have been repeatedly mentioned as the key barriers to participation in FP7/H2020. Those can be structured in following four main categories.

Low success rates of submitted project proposals resulting from a high level of oversubscription in FP7/H2020 programmes hampers the participation of EU-13 countries in FPs and further discourages research teams from preparing and submitting new project proposals. The demotivation effect of low success rate is apparent especially in business enterprises, for which the low success rate increases the cost of participation in FP7/H2020 projects. Though the high level of oversubscription in FPs holds true for both EU-13 as well as EU-15 countries, relatively lower success rate of EU-13 in FPs makes this barrier more serious in this region.

Rules for remuneration introduced in H2020 programme contributed to lower motivation of researchers from universities and public research institutions to participate in this programme either (note that the project overlapped with the decision of the EU Research Commissioner to increase EU-funded researchers in low-income countries to match national pay rates, and to offer additional bonuses of up to €8,000 a year). The basic salaries of researchers at universities and public research institutions are generally considerably lower and do not include all benefits. Limited possibility of top-up funding to the basic salary in H2020 projects discouraged researchers from some EU-13 countries from participating in H2020 projects. Since such limitations have not been introduced in national funding schemes, the national funding resources became more attractive. Another aspect related to relatively lower salaries in public research in EU-13 countries relates to the feeling of inferiority, where partners from EU-15 are remunerated differently for the same amount and quality of work. This again decreases motivation of researchers from EU-13 countries to participate in FP projects. Although the remuneration gap between EU-15 and EU-13 has been mentioned several times as a significant barrier to participation in FPs, some interviewees emphasized that this is not the most important obstacle.

Supporting infrastructure that provides professional services for preparation of project proposals and for project management is less developed in EU-13 compared with EU-15 countries. The main issue does not rest on information services provided by the network of National Contact Points for FPs that have been gradually improved. More problematic is the lack of internal and external professional services that would enable the researchers to focus on the essence of the FP projects instead of organising all the administrative and project management issues.

The EU-13 research teams are in general not sufficiently integrated into EU research collaboration networks. Although some researchers and research organisations from EU-13 countries have successfully integrated into existing networks of collaborating research teams, many research teams are less internationalized and have insufficient linkages to EU-15 organisations that participate in FPs. Another aspect related to collaboration networks mentioned by interviewees is the fact that EU-13 teams involved in FP projects often do not belong to the core of the project team and play rather a complementary role. This fact corresponds among others to lower average financial contribution per project compared to EU-15 countries.

Next to the above repeatedly mentioned barriers the interviewees named also other obstacles to the successful participation in FPs, like the lack of critical mass in R&I that decreases the possibility of participating in large H2020 projects, lack of synergies between national and FP funding, lack of ambitions and strategic management of universities and public research institutions.

Position of FP7/H2020 in national R&I systems

Stronger integration of national R&I in European research area and internationalization of R&I in general belong typically to the national priorities of R&I policy. In some countries there are explicit strategic initiatives for strengthening the participation in FPs (e.g. the Polish 'Pact for Horizon 2020' on mutual effort to increase the national participation in H2020 agreed between the Ministry of Science and Higher Education and scientific organisations), in all interviewed countries there are specific policy measures (grant schemes) aimed at facilitating the preparation of H2020 projects, attracting researchers from abroad or supporting positively evaluated but not funded applicants to H2020. Some interviewees, however, doubted the effectivity of existing policy instruments and the speed and appropriateness of their implementation.

Next to the grant schemes and policy measures directly aimed at increasing participation in FPs, many EU-13 countries included international collaboration among evaluation criteria assessing quality and performance of universities and public research institutions. Strong emphasis on excellence, internationalization and impact of conducted research in evaluations of universities and public research institutes seems to create positive motivations for researchers to integration in EU research collaboration networks. This is especially the case if the evaluation results are linked to institutional funding allocated to universities and public research institutions. The research evaluation systems in EU-13 countries still undergo developments towards international standards in evaluating research and their impact on positive motives to participation in FPs has not been observed yet.

Active participation of national representatives in FP7/H2020 elaboration processes and formulation of calls

The interviewees frequently claimed that the EU-13 countries are rather underrepresented in EU advisory bodies. This fact does not have its origin in the European structures who strive to achieve a well-balanced composition of advisory bodies with respect to the representation of various Member States or gender. In fact the relatively lower representation of EU-13 countries in advisory bodies for the EU R&I policy arise from personal willingness and readiness of researchers and national policy-makers to actively participate in EU advisory groups and committees.

The insufficient personal willingness of researchers from EU-13 to participate in FPs design might be demonstrated by lacking self-nomination to databases of experts used for evaluation of FP projects. If individual experts do not participate in evaluation processes they miss the opportunity to get experiences needed for writing competitive proposals. In addition, they can hardly expect that they will be invited into various advisory groups for R&I policy making.

With regard to more active participation in the programme design, some interviewees suggested that NCPs should play more visible and influential role. They should actively help to transfer information from national research systems and communities to the programming process at the EU level. They can also help researchers to write attractive CV, recommend what expertise might be highlighted etc.

Also the researchers themselves should be more active in collecting and sharing their views on the future shape and focus of the EU R&I programmes, e.g. through existing or new interest groups or associations.

Some of the interviewed countries (e.g. Lithuania or Poland) focus on strengthening their scientific diplomacy in order to improve the conditions for integration of national R&I in European Research Area.

Experiences with Spreading Excellence and Widening Participation Programme

There is a miscellaneous perception of Spreading Excellence and Widening Participation Scheme by interviewed policy-makers and experts. This is due to the fact that this is a new programme that has been launched only recently (2014) and there is no evidence of its impact on the research potential of EU-13 countries and their readiness to international research collaboration yet.

Generally, the interviewees agreed that this programme has set the right direction for improving the conditions for mutual collaboration in R&I, for strengthening the R&I potential of EU-13 countries, and

for increasing the effectiveness of EU investments in R&I. Some interviewed policy-makers and policy experts stated, however, that this scheme seems to be too small to have a substantial positive impact on strengthening the research potential of EU-13 countries.

As far as the specific measures for spreading excellence and widening participation in Horizon 2020 (namely Teaming, Twinning, ERA Chairs, Policy Support Facility) are concerned the respondents usually commented on the Teaming and ERA Chairs.

Teaming is definitely the most visible funding scheme of the Spreading Excellence and Widening Participation programme. It was pointed out that Teaming might partly substitute cohesion policy and better coordination of this funding scheme with investment from European Structural and Investment Funds is needed in this respect. In addition, based on existing results of evaluated calls it was also noticed that the success of a project to large extent relies on the quality of the partnering institution from the high R&I performing country and only partly on the quality and readiness of the research organisation from the widening country.

The experiences of interviewed policy-makers and experts with ERA Chairs are mixed. Some welcome ERA Chairs as an effective tool that helps to change carrier structures at supported public research institutions and to develop their management structures towards well-functioning systems. Others, on the contrary, pointed to examples of the disappointment of excellent researchers attracted by the research organisation from widening country and their frustration caused by the inability to enforce any structural changes at receiving research organisations.

Another aspect related to Spreading Excellence and Widening Participation programme that has been mentioned several times is again the relatively low success rate that decreases the motivation of research organisations to spend time and money on the preparation of projects with only limited chance to succeed.

Synergies between FP7/H2020 and EU Structural Funds

Synergies between H2020 and European Structural and Investment Funds belong to topics that are very high on the agenda of policy discussions both on EU as well as national levels. EC put a lot of effort to foster synergies between ESIF and H2020 and bring the rules for allocating support to R&I through these two funding streams together. It resulted in several policy measures and rules that enable these synergies (the last achievement was Staff Working Document on State Aid Rules to national and regional funding schemes that offer alternative support to SME Instrument project proposals with a Horizon 2020 'Seal of Excellence').

From the perspective of EU-13 national R&I systems the different legal framework of H2020 and ESIF funding seems to be the key obstacle to synergies between these two supporting schemes. One issue that was already tackled by the Staff Working Document mentioned earlier is related to the State Aid rules. Next to that, there are also conceptual issues concerning the extent of international collaboration in supported projects. While H2020 strongly emphasizes the international dimension of collaborative projects, ESIF rules set limits on expenditures that might be spent outside the targeted region. Also space for better alignment of accounting and auditing practices has been mentioned during the interviews that would eliminate uncertainties during project audits related to eligibility of costs or avoiding of double financing.

Another important issue touched by respondents was whether ESIF crowd in or crowd out the participation of EU-13 in H2020. Although there are good examples of complementary effects of FPs and EU Structural Funds on the development of research capacities and strengthening their potential for excellence (e.g. the Central European Institute of Technology), some of the interviewees pointed to the issue of a limited absorption capacity of national R&I systems for both funding streams. In some countries with smaller research systems (e.g. Slovakia) the availability of EU Structural funds for R&I led to drop in the number of proposals submitted in FPs. In a long-term perspective, this might result in a lock-in effect of lower quality research when national research teams compete among themselves instead

of opening up to the international research competition. This is exactly the opposite effect to what the synergies between H2020 and ESIF aim to achieve. On the other hand, the quantitative analysis presented in Hypothesis no. 8 does not confirm that the easier access to other financial resources discourages researchers from applying for FP funding.

The interviews further confirmed that there is a great potential for utilizing the recent investment in R&D infrastructures in EU-13 that are currently not used in a proper way. Therefore, new mechanisms should be introduced in order to increase the attractiveness of these new infrastructures and their integration in ERA.

Measures encouraging the participation in FPs

The interviews with policy-makers and experts to some extent confirmed that there is only a limited knowledge of and progress in implementing recommendations provided to national R&I policy-makers by previous studies and projects focused on increasing participation of EU-13 in FPs. With respect to concrete suggestions how to increase participation and success rate of EU-13 in H2020, following key groups of recommendations have been highlighted.

In order to increase the motivation to submit proposals to H2020, the interviewees pleaded for implementing measures that would increase the overall success rate. It was suggested to decrease the competition in FPs by fostering concentration in terms of topics and budget. In addition, the interviewees stressed the need for increased quality of evaluation system that will fulfil also a formative role for improvement of future project proposals. Another aspect that might help to increase the success rate rest on the improvement of supporting services for writing proposals, project management and more active representation in advisory bodies for EU R&I policy. The interviewees also pleaded for changing the rules (limits) for personnel costs in H2020.

In order to facilitate penetration of research teams from EU-13 into existing EU collaboration network, the interviewees proposed to strengthen special support for networking between EU-13 and EU-15 (WIDESPREAD, KICs, etc.). Good experiences from FP7 have been mentioned, namely the Specific Programme 'Capacities': Research potential of Convergence Regions (FP7-REGPOT) projects that effectively facilitated the creation of links and collaboration networks between research organisations from convergence regions and well-regarded research organisations elsewhere in the EU. These projects also helped to strengthen and develop the capacities of researchers from convergence regions.

In order to make the research teams from EU-13 more attractive for collaboration with EU-15, the interviewees stressed that visibility of excellence existing in EU-13 countries needs to be strongly promoted by national governments. In addition to that, new widening mechanisms for better integration of the new R&D infrastructures in ERA might be considered (e.g. by introducing additional sub-criteria for engaging the new R&D infrastructures).

As we can see, the proposed measures for the better integration of EU-13 in ERA largely correspond to the barriers highlighted in the first part of the interviews.

7.3. Conclusions

Interviews complemented the data analysis and online survey by qualitative views of experts responsible for policy making or policy advice at national and European levels. The interviews confirmed and validated some of our findings based on quantitative analysis and results of the online survey among successful and less successful participants in FP7 and H2020.

All the respondents perceive the participation of EU-13 countries in FPs as inadequate. They find important to strengthen the effort of national policies to facilitate, promote and support the participation of research teams from EU-13 in European research collaboration. In this respect, it is gratifying that national policies in EU-13 countries prioritize openness of national R&I systems, their internationalization and integration in European research collaboration networks. On the other hand,

implementation, results and real effects of the policy endeavour in this field are still falling behind its expectations.

The low success rate is the most significant barrier to participation of EU-13 in FPs, which confirms the results of the online survey. Rules for calculation of personnel costs in H2020 and remuneration gap are also topics intensively discussed in national debates on how to make H2020 more attractive for researchers from EU-13. With respect to the rules for calculation of personnel costs in H2020, the European Commission introduced changes in 2017 that react to the reservations of some EU-13 countries and enable more flexibility in eligibility of personnel costs.

The interviews also highlighted the need for readiness of research teams from EU-13 for international collaboration and their connection with existing European research collaboration networks. In this respect, the Spreading Excellence and Widening Participation Programme launched in 2014 goes in the right direction. Despite the fact that this programme is still in its early stages of implementation, it has introduced fresh impulses for strengthening the R&I potential of EU-13 countries and their better integration into ERA. The preliminary findings also show that all the instruments of the Spreading Excellence and Widening Participation programme need to be implemented in a synergetic and well-balanced manner and need to stimulate reform efforts at the national and institutional levels simultaneously.

In addition to the initiatives at the European level, also national R&I policies can be more active in motivating to and facilitating strategic partnerships of research organisations and infrastructures with excellent European research organisations. Some EU-13 countries have already or are planning to strengthen their activities in scientific diplomacy.

Another point highlighted by the interviews is related to synergies between H2020 and European Structural and Investment Funds. It has been emphasized that conditions for synergies between these two funding streams need to be improved and better communicated not only among various DGs in the European Commission, but also within individual Member States, so that the funding instruments do not displace each other but together strengthen effectively the R&I potential of the European Research Area.

Lastly, the responding policy-makers and experts stressed the importance of active participation of EU-13 in EU R&I policy design through involvement in advisory bodies or professional partnering associations. In this respect, NCP networks might play a more visible role and help to the mutual transfer of information between European R&I policy structures and national R&I systems.

8. Conclusions

The Framework Programme is the EU's primary instrument for the creation of the European Research Area, 'a unified research area open to the world based on the Internal Market, in which researchers, scientific knowledge and technology circulate freely and through which the Union and its Member States strengthen their scientific and technological bases, their competitiveness and their capacity to collectively address grand challenges.'

The FPs are expected to produce European added value. Investing in research is considered essential for achieving smart, sustainable and inclusive growth and jobs. The principle of '*juste retour*' does not apply. Research needs to be of the highest quality, produced in international collaboration and selected on a competitive basis. Under such conditions, uneven participation is unavoidable.

However, after almost twenty years of access to the opportunities of the FP, the EU-13 still lags behind the EU-15. What's more, the knowledge that is produced needs to be applied in national contexts, and the FPs also aim to increase cohesion and promotes social responsibility. This is why uneven participation is not only a problem for the RPOs that compete for funding to perform research projects. It is a problem pertaining to the achievement of the higher objectives of the EU FPs as such.

The aim of this project is to explore, identify and enlighten reasons for the low participation and success rate of EU-13 countries, in order to improve their future performance in Horizon 2020 and FP9.

EU-13 participation in the FPs is indeed considerably lower than that of the EU-15. EU-13 organisations also coordinate a lower percentage of the projects in which they participate. And they receive lower financial support per participation.

A detailed study of participation shows that lower participation is not a generic problem of the entire EU-13 and the entire FP. First, there is considerable variation among the EU-13 Member States. In the literature and in our own results, three groups can be discerned:

1. CY, MT, EE, and SI are consistently among the strong performers in Horizon 2020.
2. CZ and HU do well in some aspects of performance, particularly in FP7.
3. BG, HR, LT, LV, PL, RO, and SK generally make up the lower end of the participation ranking, barring the occasional exception.

The participation of EU-13 Member States also varies by FP funding scheme. The FPs consists of a variety of funding schemes that each serves specific objectives, such as advancing the frontiers of knowledge by providing grants to excellent researchers (ERC), supporting the international mobility and career development of researchers (MSCA), and promoting the implementation of existing knowledge and the creating of networks in specific problem areas such as the Grand Challenges (CSA). Each funding scheme requires particular skills and capabilities. The various EU-13 Member States appear to be better equipped for some funding schemes than for others. Generally speaking, EU-13 participation is lower in schemes aimed at excellence and innovation, and higher in coordination and support.

European Commission studies, monitoring reports, policy reports, and the scientific literature provide a host of explanations. The most prominent causes that are proposed relate to:

- *Socio-economic conditions*: Low levels of R&D expenditure; poor quality R&D infrastructure; and the relatively small size of EU-13 countries.
- *Excellence, quality and competition*: a lack of excellent researchers and institutions; easy availability of alternative funding opportunities, particularly the European Structural and Investment Funds; evaluation systems that focus on quantity rather than quality.
- *Experience*: the more an organisation participates and coordinates, the greater its chances of future participation and coordination, which implies that low participation in the present hampers its participation in the future.

- *Network formation*: EU-13 Member States are distant from the EU-15, they are generally small and lack international contacts and professional networks; the European R&D network is dominated by a cluster of strong participants from the EU-15 who form a 'closed shop' or an 'oligarchic core', creating barriers of entry for the EU-15.
- *FP7 design and governance*: EU-13 Member States have an insufficient influence on the FP; the perception is that administrative burdens are high and rules complicated; the rules regarding the calculation of personnel costs are problematic.

The low level of R&D resources, the lack of experience, and the low reputation of EU-13 organisations have an effect on the networks they can create. This creates a 'Matthew Effect': those who participate a lot will accumulate more participations in the future than those who participate less, reinforcing the low participation of those who participate less.

Not every explanation is supported by strong empirical evidence and some explanations are based on results for FP4, FP5, or FP6. We tested eleven hypotheses that emerged from the existing literature. The results of these tests gave an indication as to where the heart of the problem of low EU-13 participation really lies.

Four hypotheses were rejected:

- There are not enough (eligible) participants in the EU-13 relative to the EU-15 (*hypothesis 1*).
- Prospective participants in the EU-13 have alternative and more easily accessible funding opportunities that are less easily available in the EU-15 (*hypothesis 8*).
- It is too soon to expect a raise in participation rates as EU-13 R&I actors still have to prove their capabilities (*hypothesis 9*).
- The EU-13 has an insufficient influence on the work programme of the FPs (*hypothesis* 11).

The number of participants is low in some EU-13 Member States but not in all. There is an easy alternative funding source (the ESIF), but willingness-to-submit proposals to the FPs (in participations in proposals per million population) is not affected. Smaller EU-15 Member States actually have an incentive to look for funding and collaboration partners outside their country. And the experience of EU-15 Member States that joined more recently (Spain and Portugal in 1986; Austria, Sweden, and Finland in 1995) shows that the problem of low participation is likely to persist. The representation of EU-13 countries in advisory groups for R&I is absolutely lower than the of the EU-15, however, it is proportional to the size of national R&I systems.

Three hypotheses were tentatively accepted:

- EU-13 organisations are less active in the Framework Programme than EU-15 organisations (*hypothesis* 2).
- Prospective participants from the EU-13 are not good enough relative to the EU-15 (*hypothesis* 4).
- There is a cognitive distance between the scientific and technological portfolio of prospective participants from the EU-13 and the portfolio of the more successful EU-15 (*hypothesis* 6).

What these hypotheses have in common is that they have been confirmed for some EU-13 Member States but rejected for others. In addition, parts of the EU-15 perform at EU-13 levels. This indicates that the problems represented by these hypotheses are not specific to the entire EU-13 nor absent from the EU-15.

The remaining hypotheses were confirmed, which means that:

1. The quality of proposals involving participants from the EU-13 is lower than that of proposals not involving participants from the EU-13 (*hypothesis* 3).
2. Prospective participants from the EU-13 have weaker connections to the collaboration network in FPs than participants from the EU-15 who have more connections and are more central to the network (*hypothesis* 5).
3. Low rates of participation in FPs are a reflection of the relative weakness of the R&I systems of the EU-13 compared to the EU-15 (*hypothesis* 7).

4. The problem of FP participation is specific to certain instruments in FP7 and Horizon 2020 (*hypothesis* 10).

Hypotheses 3, 5, 7 and 10 confirm the main causes reported in the literature review for the entire EU-13. Their R&I systems are weaker, their organisations produce lower quality proposals, and they have a weaker position in the European R&D networks. The problem of relatively lower FP participation is specific mainly to funding schemes aimed at excellence and innovation. On the contrary, it is relatively high in areas where existing knowledge is used.

Low participation is to some extent a localised problem. Low activity, a mismatch in specialisations, and low scientific quality were not found in all EU-13 Member States (hypotheses 2, 4, and 6). The problem of low participation was specific to certain funding schemes (hypothesis 10), particularly funding schemes that focus on excellence and innovation. There is no point in waiting for the root causes of low participation to go away (hypothesis 9). Intervention is necessary.

Our results point in the direction of solutions. Some solutions will be the responsibility of each Member State government. Raising the quality of national research performance may require introducing national excellence programmes (comparable to the ERC) that stimulate frontier research while supporting the career development of talented academics. Higher levels of public R&D expenditure and investments in the research infrastructure (facilities, ICT networks, etcetera) are also a responsibility of government.

Research performing organisations will need to change certain practices to strengthen their competitive position vis-à-vis the EU-15. They need to place a stronger emphasis on quality rather than quantity in evaluations and performance assessments. Another measure they can take is to encourage talented researchers who emigrated to North America or the EU-15 to return, taking with them all their experience, knowledge, and network connections.

The EU needs to take action where low participation is caused by the design and governance of the FPs as well as where patterns of participation that have emerged over time and have now become self-reinforcing create barriers of entry. The EU may provide opportunities for repeated participation, giving EU-13 organisations the opportunity to build experience, accumulate a reputation, and strengthen their network position. In the later phases of Horizon 2020, the EU can fund projects that support EU-13 Member State governments in strengthening their R&I systems and introducing incentive schemes that encourage competition and excellence. Given that proposals written in collaboration with one of the TOP20 institutions of Horizon 2020 have higher quality, we recommend expanding the Teaming and Twinning actions of the 'Spreading Excellence and Widening Participation' programme, giving more EU-13 organisations the opportunity to collaborate with the strongest participants in the FP. Also, the EU needs to ensure that EU-13 organisations have sufficient influence on the FP Work Programme and that the FPs are adequately aligned to the needs, capabilities, and grand challenges of the EU-13.

But above all, we have emphasised that the effect of each of these options can be maximized if the implementation is connected to the implementation of options at other levels. Open science and open innovation require that successful organisations are part of regional hubs and well connected within European innovation dynamics.

9. Policy options

9.1. Introduction

The issue of low participation of EU-13 in the Framework Programme is a many-headed, persistent problem, which has no one-size-fits-all-solution. Generally speaking, the scientific literature and advisory reports point to a similar overall mechanism. EU-13 have a lack of excellent researchers and research organisations who operate in national contexts with insufficient resources and incentives. As a result, they are insufficiently prepared to compete with EU-15 researchers and research organisations within the Framework programme, which reproduces their peripheral position in European research and innovation, hinders accumulation of experience and opportunities to improve in next rounds. It is rather simple to harvest a long list of barriers and policy options from reports, surveys and interviews, which targets elements of this mechanism. But clearly, a more integrated approach is needed which takes into account the differences between the EU-13 countries, and differences between the FP instruments.

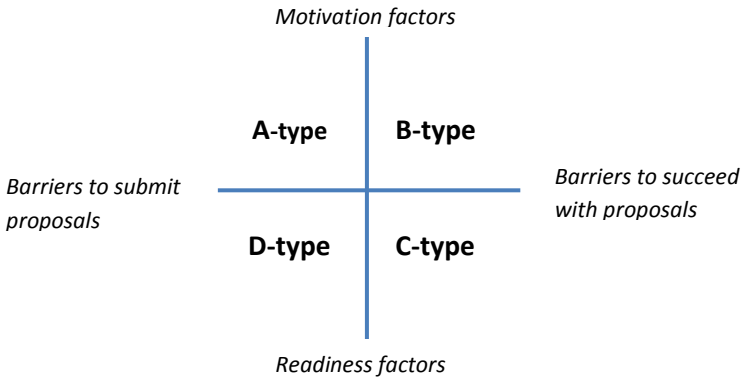
A detailed study of participation shows that lower participation is not a generic problem of the entire EU-13 and the entire Framework Programme. First, participation of the EU-13 Member States varies by FP funding scheme. Generally speaking, EU-13 participation is lower in schemes aimed at excellence and innovation, such as the European Research Council, the Marie Skłodowska-Curie Actions, and Collaborative Projects and Innovation Actions. It is higher in coordination and support actions.

Second, there is considerable variation among the EU-13 Member States. In the literature and in our own results, three groups can be discerned:

1. CY, MT, EE, and SI are consistently among the strong performers in Horizon 2020, including in the schemes aimed at excellence and innovation, except for EE and SI participations in ERC.
2. CZ and HU do well in some aspects of performance and their R&I systems have similar features to the first group. However, this potential is not reflected in the level of participation in the schemes aimed at excellence and innovation, which may also due to lack of incentives to participate.
3. BG, HR, LT, LV, PL, RO, and SK have the most unfavourable starting conditions given size and funding of national R&I system and generally make up the lower end of the FP participation ranking, barring the occasional exception.

Furthermore, it has to be emphasised that throughout our study we found evidence of EU-15 countries with some similar R&I system characteristics or FP participation levels as some of the EU-13 countries. Our policy options are primarily aimed at improving the participation rate of group 3 and 2 countries mentioned above.

Based on literature review, data analysis, survey results and interviews with policy-makers and policy experts we have synthesised the main barriers to the participation and success of EU-13 countries in the EU FP. These barriers have been organised along two dimensions. In the first dimension, we distinguish between *motivations* and *readiness* to participate. In the second dimension, we distinguish between *barriers to submit proposals* to the FPs and *barriers to succeed with a proposal* in project evaluation. We have used these two dimensions to cluster barriers into four distinct groups (see the following scheme). Note that the data do not always point into the same direction. E.g. while the survey and literature review indicate that researchers motivation is reduced by an easier access to national funding, hypothesis 8 on this explanatory factor was not confirmed.



A-type (Barriers to submit proposals related to motivation)

- Low success rate ('Success rate trap')
- Easier availability of national and ESIF research funding
- Insufficient options for exploitation of research results of FP projects
- National evaluations of research organisations do not emphasize international collaboration
- Limited understanding of the benefits of FP participation
- Lack of motivation due to the rules of calculating personnel costs
- Low funding rates
- Inability to get co-funding for FP projects

B-type (Barriers to succeed with proposals related to motivation)

- Existing networks constituting barriers to entry
- Not achieving appropriate influence on the intentional content of the FP calls for proposals

C-type (Barriers to succeed with proposals related to readiness)

- Lack of project management skills and insufficient project management support
- Lower quality of research
- Limited skills on drafting proposals
- Lack of experience as evaluators and participants in FP schemes
- Limited understanding of FPs

D-type (Barriers to submit proposals related to readiness)

- Lack of professional contacts and networks
- Scientific and technological distance between EU-13 and EU-15
- Structure of industry in EU-13 and its position in global value chains
- Lack of research capacity

It is clear from the evidence and the combination of barriers that any strategy to stop patterns of persistent, low participation in FP requires actions at three levels, as is also clear from the five hypothesis that were confirmed.

1. The local level of research and innovation organisations. We could confirm the hypothesis H3 that the quality of proposals involving participants from the EU-13 is lower than that of proposals not involving participants from the EU-13. Especially for the low-performing countries, it is also reported that the readiness of research organisations to submit and succeed

proposals is low, due to low understanding of FP benefits, administrative capabilities, and internal reward systems. Evidence from earlier studies shows that experience at the organisational level with FP participation increases the chance of success in next FP rounds significantly.

2. The national levels of R&I systems which do not always provide a supportive context for FP participation in terms of national funding opportunities, career systems, critical mass of research and innovation actors. We could confirm the hypothesis H7 that low rates of participation in FPs are a reflection of the relative weakness of the R&I systems of the EU-13 compared to the EU-15 (*hypothesis* 7). In a traditional policy mode, such contexts would operate on organisations separately. In an open science and innovation perspective though, it is important and more effective to create and exploit existing network connections between national and regional R&I actors to improve motivation and readiness to participate. (RISE group 2017)
3. The European level which through the setup of the FP instruments as well as the overall research and innovation dynamics at European level, may limit the opportunities for EU-13 to participate. We could confirm hypothesis H5 that prospective participants from the EU-13 have weaker connections to the collaboration network in FPs than participants from the EU-15 who have more connections and are more central to the network. We could also confirm the hypothesis H10 that the problem of FP participation is specific to certain instruments in FP7 and Horizon 2020, and hypothesis H11 that the EU-13 has less influence on the work programme of the FPs. Again, it is important here to look at this from an open science and open innovation perspective, which implies that the challenge is to improve the connection between EU-13 needs and competences with EU-15 and FP and remove type D barriers.

Policy options will be most successful if they address the situation at the multiple levels. It is insufficient to adapt EU instruments to the unfavourable competitive positions of some EU-13 countries, without creating a perspective and incentive to change these competitive positions. Likewise, it is insufficient to remove motivational related barriers if they will not result in an increase in actual participation levels, or in the improvement of readiness at the longer term. The satisfactory participation rate of some EU-13 suggests that it is possible to align characteristics of national R&I systems to the opportunities of the FP.

The following policy options build upon the confirmed hypothesis, the perspectives of stakeholders surveyed and interviewed in this study and on the recent report of the RISE group (2017) on open innovation and open science in Europe. Among the main insights in of the RISE group is the need to create or exploit the existence of pockets of excellence (Reid et al. 2016) in so called convergence countries, which include some of the EU 13 countries with low FP participation. Such pockets of excellence (PoE) may themselves be well integrated at the European level, but in an open economy and research and innovation system, such pockets will only realize the ambition of FP to improve competitiveness – if they are regionally embedded in hubs that can absorb new knowledge and innovation. This means that the cognitive and technological distances between such pockets and firms, universities and other R&I actors within the direct environment of a PoE should not be too large. Or in more positive terms: through connecting regional R&I actors to PoE they can profit from its competences and capabilities and in the long run, a PoE will profit through increased ability to exploit results, new knowledge and innovate.

The policy options we formulate below reflect the logic of the RISE group report (2017) that within an open innovation system, competitiveness depends on knowledge flows between different actors and at different geographical levels. We have grouped the options into five headings, reflecting the five confirmed hypothesis, and addressing organisational excellence, optimum regional and national R&I system governance and a convergent innovative Europe. The order of the options may read as a sort of linear model suggesting that one should start with developing from strengthening local and organisational capacities, then improve national contexts and subsequently create better connections at European level. Such a reading would be misleading, and ignoring the shared responsibility of stakeholders at all levels to improve EU-13 countries position in FP.

The options are formulated at a rather abstract level, but each of these options is further elaborated in a set of options that might remove specific barriers of types formulated above. The relevance of these options depends very much on the starting position of each of the EU-13 countries. It cannot be emphasised sufficiently, that our findings show that the phenomenon of the low participation of EU-13 countries is differentiated in many respects.

9.2. Option no. 1: Creating and exploiting the existence of pockets of excellence

It is vital to increase the chance of researchers and research groups from the countries with the lowest level of participation is to create or develop pockets of excellence (Reid et al. 2016, RISE group 2017) within these countries. Such pockets of excellence can act as regional or national hubs within European research and innovation programmes, and become drivers of change within their own country. This requires long-term planning and a well-balanced interaction between EU Structural Funds, FP instruments and national funding. (RISE group, 2017)

Smart specialisation strategies often aim at developing new research capacities through EU Structural Funds in EU-13 and several new research centres and infrastructures have been built in EU-13 countries over the last 10 years. Many of the new research centres and infrastructures are superbly equipped with most up-to-date instrumentation. Several of the barriers identified indicate that the potential of these new research capacities is not fully exploited. Due to the newness of teams and infrastructures on the international scene they often lack contacts and visibility to the European and world research community and may lack sufficient experience with international projects. Also generally less developed managerial skills as well as insufficient organisational capabilities limit strategic management, internationalisation and effective use of the new research capacities. Following steps will encourage the development of pockets of excellence and European hubs. The options are formulated at a general level, but of course, their urgency depends very much per country.

Option 1a. Managerial skills and organisational capabilities to organise and administrate research projects and programmes, as well as the network relationships, should be improved. This will remove type C and D barriers and can be done by e.g. through implementing various options under option 4.

Option 1b. Visibility and attractiveness of new research centres and infrastructures to research communities in EU-15 countries should be raised, which will remove type B and C barriers, and could be facilitated through opportunities under option 5

Option 1c. Funding available at the national level or through Structural funding should be used as leverage to attract FP funding, as part of improving governance of R&I systems and remove barriers of type A.

Option 1d. Governance of these pockets of excellence, including priority setting, evaluation and monitoring and funding conditions should take into account the European hub-function, in order to reduce cognitive and technological distances and remove barrier type C.

Option 1e. Research teams from EU-15 countries should be encouraged to use new research infrastructures established in EU-13 countries for their research activities, to remove type B and C barriers. Option 5 further elaborates this.

9.3. Option no. 2: Improving governance of national R&I systems

The differences between EU-13 countries in the participation rate, and several of the barriers identified indicate that improving the governance of national R&I systems is a key factor in raising participation rates. Many EU-13 countries lack a sophisticated system of periodical evaluation of research organisations closely linked to institutional funding. The national steering of R&D is thus void of some

basic information required for influencing effectively the desired behaviour of research organisations management.

Also strategic management of research organisations (including universities) and many private, especially small and medium-sized enterprises is rather underdeveloped in EU-13. Top managers (rectors, deans, directors of research organisations) are recruited from researchers from their own institutions, who rather seek to maintain the status quo than to develop international cooperation or knowledge transfer. Besides, the issue of strategic management in general and international collaboration in particular is not involved among evaluation criteria for research organisations and universities. Instead, in majority of the EU-13 countries research organisations and universities are evaluated on the basis of the quantity of research outputs (e.g. research papers) or some basic indicators of quality.

These facts do not sufficiently motivate researchers or managers of research organisations to engage in international cooperation including participation in FP7/H2020. Specific improvements that national governments can undertake are:

Option 2a. Include the European dimension terms of European research and innovation funding priorities within FP as well as networking and market opportunities for national actors into priority setting and smart strategies for national R&I. This will motivate actors to participate and remove type A barriers.

Option 2b. Use national funding for research organisations more explicitly as leverage to increase the participation within FP, e.g. through providing small budgets to prepare new project applications, reward successful acquisition of new entrants, create opportunities to exploit results of FP projects. This may motivate actors to submit (remove type A barriers), and increase the chance of success (increase type B barriers).

Option 2c. Establish a system for periodical evaluation of research organisations that will take account of the level and intensity of international collaboration, quality of research management, incl. management of human resources. Such schemes will reward excellence and improve the readiness of research organisations to participate in FP projects (type C & D barriers)

Option 2d. Reinforce smart specialization processes and activities, evaluate their implementation and utilize various funding resources (national, ESIF, H2020 and others) in a synergetic way to strengthen the position of regions in areas of their competitive advantage. Within such regions motivations to submit to FP may increase as well as the ability to succeed. (remove type B and C barriers)

9.4. Option no. 3: Improving use and exploitation of FP R&D projects

By their nature, FP projects have a fixed end, even when there are further opportunities to use and exploit the project results. At the same time, successful exploitation of R&D outputs resulting from FP projects is a significant factor encouraging researchers to participate in future European research collaboration.

Business enterprises in the EU-13 Member States are due to their underdeveloped strategic management and limited innovation capacities less capable to absorb and further exploit results from international research collaboration projects. As a result, there is a limited number of SMEs in the EU-13 countries effectively motivated to participate in FP research projects.

There are already specific instruments of the FPs in place that aim to increase opportunities for exploitation of new knowledge and technologies by SMEs with limited links to excellent research (the case of all EU-13 countries). SME Instrument and Fast track to innovation mechanism are the two most prominent instruments utilizing the bottom-up approach.

Experiences with FP instruments may increase if research and innovation actors have clear opportunities to follow up on successful projects. This can be done by:

Option 3a. Strengthen the opportunities for effective use of R&D outputs resulting from FP projects, e.g. by introducing proof of concept scheme (similar to ERC PoC) that would enable follow-up activities leading to successful implementation of R&D results achieved in FP projects. Such opportunities increase the attractiveness of FP participation and remove motivational type A barriers.

Option 3b. Create national funding schemes, from EU Structural Funding or otherwise, for national or regional exploitation projects in which FP participants collaborate with other national and regional actors to exploit results from EU projects. Such opportunities increase the attractiveness of FP participation and remove motivational type A barriers, but also may increase the likelihood that projects are selected, as partners can show more convincingly that there are opportunities and resources available for exploitation of results.

Option 3c. Rationalize, simplify and strengthen the FP support of close-to-market innovation activities of SMEs (in particular the SME Instrument and the Fast track to innovation mechanism). It is useful in this respect to reinforce mechanisms that combine grants with equity financing. Better understanding of the structure of supporting mechanisms by innovative SMEs and higher success rate in these funding schemes may remove motivational type A barriers.

9.5. Option no. 4: Strengthening of NCPs

Several barriers identified refer to insufficient understanding within low participating countries of EU-13 of FP opportunities and insufficient capabilities to develop eligible and high quality proposals. While it is beyond the scope of this study to assess the actual performance of the National Contact Points, given their remit and budget, it seems that there is some space for further action in this respect. The real problem, however, seems to be the lack of institutional support from within the university/research organisation. Therefore, the development of capacities within institutions to aid researchers in preparing and managing their projects should be politically supported. Specific actions related to barriers identified which NCPs could undertake or strengthen are:

Option 4a. Build good case material about successful use of FP instruments by EU-13 research and innovation actors that can serve as exemplars for new entrants. Case material should be sufficiently diverse in order to attract the attention of a wide range of research and innovation actors, including new entrants and incremental innovators and remove motivational barriers of type A.

Option 4b. Provide clear guidance and support on administrative aspects of FP instruments, counter attacking myths about bureaucratic overload. Such guidance will increase readiness to submit and remove type D barriers.

Option 4c. Develop programmes to improve managerial and administrative capabilities within research and innovation organisations to manage FP projects, and remove type C barriers.

Option 4d. Develop regional and national communities of practice of actors responsible for the management and administration of FP projects, and remove type C and D barriers not only at an organisational level but also nationally.

Option 4e. Use experiences and capabilities of pockets of excellence to support other regional and national actors in their attempts to participate in FP. This will indirectly remove C and D type barriers.

Option 4f. Support and facilitate national actors involved in the management of FP instruments (preparation, lobbying, selection of proposals, etc.). Through this, the problem of too less influence is addressed, and type C barriers may go.

9.6. Option no. 5: Expanding Spreading Excellence and Widening Participation

Should the FP contribute to increasing the global EU competitiveness then it must be driven by an uncompromised emphasis on excellence. This holds good not only for the ERC projects but for the collaborative research projects performed by large consortia as well. Campaigns aimed at increasing the number of EU-13 teams which participate in FP project proposals preparations are counterproductive if induce a decrease in the participation and/or financial success rate in the FP. Thus emphasize the excellence of consortia as a criterion for project proposals evaluation.

From the evidence in this report, it is clear that existing relationships with participating research organisations improve the chance of success in FP competitive funding considerably and that within Europe a number of national research organisations have core positions in the overall network of EU research and innovation collaborations.

The Spreading Excellence and Widening Participation programme is still in its early stages of implementation and has introduced fresh impulses for strengthening the R&I potential of EU-13 countries and their better integration into ERA. The interviewed policy-makers and expert emphasized that the instruments of the Spreading Excellence and Widening Participation programme need to be implemented in a synergetic and well-balanced manner and need to stimulate reform efforts at the national and institutional levels simultaneously. Options for further implementation of this programme include:

Option 5a. Enlarge the budget for the programme in order to ensure that sufficient research and innovation actors are reached through the programme and a critical mass of FP participants develops. This will remove type B and C barriers.

Option 5b. Take into account the quality of organisational strategic management as a criterion for evaluating research capacities of consortia members. The aim is to encourage especially research organisations in EU-13 to improve their strategic management, incl. management of human resources and as such take action to remove type A and D barriers on the longer term.

Option 5c. Emphasize also the excellence of EU-13 partners as a criterion for evaluating project proposals. The aim is to avoid that projects are dominated by EU-15 partners and the cognitive and technological distance of EU-13 partners is too large to fully profit from the collaboration. Though this may create further pressure on the EU-13 organisations and increase type A and B barriers, on the long-term it ensures that FP participation of EU-13 countries is effective and has spin-off effects into the regional.

Option 5d. Encourage specifically collaboration between national research organisations and TOP European research organisations. Collaboration with TOP 15 in the FP7 and/or TOP 20 in the H2020 has considerably increased the participation success rate of EU-13 and it may increase future participation opportunities in FP for the EU-13 partners, and remove type B and C barriers.

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Annex 1: Questionnaire for survey among FP7/H2020 participants

Basic information

Q1: What is/was your role with regard to the FP7/H2020 projects?
Single choice: researcher, project manager, administrative support

Q2: What is a typical role of your organisation in FP7/H2020 projects?
Single choice: coordinator, work package leader, task leader, team member

Motives for participation in FP7/H2020 projects

Q3: Please rate following motives that drove your decision to participate in FP7/H2020 projects according to their significance:
Rating scale 1 – 5: unimportant – extremely important

- To address scientific, technical or societal challenges
- To develop and extend internal knowledge and capabilities
- To access capabilities or research facilities that do not exist in your organisation
- To develop new or improved relationships or networks
- To facilitate mobility of researchers
- To access research funding
- To develop new or improved commercial products, services, technical codes or standards
- To create new or improved facilities or infrastructure
- To develop new or improved regulations or policies
- To comply with the national strategy of participation in H2020
- To be successfully evaluated in the national R&D assessment
- Other (please specify)

Q4: Did/Does the topic of FP7/H2020 call you applied in correspond to the long term research agenda of your institution?
Single choice: yes / no

Q5: Do benefits of your participation respond to your initial expectation?
Single choice: yes / no

Barriers to higher participation in FP7/H2020 projects

Q6: Please, assess the following barriers to your participation in FP7/H2020 projects according to their significance:
Rating scale 1 – 5: unimportant – extremely important

- Limited in-house internal skills on drafting proposals or project management
- Lack of information about funding opportunities from FP7/H2020
- Non transparent proposal evaluation procedures
- Easier access to national resources for funding R&D projects
- Inability to get co-funding for FP7/H2020 projects
- Low funding rates
- Low success rate of project proposals
- Long time from submitting proposal to contract
- Limited links to potential partners
- Bureaucratic application and reporting procedures
- Unclear implementation of FP7/H2020 financial rules in your national R&D environment

- Risk of committing unintended mistake in using FP7/H2020 financial support
- Irrelevance of programme topics and goals to own research agenda
- Negative experiences gained from previous unsuccessful project proposals
- Negative experiences gained during solution of previous FP projects
- Other (please specify)

Services supporting participation in FP7/H2020 projects

Q7: How beneficial for your participation in FP7/H2020 projects do you consider services provided by the National Contact Points (NCPs)?

Rating scale 1 – 5: not beneficial at all – extremely beneficial

Q8: How beneficial for your participation in FP7/H2020 projects do you consider internal supporting services provided by your organisation (project offices, project management teams, administration support, etc.)?

Rating scale 1 – 5: not beneficial at all – extremely beneficial

Q9: How beneficial for your participation in FP7/H2020 projects do you consider services provided by external consultants?

Rating scale 1 – 5: not beneficial at all – extremely beneficial

Q10: What additional information, support or assistance would you like to be made available nationally?

Open question

Recommendations

Q11: Which of the following measures would help your organisation to increase participation in EU Framework Programmes for research and innovation (H2020 or FP9)? Please indicate relevance of the proposed measures.

Rating scale of 1 – 5: not relevant at all – extremely relevant

- Existence of national strategy with clear goals to be achieved in H2020
- Existence of a periodical evaluation of research organisations including assessment criteria such as membership of the global research community
- Active science-oriented lobbying for designing H2020 work programmes
- Representation of national experts in advisory bodies for EU R&I policy and as evaluators of project proposals
- Raising awareness, information and advice on accessing H2020 funding
- Promotion of international networking
- Advice and quick checks of project ideas
- Support in searching for international partners
- Grants for exploring project feasibility and validation of project ideas
- Grants to seek advice from specialized consultants
- Provision of training, mentoring and coaching in course of the whole project preparation phase
- Introducing additional criterion for differentiation related to new comers in the evaluation of proposals
- Increasing number of smaller scale projects in H2020/FP9
- Softening the researchers' remuneration gap between Member States

Optional

Q12: Do you participate in discussions about the next EU Framework Programme (FP9)?

Single choice: yes, I have had a chance to give my suggestions / no, I have had no chance yet, but I would like to participate in future / no, I do not plan to participate in those discussions

Q13: Is involvement of national representatives (research organisations, public administration, businesses, associations, etc.) in the preparatory process of the next EU Framework Programme sufficient?

Single choice: yes / no

Q14: Are interests of your country in FPs effectively enforced?

Single choice: yes / no

Annex 2: General structure and content of the interviews

(interview for approx. 30 min)

1. Perception of barriers for participation in FP7/H2020

Do you consider participation of your country in FPs adequate? (in relation to the size of R&I system in your country)? In the case you consider the participation inadequate could you please specify measures on the national level taken to increase the participation in FPs?

Are there any specific obstacles that discourage participation of research teams from your country in FPs? (e.g. inappropriate topics, insufficient quality of R&I, lack of project management skills, lack of contacts, inability to exploit results, availability of other funding sources, in particular national, etc.)

What is the general attitude to FPs in your country? What is the attitude of policy-makers and of researchers?

How would you characterize the relevance of the FPs for the EU and your national R&D system within the EU?

2. Position of FP7/H2020 in the R&I funding system

What role does the FP7/H2020 play in the R&I funding system in your country with respect to:

- Internationalization strategy - Does your country have any strategy for international R&I collaboration? Is there any specific strategy or policy measures aimed at increasing participation in FP7/H2020?
- National R&D priorities and topics – Are there any synergies and complementarities between FP7/H2020 and national priorities?
- Volume of national financial sources – Are there any national or other international funding resources that are more attractive for applicants in your country?
- Evaluation of research organisations – Does international collaboration and participation in FPs belong to assessment criteria for evaluation of research organisations?

3. Active participation of national representatives in the FP7/H2020 elaboration process (negotiations) and formulation of calls

The FP activities are focused at generating the European Added Value. Is this concept understood and considered properly in your national processes aimed at contributing to the FP7/H2020 design and calls formulation?

Is your country adequately represented in advisory bodies involved in formulating priorities, objectives and topics of FPs? If not, what is the reason? (e.g. lack of expert knowledge and/or lobbying experiences, EC does not listen, …)

4. Experiences with Spreading Excellence and Widening Participation Scheme

Do you consider this scheme positive in terms of strengthening the research potential in your country and participating of your country in FPs?

Which instruments of WIDESPREAD scheme have or might have the most positive impact in your country? (ERA Chairs, Teaming, Twinning, PSF)

Do you think existing instruments should be extended and strengthened in the next FP?

5. Synergies of FPs and EU Structural Funds

Does your country use EU Structural Funds for R&I funding? If yes, do you consider the EU SF complementary to FP funding or rather substituting the FPs?

Could you provide us with any example where money from EU SF and FPs were invested in a complementary way?

6. Measures encouraging the participation of researchers from your country in FPs

Are there any particular recommendations from previous projects and studies of the EC on expanding participation of EU-13 countries that have been implemented in your country?

Would any of the following measures help improving conditions for participation of your country in FPs?

- Additional criteria related to newcomers
- Mitigation of the researchers' remuneration gap between EU-13 and EU-15 Member States
- Sustain or increase number of smaller projects in comparison with larger projects
- Establish an appropriate balance between EU-13 and EU-15 representatives in Advisory Groups and expert panels
- Establish an appropriate balance between the accent on 'uncompromised excellence' and opportunity to participate driven by the rule 'what you pay in is what you get back'
- Promotion of researchers' mobility and scientific exchange

Investing in research is considered essential for achieving smart, sustainable and inclusive growth and jobs in Europe. The EU Framework Programme for research and innovation is the EU's primary instrument for building the European Research Area. Framework Programmes are expected to produce European added value: therefore the principle of *juste retour* does not apply. Research needs to be of the highest quality, produced in international collaboration and selected on a competitive basis.

Under such conditions, uneven participation is unavoidable. However, Framework Programme participation appears to be disproportionately weak for an entire region of the EU. After almost 20 years of access to the opportunities of the FPs, the EU-13 still lags behind the EU-15. The aim of this study is to explore, identify and enlighten reasons for the low participation and success rate of EU-13 countries, in order to improve their future performance in Horizon 2020 and in future Framework Programmes.

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