Baltic Science Network

Connecting through Science

Participation in ERA and Baltic Sea RDI Initiatives and Activities: Analysis and Policy Implications for Widening Participation of Strong and Moderate Innovators

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Project in brief

Baltic Science Network (BSN) serves as a forum for higher education, science and research cooperation in the Baltic Sea Region (BSR).

BSN is a policy network gathering relevant transnational, national and regional policy actors from the BSR countries. The Network is a springboard for targeted multilateral activities in the frame of research and innovation excellence, mobility of scientists and expanded participation. These joint activities are modelled with an overall aim to ensure that the BSR remains a hub of cutting-edge scientific solutions with the capacity to exploit the region's full innovation and scientific potential. The activities are modelled as examples of best practice, which form the basis of the policy recommendations drafted by the Network.

The platform is tailored to provide advice on how to enhance a macro-regional dimension in higher education, science and research cooperation. Recommendations jointly formulated by the Network members address the European, national and regional policy-making levels.

BSN is a flagship of the EU Strategy for the Baltic Sea Region under the Policy Area Education, Research and Employability, as well as one of two cornerstones of the Science, Research and Innovation Agenda of the Council of the Baltic Sea States.

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DISCLAIMER

This working paper is based on input from stakeholders and BSN partners and does not necessarily reflect the views of all participating Member States and organisations.

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Lühikokkuvõte

Käesolev uuring analüüsib Euroopa ja spetsiifiliselt ka Läänemere teadusruumi koostöödünaamikaid ja koostöö tugevdamise võimalusi erineva innovatsioonivõimekusega riikide vahel. Läänemere teadusruumi kujundavate poliitikate puhul tuleb arvestada erinevate väljakutsetega:

1. Kõige olulisem on riikidevaheline suhteliselt madal funktsionaalne (st arengutasemest ja teaduse spetsialiseerumisest tulenev teemade ja huvide) lähedus võrreldes geograafilise, aga samuti seadusandliku ja kultuurilise lähedusega. Seega ei ole kõik võimalikud teadus-, arendustegevuse ja innovatsioonipoliitika (TAI poliitika) eesmärgid kõigile Läänemere riikidele ühtmoodi olulised.
2. Lisaks tekitavad mitmed globaalsed ja EL taseme trendid Läänemere riikide jaoks erinevaid ja asümmeetriliselt esinevaid väljakutseid, mis omakorda takistavad iseeneslikult suurema funktsionaalse läheduse tekkimist. Tulenevalt Läänemere piirkonna riikide erinevatest TAI võimekustest on Läänemere erinevatel kallastel TAI poliitikas võrdlemisi erinevad koostööga seotud prioriteedid: kriitilise massi loomine rahvusvahelise konkurentsivõime saavutamiseks vs regionaalne konvergents ja järelejõudmine.
3. Lisaks mõjutab Läänemere-äärsete riikide teadussüsteeme juba praegu laiaulatuslik ja keeruline institutsioonide, poliitikate, instrumentide ja võrgustike süsteem ning teadlased ja ettevõtjad neis süsteemides tõlgendavad ja kasutavad erinevaid Läänemere regiooni puudutavaid koostöömeetmeid väga erinevatel eesmärkidel ja viisidel. EL taseme TAI strateegiate kujundamise protsessid on Läänemere regiooni koostöösse andnud väga olulise panuse – need on toiminud teaduskoostöö ergutajana (eriti teatud temaatilistes valdkondades nt mere- ja keskkonnauuringud). Samas tuleb nende mõju hinnata kahetiselt: ühest küljest on need protsessid kujundanud dünaamilise ja sidusa rahastuskeskkonna, kuid negatiivse poole pealt on samuti loonud juurde koordinatsiooniprobleeme nii TA tegijate, aga ka rahastajate ja korraldajate jaoks.
4. Viimastel aastatel on aga mitmed tegurid ohtu seadnud mõõdukate innovaatorriikide (ja ka mõnede tugevate innovaatorriikide) TAI võimekuste jätkusuutlikkuse ning see ei tule loomulikult kasuks ka koostööle. Nendeks teguriteks on EL13 riikide suur sõltuvus struktuurivahenditest, aga samuti hiljutised kasinusmeetmed ning erinevate tasandite TAI rahastusskeemide paljusus Läänemere regioonis. Nende tegurite koosmõju on viinud selleni, et rahalised stiimulid domineerivad kasvavalt rahvusvahelise koostöö suunajatena. Seetõttu on muuhulgas oluline mõelda, kuidas suurem lähedus TAI süsteemide institutsionaalses korralduses aitaks olemasolevaid meetmeid paremini kasutada suurema sisulise/funktsionaalse läheduse saavutamiseks. Oluline on lähendada erinevate riikide stiimuleid nii organisatsioonide kui ka indiviidide (teadlaste, ettevõtjate) tasandil kogu Läänemere piirkonnas.

TAI koostööinstrumentide pakette võib toimimise loogika järgi jagada kolmeks mudeliks: integreeritud mudel, koordineeritud mudel ja detsentraliseeritud koostöö. On selge, et EL

uuemad instrumendid (PCP, PPI), mis eeldavad suuremat funktsionaalset lähedust ja toimivad integreeritud mudeli loogika alusel, vajavad samuti mõõdukate innovaatorriikide seadusandlike ja juhtimisprotseduuride märkimisväärset kohanemist erinevatel tasanditel ja see näib olevat väga suureks probleemiks nii Balti riikides kui ka laiemalt EL13 riikides. Läänemere regiooni ja riiklikud meetmed on järginud pigem koordineeritud ja detsentraliseeritud koostöö mudeleid, mille tulemuseks võib olla see, et integratsioon EL suunal on tugevam (eriti arvestades meetmete finantsmahtusid). Samal ajal on nii mõnedki Läänemere piirkonnale olulised meetmed (BONUS; INTERREG) saanud tugevneda tänu EL rahastuse kasvule, mis võib anda baasi tulevaseks koostööks.

Kuna paljud Läänemere riigid on väga väikesed, siis nende jaoks on strateegiliselt oluline olla hõlmatud võimalikult laialt erinevatesse koostöövõrgustikesse. Käesolev analüüs näitab, et kuigi rahastuse hulk EL raamprogrammist on kasvanud just EL13 riikides, siis võrreldes H2020 perioodi ja FP7 perdioodi rahestusskeeme ei ole laiem integratsioon õnnestunud ei EL13 ega ka Läänemere regiooni riikide jaoks. Instrumente detailsemalt analüüsides selgub, et enamik mõõdukaid innovaatorriike saab hakkama ülesehituselt detsentraliseeritud meetmetes osalemisega, kuid suur osa meetmeid toimib integreeritult (nii regionaalsel tasandil kui ka organisatsioonide vahelises koostöös) ning neid meetmeid ei suudeta kasutada kas üldse (EL tasandi uuemad koostöömeetmed) või siis sünergeetiliselt oma eesmärkide saavutamiseks (paralleelsed regionaalsed ja EL meetmed). Paljud Euroopa Teadusruumi ja Läänemere piirkonna meetmed eeldavad järjest enam rahalise panustamise soovi ja võimekuse olemasolu, mis omakorda eeldab riikidelt suuremaid TAI investeeringute eelarveid. Praegune osalemise dünaamika neis meetmetes näitab, et FP9s ootab mõõdukaid innovaatorriike veelgi suurem "järelejõudmise" vajadus (ehk lõhe tugevate innovaatoritega kasvab). Väikeriikide ülikoolide kasvav integreeritus Euroopa koostöövormidesse võib edaspidi vähendada koostööd Läänemere ülikoolide võrgustikes.

Käesolev uuring kinnitab juba teadaolevaid koostööbarjääre, nagu näiteks ebapiisav TAI investeeringute tase EL13 riikides, puudulik sünergia EL tasandi, riikide fookuste ja funktsionaalse toimimise vahel, piiratud ligipääs võrgustikele ning puudulikud kogemused projektitaotluste ja -juhtimise osas. Teadlased on reaktsioonina kahanevatele edukuse määradele asunud üha rohkem "mängima" taotlemisreeglitega et maksimeerida oma taotlemise edukust, mis kindlasti ei tule kasuks funktsionaalse läheduse suurendamisele ega ka teaduse arengule pikaaajalises perspektiivis. Geograafiline lähedus ei mängi H2020-s enam nii suurt rolli, pigem on oluline tulemuste rakenduslikkus (innovatsioon) ja vastavad partnerid, keda aga tulenevalt mõõdukate innovaatorriikide TAI süsteemide väiksusest, fragmenteeritusest ja nõrkusest, on seal raske leida. Seega on selge, et geograafilisest lähedusest ei piisa TAI koostöö arendamiseks Läänemere piirkonnas ja seda isegi suurema funktsionaalse lähedusega temaatilistes valdkondades.

Samas, spetsiifiliselt Euroopa Teadusruumi laienemisele (*widening*) suunatud meetmeid näevad teadlased mõneti pikaajalise TAI koostöö arenguloogikaga vastuolus olevateks. Neid kasutatakse rahaliste probleemide lahendamiseks, kuid samas nähakse, et need ei ole jätkusuutlik viis TAI võimekuste ja koostöö arendamiseks. See paistab eriti välja just neis EL13 riikides, kus on vajalikud pigem infrastruktuuriinvesteeringud kui pehmed meetmed. Sama

kehtib ka PPP ja P2P skeemide puhul, kus vajatakse lisaks *top-up* rahastamist. Seega sõltub mõõdukates innovaatorriikides meetmete kasutamise efektiivsus pigem strateegilistest otsustest ja valmidusest rahalisi kohustusi võtta: teadlased järgivad siin riigipoolseid valikuid, kuid tõenäoliselt ei juhi neid. Kuna EL13 riigid tegelevad aga eelkõige oma TAI süsteemide võimekuste rajamisega, siis riikide tasemel paistavad need meetmed olevat aga kõrvaliseks probleemiks.

Samas peaks erinevate tasandite poliitikaid arendama süsteemsema toimimise suunas, st. EL, Läänemere regiooni ja riikliku tasandi otseselt seonduvate ja/või täiendavate eesmärkidega poliitikate kaardistamist ja positsioneerimist. Lihtsamad ja omavahel harmoneeruvad reeglid (sh riiklike regulatsioonide paindlikkus) vähendaksid koostööbarjääre erinevate riikide teadlaste vahel. Kõigis Läänemeremaades vajatakse teadlastele arusaadavat, ajakohast ja süsteemset toetust koostööks olulise informatsiooni jagamise näol. Euroopa Komisjon peaks toetama rohkem alt-üles initsiatiive reeglite harmoneerimise kaudu; meetmete edukuse määrade prognoositavust ja tõstmist teaduskoostööle suunatud rahastuse suurendamise kaudu ning oluliselt paremini kujundama oma kommunikatsioonistrateegiaid teadlastele, riigiasutustele, ülikoolidele ja ettevõtetele.

Rahvusvahelisi parimaid praktikaid järgides peaks Läänemere regioon eelkõige määratlema ühised teadushuvid ning neid ka EL teadusalastes strateegiaprotsessides esindama. Seda ühist arusaama regiooni sees ning ühist imagot väljaspool regiooni tuleks toetada teekaardiga, mis ühendaks ajakohase ja süsteemse info eesmärkide ja teadusinstrumentide kohta kõigil poliitikakujundamise tasanditel. Läänemere-äärsed riigid peaksid seisma hea selle eest, et nende seadusandlus, raamatupidamise ja auditeerimise praktikad, osalemisreeglid ja -regulatsioonid oleksid sel määral ühilduvad, et ei takistaks koostööd. Riskid peaksid samuti olema riigi (ja mitte üksikteadlase) tasandil maandatud, et stimuleerida teadlaste valmisolekut rahvusvahelisi projekte ette võtta. NCP-de parem võimestamine aitaks laiendada konsultatsiooni ja mentorluse tegevust.

Kuna erinevaid teaduskoostöö suurendamiseks vajaminevaid poliitikameetmeid on palju, siis grupeerime neid selles raportis *reguleerivateks* instrumentideks (ehk piitsad), *rahastamise* instrumentideks (ehk prääniku), ning *info ja kommunikatsiooniga* seotud meetmeteks (ehk jutlused), mille kooskasutamine on väga oluline, et erinevad stiimulid samaaegselt "nügiksid" TAI süsteemis toimetavaid agente (teadlasi, ettevõtteid, ülikoole, avaliku sektori autusi jt.) suurema rahvusvahelise koostöö poole Läänemere piirkonnas. Kuna TAI meetmed muutuvad järjest komplekssemaks hõlmates rohkem ja erinevaid partnereid, siis Läänemere riikide ühine panustamine nii regiooni nähtavusse kui ka koostöösse, samuti kommunikatsiooni teadus- ja poliitikakujundamise ringkondade vahel aitaks suurendada edu saavutamise tõenäosust (mida võib väita suhteliselt eduka Vahemere piirkonna riikide koostöö näite alusel).

Eelnevast johtuvalt soovitame Läänemere regiooni TAI koostöö soodustamiseks kasutada kahte tüüpi uudsemaid poliitikameetmeid: esiteks selliseid meetmeid, mis kiirendaksid ja võimendaksid *alt-üles* koostööalgatuste tekkimist (enamasti riikide ja organisatsioonide tasandi meetmed) ja teiseks sellised meetmeid, mis *ülalt-alla* püüavad algatada ja juhtida

Läänemere koostööd kas uutesse valdkondadesse ja/või uute partnerite poole (siin eelkõige regiooni ja riikide tasandi meetmed). Mõlemad erinevad tavapärastest eelkõige seetõttu, et püüavad saavutada suuremat funktsionaalset lähedust.

1. Kiirendavad alt-üles suunaga tegelevad poliitikameetmed peaksid andma lisanduva või ka kordistava efekti Läänemere piirkonna väljakutsete lahendamiseks. Need on vajalikud, kuna Läänemere piirkonnas on juba lai olemasolevate meetmete raamistik, mille abil püütakse mobiilsust, infrastruktuuride ühiskasutust ja teaduse ekstsellentsust arendada. Spetsiifiliste meetmetena pakume välja ühise teenuspiirkonna loomisele keskenduvaid meetmeid näiteks virtuaalsete ja jagatud teenusepiirkondade näol. Samuti võiks luua Läänemere riikide ühise rahastamise fondi H2020 meetmete konkurentsis "teiseks jäänud" projektitaotluste rahastamiseks, mis on regiooni jaoks olulised ja mille rakendustingimused töötatakse välja ühiselt Läänemere riikide poolt (nt. BSN raames).

2. Ülalt-alla poliitikameetmete näidetena tuleks kõne alla ühised grandid või koordineeritud poliitikameetmed eri riikides, mis toetaks Läänemere spetsiifiliste teemade rahastamist seejuures määratledes riikidevahelise tööjaotuse (nt erinevad riigid oma meetmetega toetaks omavahel läbiräägitult ja üksteist täiendavalt temaatilisi TAI fookusteemasid). Siin võiks olla võimalikuks näiteks Läänemere läbimurdeteaduse 'kiirendi', mille kaudu rahastataks suure riski, kuid ka oodatava suure tuluga projekte uutes või interdistsiplinaarsetes valdkondades (nt küberjulgeolek, suurandmed, targad linnad, biomajandus vmt), kus Läänemere piirkonnas kriitilise massi saavutamine on oluline globaalseks konkureerimiseks (jällegi võib lahendada seda nii ühiskassa kui ka riigi tasandi meetmete omavahelise koordineerimisega). Läänemere piirkonna kui ühise teenusruumi arendamine on üks võimalus, kuidas erinevaid TAI osalejaid ergutada teadustulemusi rakendama.

Kõik need eeltoodud meetmed oleks võrdlemisi uuenduslikud (vähemalt regiooni tasandil) ning võimaldaksid ka EL kontekstis toetada Läänemere kui eeskujuks oleva piirkonna imagot spetsiifiliste (niši-) teadusvaldkondade toetajana ning vastavates valdkondades arendada nii institutsionaalseid võimekusi koostööks kui ka teaduse üldist taset.

Executive Summary

This study focuses on three major topics:

1. The set-up, governance and funding of instruments supporting RDI policies in BSR by answering the following quesions:

- *What are the existing RDI cooperation oriented instruments and programmes used in BSR countries, are they designed internally and coordinated as part of broader policy mixes?*
- *Which instruments and programmes have had wider impact on RDI cooperation in BSR and more broadly?*

2. The mapping of existing RDI cooperation patterns and networks in BSR and the analysis of factors holding back their development by answering the following questions:

- *What countries and types of institutions are most actively cooperating within the ERA and BSR instruments? What is the role of different institutions, enterprises?*
- *What factors are hindering and supporting the widening in ERA and BSR activities?*

3. The analysis and recommendations for developing novel cooperation-enchancing policy instruments in BSR by focusing on the following questions:

- *What new programmes are needed to encourage RDI partnerships in BSR?*
- *What instruments could improve the participation capabilities of moderate innovators?*
- *What kinds of instrument designs and managerial practices may be best suited?*

We find that policy challenges to enhancing research, development and innovation (RDI) cooperation in the Baltic Sea Region (BSR) are manifold:

1. The relatively lower functional proximity (reflected in the existence of common interests, both substantive and financial, regarding RDI cooperation in specific RDI fields e.g. food, health, energy, transport, environment, civil security, safety, maritime affairs, science and education, culture), compared to physical and relational proximity, among many BSR countries and regions implies that not all RDI challenges and actions will be of common interests to all regional actors.
2. BSR cooperation is already influenced by a vast, complex and partly overlapping system of different institutions, policies, instruments and RDI networks. For example, while instruments such as those connected to EUSBSR and BONUS focus on the Baltic Sea as a key object of research and cooperation, in other initiatives BSR acts as a place or platform for cooperation (eligible territory), which will be driven not so much by functional proximity but by political and policy imperatives. At the same time, global and EU-level drivers of RDI might supersede further functional proximity in the region and, thus, challenge or compete with the regional and national interests and priorities. Differences in actual RDI capabilities of different countries or regions may also lead to different interests regarding RDI cooperation: more developed regions may be interested in building collective critical mass for global competitiveness whereas less developed regions may be interested in intra-regional convergence and catching-up effects.

3. A number of studies highlight that the EU-level strategy-making processes may have been an additional driver for transnational cooperation in BSR (especially in some thematic areas such as the environmental and maritime issues). The increased role of the EU in the region may have had a twofold effect by supporting the creation of a more dynamic multi-level governance model while also creating and further intensifying the coordination problems between different organisations and government levels in BSR. The "policy mixes" co-created by the EU, BSR, regional and national policies and initiatives are implemented by scientists and innovators and interpreted and used in different ways and for different purposes. Thus, the perceptions and actions of scientists and innovators working in this multi-level arena of RDI policies are crucial in determining the actual content and implementation of strategies and policies.
4. Different levels of RDI funding, but also the high dependence of some countries on European Structural and Investment Funds (ESIF) and the impact of the recent financial crisis and subsequent austerity trends have created the threat that especially (but not only) the moderate-innovator countries may be undercutting their basic RDI capabilities (and funding) that are necessary preconditions for functional proximity-driven RDI cooperation. Given these differences in the importance of foreign and especially EU funding mechansims for RDI, a crucial issue in analysing the effectiveness of transational-cooperation-oriented RDI policy instruments and the overall policy mix is whether the locational proximity of a specific region (BSR) is complemented by relational and functional proximity.

In BSR as a whole, the majority of RDI investments are made by Sweden, Denmark and Finland. Poland and three German BSR states are contributing equally, but less than the former three countries. While the financial capacity of Baltic States is rather marginal, the participation levels (participations, funding shares etc.) of the Baltic States in different BSR (but also EU) cooperation programmes are much larger compared to the financial capabilities of their innovation systems. The magnitude of EU funds has grown for the BSR region as a whole, and this trend is observable also in areas that can be considered core topics of BSR (environment, energy, maritime research etc.). Widening instruments have become less relevant for the whole BSR region, but ERA-NETs, for example, have gained in importance compared to the period of 2007-2013.

As many BSR countries are small, the integration patterns vs isolation patterns in transnational cooperation are highly relevant. In this study, we use the segregation indexes and their dynamics to assess whether the BSR, but especially the EU13 countries of the region, have achieved wider integration within the European Research Area (ERA) and the BSR science cooperation (which they are aiming for) or not. We conclude that while EU13 has managed to gain relatively more funding from FP, this has not necessarily increased the integration of these countries within ERA; similarily the concentration (and not wider integration) is visible for the whole BSR. These results are confirmed also across most thematic instruments. We can argue that the BSR group is having higher isolation compared to the EU13, suggesting that for the moderate innovators, cooperation with other EU13 members remains wider in the Horizon 2020 framework. Alternatively, we can argue that thematic (functional) proximity

within BSR is more concentrated in H2020 projects. Those two claims further highlight the need to discuss the policy tensions of small countries in wider vs deeper integration in the EU.

The thematic cooperation patterns showing the growing segregation of thematically important fields elaborates the challenge for BSR in developing closer functional proximity within BSR. The threat that global drivers will supersede thematic cooperation based on BSR interests (energy, health, transportation, security) seems not to be realised in H2020. Based on our results, we can argue that the tension between the financial incentives of thematic cooperation via H2020 on one hand and the broader integration to the thematic knowledge base on the other hand seems to be solved in favour of the former incentive. The internal BSR cooperation within the H2020 instruments has also not grown, as the values of isolation indexes are increasing between FP7 and H2020.

A more detailed view on cooperation patterns within the frameworks of different instruments brings us to the conclusion that most of the moderate-innovator countries in BSR are operating quite well according to the logic of decentralised collaboration, but most of the instruments, growingly also on the regional level (INTERREG, BONUS, STRING – aimed at strengthening the meta-regional funding spaces) and inter-organisational networks (NOVA, BOVA cooperation) are operating in the integrated mode. As discussed above, ERA and BSR cooperation increasingly entails the instruments, where financial commitments backed by national funding are needed (e.g. Joint Programming Initiatives (JPI), PCP etc.) requiring a greater willingness and capacity to invest in transnational cooperation. Moderate innovators need to increase their contributions in this field to enter these cooperation activities or, alternatively, they need to catch up even more in FP9. The inter-organisational-level BSR cooperations contribute to the institutional richness of the region, but on the other hand, considering the limited capabilities of the few actors in moderate innovators, the integration potential of those networks is under-utilised. As moderate innovators increasingly engage in the activities of EU-wide networks, there can be a danger in weakening inter-organisational BSR cooperation forms in the future.

Well-known and widely discussed cooperation barriers for moderate innovators – insufficient R&D investments in EU13 countries, lack of sustainable and functional synergies between national research systems and EU research foci, but also insufficient access to existing networks and limited experiences with project applications and management – also found support in our study. We found that while achieving higher funding levels in the context of low success rates of H2020 instruments, the substantive importance and content of projects may become secondary next to “gaming” the rules of different funds, which will be detrimental to functional cooperation as well as research progress in the longer term. Regarding the logics of putting together transnational research consortia, the geographical coherence or logic of projects does not matter for application success as much as the applicability and diffusion of research results. For moderate innovators, this has created an additional challenge of finding appropriate industry-/market-partners, and while SMEs and public-sector organisations can be found locally, collaboration with larger industry actors often takes place transnationally. While this may be beneficial for ERA-wide knowledge and technology diffusion and

networking, finding such partners internationally tends to be an additional barrier for the EU13 research groups and especially for new entrants to the transnational cooperation arena.

Regarding the EU13 focused policy goal of "spreading excellence, widening participation" in ERA, most researchers seem to interpret these measures as political tools that partly contradict the "normal" ways of transnational cooperation that are predominantly based on scientific excellence, international reputation and long-term network building. Of course, researchers living under strong financial pressures and constraints are willing to accommodate their behaviour with such funding mechanisms, but they also recognise that this may not be a sustainable way forward if sufficient basic RDI capabilities are lacking both in academia and market. This seems to be especially crucial for the EU13 countries that would often need stronger investment into infrastructure and basic research capabilities than soft mechanisms of network building, such as COST, Twinning etc. The same seems to apply to EU's PPP and P2P schemes and similar joint initiatives where top-up funding is needed. Thus, the effectiveness of these measures for EU13 seems to depend to a large extent on the strategic choices and commitments by policy makers: researchers are likely to follow, but not lead, such choices, as entrance to existing networks requires significant policy-level commitment and financial commitments. Overall, while such soft instruments are necessary for networks building and sustaining ERA, these are not the primary needs of EU13 countries that would need to first invest into their own basic RDI capabilities and allow the RDI systems to mature.

Analysts and policy-makers have brought out several key lessons, best practices and instruments which can be suggested to all, but especially moderate-innovator countries, to improve their participation in H2020, namely concentrate more on functional proximity creation; juste retour of finances should not be the goal. As all research areas cannot be addressed simultaneously, a selective and strategic approach to participation is seen as superior demanding clear national strategic plans and appropriate alignment of EU and national objectives, and synergetic use of ESIF is needed to build advantages. As the instruments have grown in complexity, better communication of national research and policy circles with EU counterparts is needed, and for achieving better results, joint efforts of BSR countries in creating visibility but also shaping the design of these policies would probably lead to greater success (based on the Mediterranean cooperation example).

While the specific policy instruments for increasing transnational cooperation (we suggest a list of policy interventions for EC, national governments, but also organisations) may differ in their rationales, intervention logics, institutional set-ups, scale and scope, we deploy an analytical framework of Verdung joining the regulatory instruments (the sticks), economic and financial instruments (the carrots) and informative instruments (the sermons) for bringing out the individual instruments, which if jointly used are "nudging" the incentives of agents (researchers, etrepreneurs, etc.) to increased transnational cooperation. We suggest using two types of transnational RDI cooperation policies – at first policies that can speed up bottom-up transnational cooperation initiatives and, second, policies that try to initiate and steer new types and forms of transnational RDI cooperation either in new domains (of research, societal challenges) and/or between new partners (from different regions, economies etc.). These

policies often depart from territorial and/or relational proximity and try to increase functional proximity through policy interventions.

1. The "speeding-up" policies could provide additional leverage to tackle common BSN challenges, especially as BSN has already established several incentives/funding schemes for fostering transnational research and innovation in the region and cooperation in the specific areas of scientific excellence, but also supporing the further utilisation of R&I infrastructure and mobility. As specific incentive mechanisms, we can propose the creation of a common service area by virtual service centres, shared service centres, but also the BSR 2nd best funding facility for the project proposals that receive very good evaluations but fail to receive the funding from two-phase programmes of H2020 (e.g. ERC, SME, Teaming) while being highly relevant for the region as a whole. The criteria, the selection committee, the institutional set-up, etc. could be worked out at the level of BSN.

2. In the case of top-down policies aimed at wider BSR challenges, where the mere reliance on bottom-up initiatives for cooperation may be insufficient, the creation of BSR societal-challenges initiatives (e.g. in environment, energy, health) is required: either joint grants or coordinated policy initiatives with national and regional divisions of labour, i.e. different but complementary (as agreed and coordinated) RDI focuses and types of funded activities in different countries or regions of BSR. The creation of the BSR breakthrough accelerator allowing RDI grants for cooperative exploratory and/or high-risk and high-return projects in new upcoming interdisciplinary fields, such as cyber security, big data, smart cities, bioeconomy, etc., where cooperation at the level of BSR would be essential to create critical mass to compete globally (could again be jointly organised grants with common pot or topic-level coordination of different national policy initiatives and instruments); creation of BSR as a "common service area" to engage different actors in common diffusion- or application-oriented activities.

The developments in the aforementioned areas would potentially promote BSR as a role model in advancements of specific (niche) research areas and building the specific institutional capacities and scientific excellence.

Introduction

In spite of the increasing research capabilities in EU13 countries and the increasing co-publication rates with the old EU members (Makkonen and Mitze 2016), one of the key policy challenges of research collaborations in the European Research Area (ERA) has to do with the relatively low and even decreasing levels of participation of EU13 countries within FPs. In 2016, a public hearing held in the European Parliament on closing the success and participation rate gap in FPs concluded that the "EU13 participation in H2020 is still very low and without intervention this trend is likely to continue." According to the recent H2020 midterm evaluation, the low participation of EU13 countries is a persistent reality (136). However, besides studies reporting lower participation and success rates (number of granted projects, funding etc.), there have been relatively few reports investigating more closely the geographical distribution or pattern of participations from EU13 countries across different FP themes, applications and projects. There have also been opinions expressed about the BSR cooperation, which began to develop independently from the EU, but has been lacking a common goal and therefore been stagnating since the EU accession was accomplished (Schymik and Krumrey 2009).

This report analyses the participation dynamics in ERA and BSR RDI initiatives and searches for policy ideas and innovations for widening the participation of strong and moderate-innovator countries of BSR and beyond. This study covers the following "innovation leaders" and "strong-innovator" countries of BSR: Denmark, Finland, Sweden, Germany (the following *Länder*: Hamburg, Schleswig-Holstein, Mecklenburg-Vorpommern[1]). The moderate-innovator countries covered in the study are Estonia, Latvia, Lithuania and Poland. In this report the first two groups are jointly referred to as "innovation leaders" and the last group "moderate innovators".

This analysis takes a bottom-up perspective while analyzing the participation of researchers in the cooperative programmes related to ERA and BSR because there is no common single agency dominating the scene, and the analysis does not focus on a single programme, but rather attempts to draw conclusions based on a set of different policy instruments and programmes.

The empirical analysis relies upon the triangulation of qualitative and quantitative data sources and research methods to increase the validity of the research results. A concept of *segregation* (meaning separation or sorting) is applied as a summary measure characterising the development of the integration of BSR/EU13-region science systems into ERA and BSR (thematic) networks. The focus is on analyzing individual choices and strategies of core RDI actors (researchers and research groups/institutions) that lead to the segregation (as opposed to integration) of researchers and research groups in different RDI projects funded and carried out in ERA in general and BSR more specifically. As the outcomes of segregation are measured

[1] While Germany as a whole is categorised as an "innovation leader" in the European Innovation Scoreboard, the EU's Regional Innovation Scoreboard categorises these regions as "strong innovators". See http://ec.europa.eu/growth/industry/innovation/facts-figures/regional_de.

on the "macro" level (mostly country or, in the case of Germany, also regional level), the study also incorporates interviews and focus groups with RDI performers (especially researchers) to corroborate whether the barriers synthesised from the literature and defined by the quantitative analysis of this study are also raised by the RDI performers themselves. Given the limited time and resources, we have conducted primary interviews and focus groups in Estonia with its most active and succesful (in terms of applying and receiving EU RDI funding) researchers from different discplines (see Appendix 2). Estonia can be considered one of the more active and successful EU13 countries in Horizon 2020 and in BSR. During the interviews and focus groups we asked the researchers for their perceptions regarding:

- Their personal motivations, incentives and main barriers to joining transnational cooperation projects;
- Main differences between how projects and consortia have been formed in FP7 vs Horizon2020;
- Whether BSR forms a "functional" region within ERA and global research networks.

The perceptions of Estonian researchers have been corroborated by secondary interviews with policy makers, industry stakeholders and experts from other BSR countries. Further studies should also look for similar feedback from the research groups of other BSR member states.

1. Policy Instruments for RDI Cooperation in ERA and BSR

This chapter aims to answer the following questions:

- *What policy instruments determine the cooperation within BSR?*
- *What are the existing instruments and programmes and how are they coordinated; what internal logic do they follow and what kind of institutions/countries participate?*
- *What are the examples of instruments and programmes with a wider impact on cooperation?*

1.1. The rationales and challenges of regional RDI cooperation

On the level of *RDI systems*, regional RDI collaboration is often seen as a panacea for many ills: creating critical mass of supply and demand factors for sustainable RDI activities; creating spaces for knowledge spill-overs and technology transfer, socio-economic development and convergence; increasing the collective competitiveness of regional actors vis-à-vis other regions of the world etc. On the level of *RDI performers*, especially researchers and research groups, the key incentives for participation in different joint RDI efforts (such as ERA) may be summed up as follows: obtaining research funding and sharing costs; networking and finding new partners; advancing personal careers for researchers; developing technology, knowledge, research excellence (especially in areas with thematic synergies and functional proximity); commercialisation of research outputs (Polt et al. 2009, 28; Reale et al. 2013; Lepori et al. 2011, 2014. See also, e.g., Hakala et al. 2002; Pohoryles 2002; Enger and Castellacci 2016).

It should be fairly logical that some of these systemic effects as well as actor-level incentives can be created or reinforced by policies, especially through funding allocations, while others

may be more natural occurrences existing even when there are no policies in place. Thus, previous policy analyses of FPs have often come to contradictory conclusions regarding the key rationales and incentives for transnational research cooperation. Several evaluations, especially since FP6, have argued that the incentives related to the development of networking, knowledge and research capabilities tend to be more important than the economic/financial incentives.[2] This has been especially emphasised in the case of EU's joint programming activities, where networking effects have been significant (windows to enter into new or extending existing international partner networks; entrance to already established and institutionalised networks, i.e. through ERA-NETs; Reale 2013, 20–22; *Updated Policy Brief …* 2016; European Commission 2016a); however, others have shown that already established networks and consortia tend to be less open to new partners and extending their networks towards new actors (Doussineau 2014, 7). It has been also argued that a relatively strong preference for EU research partnerships has been more common amongst smaller European countries (Okubo and Zitt 2004; Tijssen 2008). Finally, more recent studies of stakeholder perceptions show that the lagging growth of national RDI funding has made financial incentives and fund raising much more important for research organisations (European University Association 2016). FP funding seems to also substitute the resources from other (national) funding sources in old member states. In Central and Eastern European countries, FP funding tends to compensate for the less developed infrastructure and is seen as a viable option for increasing regional innovativeness of these regions in combination with other policies (Varga and Sebestyén 2016).

Regional innovation studies have further shown that transnational cooperation and cross-border synergies depend not only on geographical closeness (*physical proximity*), but also on the partner's innovation and knowlege generation capacities and substantive complementarities to carry out research and innovation activities on sufficient levels (of academic excellence, technology readiness or market competitiveness) with a focus on areas or issues that attract other regional actors to join forces (*functional proximity*) and on the compatibility of institutional and governance structures and cultures of different regions, which reduces transaction costs and cultural barriers (*relational proximity*) (Lundquist and Trippl 2013; Boschma 2005; Tõnurist and Kattel 2016). In other words, the existence of a region as a geographical location or "space" alone is not a sufficient condition for synergetic transnational cooperation; it also takes some "natural" reason, capabilities or incentives as well as cultural fit (Scherngell and Lata 2013). In cases when the latter aspects are not sufficiently present, physical proximity may result in segregation (or unbalanced integration) within a particular region.

BSR is one of the EU's regions with a strong potential for not only physical, but also functional and relational proximity. Thus, it could benefit from transnational cooperation and cross-border synergies, and this makes it also logical that both the EU and national policy makers have sought to foster regional collaboration in RDI. Prior studies have shown that while these

[2] This is especially interesting in the context, where research funding as such appeared as the number-one objective for research centres and universities to participate in FP5 and in EU15 (incl. Austria, Finland, Ireland), see Astrom (2012), 23; Polt et al. (2009), 65. See also Pohoryles (2002); Barber et al. (2006).

policy efforts have grown more systemic, there are still important challenges in designing policies that satisfy all, or at least most, regional actors:

- The analysis carried out by Technopolis on cross-border cooperation in BSR stated in 2011 that most actors prefer bilateral or focused cooperation between few partners over cooperation through platforms that cover the entire region (Technopolis 2011).
- Jauhiainen argued in 2014 that RDI collaboration policies have been mostly driven by an idealistic win-win logic that overlooks the diversities of BSR in terms of functional capacities: "… *in these more advanced cross-border co-operation projects the focus has often been on similarities in integration or in finding perfect matching with functional complementarities in economic activities. The difference across the borders has not been used as a trigger* (Jauhiainen 2014).
- Tõnurist and Kattel (2016) have implicitly argued that there seems to be much more functional proximity between the EU15 countries than between EU13 and EU15 countries. This also translated into how policy makers from the EU15 and the EU13 countries perceive the main opportunities for and barriers to RDI cooperation in the region (Tõnurist and Kattel 2016).

Despite the rather close physical but also relational proximity (perhaps a still somewhat wider distance in governance structures and culture), we identify 5 strategic policy challenges that have influenced both functional proximity and the effectiveness of the BSR-based RDI collaboration policies:

First, it is highly likely in the case of most regions that relational and locational proximity is much higher in scope and depth than functional proximity, as *not all RDI challenges will be of common interest for all regional actors*. In other words, functional proximity is not so much a regional and nation-level characteristic, but potentially a domain-specific phenomenon.

Second, the emergence of collaboration initiatives in BSR through a history of rather ad-hoc actions on different governance level (science-driven bilateral, regional, EU) has created *a rather vast and complex system of different institutions, policy and RDI networks and instruments* that partly overlap (in rationales, target groups, funding etc.), but may at the same time cover only some parts of the broader region (either geographically or in terms of RDI domains).

Third, national and regional interests and priorities are challenged by global drivers of RDI. The concept of scientific excellence is a borderless notion driven by global scientific breakthroughs and collective curiosity and search. Modern innovation dynamics are characterised not so much by competition between national economies and regions, but increasingly by competition between global value chains (GVCs) and their respective production and innovation networks (see here also Coenen et al. 2017). Thus, *functional proximity may also be increasingly superseded by global trends and drivers.*

Fourth, *differences in actual RDI capabilities of different countries/regions* may lead to different interests regarding RDI cooperation: more developed regions may be interested in

building collective critical mass for global competitiveness, whereas less developed regions may be interested in intra-regional convergence and catching-up effects. Especially the latter challenge seems to lead to different expectations regarding the model of RDI policy governance of BSR as a whole: a bottom-up and open-ended governance system to aid the collective search for globally competitive regional RDI specialisations (and functional proximity) vs a more strategically determined and planned system to foster RDI convergence and catching-up as part of regional RDI cooperation. The former model assumes the existence of the critical mass of RDI capabilities that is necessary to take the further steps through cooperation while the latter model focuses primarily on creating the critical mass of RDI capabilities through de-facto asymmetrical cooperation of regional actors with different levels of capabilities. These two expectations co-exist in the EU RDI policies (Horizon 2020 and national policies) as well as in regional policies (European Structural and Investment Funds (ESIF) financed and national initiatives); and both of these policies aim to simultaneously improve both intra-EU convergence and the competitiveness of the EU as a whole.

Fifth, while the EU, national and regional policy makers try to set best strategies and coordinate the actions of different governance levels, the *perceptions and actions of scientists and innovators* working in this multi-level arena of RDI policies are as important in determining the actual content and implementation of strategies and policies. In innovation research, it has become relatively common to talk about the combined impact of "policy mixes" co-created by the EU, regional and national policies and initiatives. Recent meta-evaluations of the EU's innovation policy efforts argue that *it is almost impossible to measure and show the impact of single policy instrument on innovation* (Manchester Institute of Innovation Research 2012). The same researchers and innovators often implement several policy instruments in parallel (grants with different rationales and conditions) and therefore give their own meaning and direction to these instruments.

Taking into account these challenges, this study analyses the dynamics of cross-border RDI cooperation in the BSR, tries to identify the success factors as well as the main barriers to such cooperation, tries to identify policy instruments that have fostered cooperation, as well as offer recommendations for improving such cooperation on the EU level as well as in EU15 and EU13 countries.

In sum:

- *Transnational cooperation in BSR should not be taken as granted only because of the close physical proximity. The effectiveness of the BSR-based RDI collaboration policies tends to be increasingly dependent on the ability to cope with the challenges of sustaining functional proximity that is driven by domain-specifity as opposed to regional and/or nation-state specific interests and dynamics.*
- *The key challenges in facilitating RDI cooperation in BSR are strongly dependent on different aims/rationales of RDI that stem from the differences in the development stages of innovation systems of the region as well as from the global and EU-level developments in RDI that sometimes dominate over the drivers of functional proximity.*

- *The interplay of several factors (institutions, incentives, policies etc.) has led to the situation where financial incentives play an increasingly important role in guiding transnational cooperation of RDI performers in BSR countries.*

1.2. Policy instruments and the institutional context of RDI cooperation in ERA and BSR

A substantial number of different intergovernmental, transnational and supra-national RDI networks and institutions exist in the BSR that follow different modes of governance and rationales for cooperation. Lepori et al. (2011; 2014) have provided a framework to analyse the degrees of integration and institutional logics of European (joint) RDI programmes by distinguishing 3 policy-level variables that influence how different initiatives function in practice: a) *policy rationales and goal setting practices* (including specific priorities and legitimacy for this kind of cooperation); b) *organisational or managerial models* (from delegation to single national agencies to transitory coordinating structures, such as joint decision-making committees and supranational funding agencies); c) *funding sources and their management practices* (common pot vs national pot; Lepori et al. 2011, 2014). Departing from the challenge of fostering EU15/EU13 integration in the BSR, Tõnurist and Kattel (2016) have argued that given the extent of divergence of RDI capabilities, the *directionality of cooperation* can be multi- vs unidirectional, running from emulation and lesson-drawing to transnational problem solving; from formal and informal coercion to international harmonisation and policy promotion (Tõnurist and Kattel 2016).

Overall, we can distinguish three models of RDI policy cooperation, as depicted in Table 1. Model 1 (integration logic) refers to the transfer of competencies from a national to a higher institutional level, together with which a certain level of power disparity and centralisation of decision-making processes also occurs. In contrast, Model 3 (collaboration logic) relies upon decentralication strategy, whereby national actors/partners act as the dominant actors on an ad-hoc basis and often for a limited time. There are no significant power disparities that would allow imposing policy choices on each other. Model 2 (coordination logic) entails certain elements to form a more lasting relationship between cooperation partners.

Table 1 Institutional logic for joint programmes

	Model 1 Integration and vertical convergence	Model 2 Coordination and horizontal convergence	Model 3 Decentralised collaboration
Underlying rationale and legitimacy	Concentration and integration in transnational arenas to achieve a critical mass	Cooperation and competition in multi-level policy arenas; Subsidiarity: to capture benefits of each national system and to create learning effects from transnational cooperation	Promoting research collaboration to strengthen the national research basis; Decentralisation strategy

	Model 1 Integration and vertical convergence	Model 2 Coordination and horizontal convergence	Model 3 Decentralised collaboration
Convergence mechanisms	Vertical convergence via international harmonisation (multidirectional) and/or coercion (unidirectional)	Horizontal convergence via transnational communication, transnational problem-solving; Multi-directional	Horizontal convergence, either via unidirectional or multidirectional cooperation oriented on emulation & lesson-drawing
Organisational model	Joint programmes managed by a supranational agency that is fully in charge of all programme functions	Joint programming initiatives with variable geometry and levels of commitment	Ad-hoc agreements between national funding agencies; light and transient structure for joint decision-making
Funding model	Common pot (no national return rules)	National-pot or national pot with EU top-up funding	National pot
Funding source	National budget based on fixed contribution or European budget	National budget, possibly with additional EU contribution	National budgets

Source: Authors adapted version from Lepori et al. 2011; 2014; Tõnurist and Kattel 2016.

Table 2 provides an overview of the main existing instruments and their logic in supporting cross-border and transnational cooperation and networking in BSR. A detailed overview (including references the Table is derived from) is presented in Appendix 1.

The transnational policy initiatives of BSR have strong roots in horizontal coordination type cooperation initiatives (e.g. CBSS, HELCOM; see Kern 2011). Yet, it has also been argued that the considerable variety and overlap of initiatives and institutions are indicative of a lacking political will to set up a coherent policy mix for the BSR and "*it is much easier to set up institutions than to get them working properly*" (Bengtsson 2009, 6).[3] The more bottom-up-driven policy evolutions have resulted in competition between very specific interests and agendas of different nation-states (Jouanneau and Raakjær 2014). As a result, most innovation-related cooperation is said to be short-term and project-based (Jauhiainen 2014, 64; Technopolis 2011).

[3] At the policy-making level, the aforementioned problems are said to be overestimated, see Vitola (2015).

Table 2 Overview of the main instruments and their logic to support cooperation in ERA and BSR

Level of coordination	Main instruments	Key examples	The mode of governance and level of integration
Global level		Not explored in this study	
Supra-national level	The EU, incl. the European Research Area	FP7 and H2020	Supranational state model
Supra-national level	The EU, incl. the ERA	PPP Partnerships: JTI	Integration and vertical convergence
		P2P Partnerships: JPI	Coordination
		P2P Partnerships: Art. 185 BONUS and BONUS+	Integration and coordination
		P2P Partnerships: ERA-NETs	Coordination (multi-directional), whereas financial integration has increased
		Widening Participation, e.g. ERA-Chairs, Twinning, Teaming	Collaboration/coordination (strongly unidirectional)
Supra-regional level	The macro-regional cooperation in the EU	EU Strategy for the BSR - EUSBSR	Some level of vertical convergence due to reliance on the EU Structural Funds
		INTERREG	
		EC Smart Specialisation S3 in BSR	
Meta-regional level		STRING	Collaboration (multidirectional)
Regional level	Inter-governmental cooperation and transnational policy-making networks	Council of the Baltic Sea States (CBSS) & Nordic Council of Ministries (NCM) (incl. NordForsk)	Collaboration/ coordination (multidirectional); horizontal or vertical convergence (depends on the specific cooperation network in question)
	Inter-organisational cooperation and networks in the region, incl. bi- and multilateral collaboration programmes	Baltic Sea Region University Network (BSRUN); NOVA University Network, BOVA University Network; Baltic University Programme (BUP)	Collaboration and horizontal convergence (multidirectional)

Level of coordination	Main instruments	Key examples	The mode of governance and level of integration
Regional level		E.g. EEA and Norwegian-Estonian Research Cooperation	Collaboration and horizontal convergence (primarily unidirectional)
		E.g. bilateral Estonia-Latvia cross-border cooperation	Collaboration (multidirectional)/coordination (some level of vertical convergence)

According to Table 2, the rationales for cooperation in BSR are varied, from capacity building and emulation to advancing scientific excellence together with strong thematic focuses in the ERA. In addition, the table above reveals that regional cooperation in BSR is to a large extent related to the EU initiatives (funding sources or other incentives for cooperation). This also means that several BSR-focused initiatives do not have a sustainable organisational mechanism in place, especially when they rely on external funding sources. The EU-facilitiated cooperation tends to favour integration and vertical convergence as a prime logic and organisational mechanism for cooperation. Although EU-funded policy and funding instruments are based on a variety of different models, there is a growing concentration (if judged by the models underlying new instruments within H2020) towards the integration model. The meta-regional and regional instruments in BSR follow coordination and decentralised collaboration models. This implies that there is stronger integration towards the EU compared to BSR visible in the set-up of instruments.

On the positive side, a number of studies highlight that the Europeanisation of RDI policies and EU-level strategy-making processes may have been an additional driver for transnational cooperation in the region, especially in the environmental and maritime issues (Kern 2011; Bengtsson 2009, 6-7; Kern and Gänzle 2013). These studies acknowledge that the increased role of the EU in the region may have had a twofold effect:

a) it may have supported the adoption of a more dynamic and coherent multi-level governance model in the region,
b) but it may also have further intensified the coordination problems between different organisations and government levels inside the region and between the EU and regional levels.[4]

Further, European Structural and Investment Funds (ESIF) are an important driver of RDI cooperation in the region, especially in the case of EU13 member states. According to the previous studies, during 2007-2013, ca 2/3 of the ESIF of the BSR were concentrated in the Baltic States and Poland, where they have been used as a substitute for national funding of core RDI activities, as well (Jauhiainen 2014; Technopolis 2011; Vitola 2015). In the Nordic countries, the EU funds have been more oriented towards different EU joint initiatives such as

[4] For example, some argue that the success of the BONUS progamme stems from its relatively long continuity, reinforced by the EU's institutional guarantees for coordination between states, but the full integration (in particular, the real common pot) is perceived rather negatively by different stakeholders due to the *juste retour* problems. See Burbridge et al. (2014), 7-8, 38, 57.

ERA-NETs, Art 185 (Tõnurist and Kattel 2016, 6). The impact of the recent financial crisis and subsequent austerity trends have only increased this division, as the countries hit hardest by the crisis have been even more prone to substituting national funding with ESIF and hopes for H2020 success (Veugelers 2014). This has created threats that especially EU13 may be undercutting its basic RDI capabilities that are a necessary precondition for functional proximity driven RDI cooperation.

In sum:

- *According to the internal logics of RDI-cooperation-supporting instruments, three types or models can be distingushed: integration, coordination and collaboration.*
- *Although the EU-funded policy and funding instruments are based on a variety of different models, there is a growing concentration towards the integration model. The meta-regional and regional instruments in BSR follow coordination and decentralised collaboration models. This implies that there is stronger integration towards the EU compared to BSR visible in the set-up of instruments.*
- *In BSR countries, the ESIF instruments have been used rather differently. In Nordic states, these focus more on the integration of ERA; in the Baltic States and Poland, these focus more on building up the capabilities of their national research systems and are used as substitutes to national instruments.*
- *The variety of policy instruments available in BSR has created more funding opportunities for individual RDI actors, but also added difficulties to steer the cooperation towards stronger functional proximity and maintain the coherence of RDI systems.*

1.3. Funding of R&D cooperation in BSR

Considering the overall R&D funding, BSR as a region has substantially increased its total R&D funding to almost 37 billion euros in 2014, thus forming 11.4% of total EU expenditures. Leaving out the three German Länder, the rest of the BSR has grown in terms of R&D expenditure from 26 to nearly 34 billion euros (Table 3).

This growth has been driven by Sweden, Denmark and Germany, as in Finland, R&D expenditure continued to increase during the crisis years but reversed afterwards when both government and business investments started to decline (OECD 2017). Among the EU13 members, Poland and Lithuania have also increased their investments into R&D, but in Estonia and Latvia, similarly to Finland, a decline after the crisis is seen (following a small rise in Estonia in 2015). However, the historic top investment levels in those countries have been still not achieved later. In Latvia, decreasing business expenditure while government spending has increased causes this; in Estonia, besides business investments also government investments into R&D have decreased more recently.

Table 3 Total intramural R&D expenditure (GERD, Million eur)

GEO/ TIME	2007	2008	2009	2010	2011	2012	2013	2014	2015
DK	5871	6701	7066	7093	7299	7590	7686	7869	8054
DE (3 Länder)	NA	NA	NA	NA	3909	NA	NA	4190	NA
EE	174	208	197	233	384	381	326	287	303
LV	126	142	85	109	141	147	140	163	152
LT	233	258	224	220	283	298	332	377	387
PL	1764	2194	2096	2608	2836	3430	3436	3864	4317
FI	6243	6871	6787	6971	7164	6832	6684	6512	6071
SE	11608	12314	10683	11870	13157	13891	14406	13612	14581
Total	NA	NA	NA	NA	35174	NA	NA	36874	NA

Source: Authors' calculations based on EUROSTAT

Of the total BSR, Sweden invests 36.9% into research and development, Denmark 21.3% and Finland 17.7% (Figure 1), Poland and the three German states contribute similarly close to 11%, and the financial capacity of the Baltic States is still marginal (1% Lithuania, 0.8% Estonia and 0.4% Latvia). As the analysis in subsequent chapters will show, the activity level (participations, funding shares etc. comparatively to the sizes of the research systems) of Baltic countries in different BSR (but also EU) cooperation programmes is much larger compared to the financial capabilities of their innovation systems.

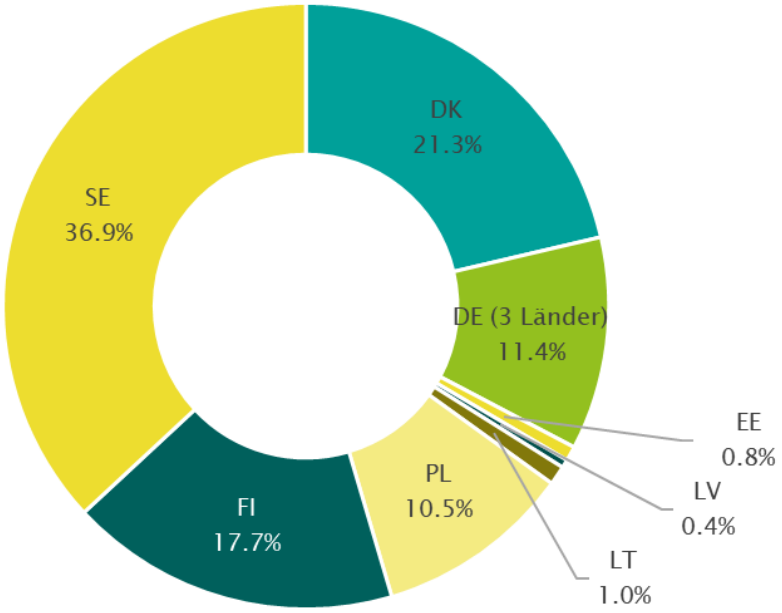

Figure 1 Share of countries in total R&D expenditure of BSR region in 2014

Source: Authors' calculations based on EUROSTAT

It is evident that the R&D systems in different countries depend on the international (abroad) funding to a different degree. Especially for the EU13, international funding sources (e.g. Horizon 2020 projects, including other instruments in Table 2, international business

contracts, funding from international organisations etc.) are increasingly important. On average, the EU13 country group finances 22–24% and the EU15 country group 11–13% of their R&D expenditure from abroad (Figure 14 and Figure 15 in the Appendix). In the EU15 countries belonging to BSR, the funding level from abroad is highest in Finland (17%) followed by Sweden and Denmark (ca 7%) and Germany as a whole (ca 4–5%). As the countries report ESIF sources differently among intramural and abroad R&D funding types, the dependence of EU13 countries (especially the Baltic States and Poland) can be even larger, considering the focus of ESIF on R&D in these countries.

More specifically, also the Horizon 2020 contributions play different roles in different countries (within the funding from abroad; see Figure 16 and Figure 17 in Appendix 2). As expected, H2020 is more important for smaller member states, where it is comparable (as total EU contribution for the period 2014–2016) to the annual amounts of total funding from abroad (Denmark), or even higher (Estonia). The relative importance of Horizon 2020 in the international funding is still higher in the EU15 countries, especially in the BSR region. Among moderate innovators, it is very high in Estonia and much lower in Poland, Latvia and Lithuania.

The magnitude of EU funds has grown for the BSR region as a whole (Table 4), and this trend is observable also in areas that can be considered core topics of BSR (environment, energy, maritime research etc.). Widening instruments have become less relevant for the whole BSR region, but ERA-NETs, for example, have gained in importance compared to the period of 2007–2013.

Larger regional-level programmes have often started as a single project (BONUS ERA-NET and BSR InnoNet) and grown into programmes of a much larger scale, like BONUS EEIG with a budget of 100 million eur for 2014–2017 and BSR Stars with a budget of 280 million for 2014–2017 (integrated with INTERREG). This observation for BSR coincides with Lepori et al.'s (2014) conclusion that the EC practice of establishing a set of instruments enabling different levels of integration (from ERA-NET to ERA-NET plus to Art 185) was a good strategy, *allowing the integration to evolve* compared to the alternative approach of stronger commitments that are the pre-conditions for, e.g., intergovernmental treaties. This is particularly important in BSR cooperation, due to varying financial capabilities among the countries involved.

The smaller (university) networks, e.g. BUP (with 74 member universities from BSR countries plus Ukraine, Belarus, the Chech Republic, Slovakia), are relevant for networking, teaching, mobility of students etc., but much smaller in scale and financial relevance. Sometimes these have a narrower thematic focus, e.g. NOVA (The Nordic Forestry, Veterinary and Agricultural University Network with 6 member universities) and BOVA (The Baltic Forestry, Veterinary and Agricultural University Network with 4 member universities) are focused mainly on education cooperation and mobility in specific fields, but also organise joint activities. Being historically among the first networking platforms for several universities, they are still considered relevant by the interviewees. However, the increasing number of networking possibilities outside these networks, together with often constrained human and financial resources, have reduced their relevance over time, causing also smaller and varying budgets, which often consist of different fundraising activities and project applications. More recently, discussions have started among

the members about the potential of these networks to enable scaling up the small focused research groups in both Baltic and Nordic countries through combining their research capacities for larger-scale project applications and activities. The relevance of these instruments is thus still underestimated by financial figures only, as besides functional proximity these networks increase relational proximity in BSR.

Table 4 Overview of the funding of main instruments to support cooperation in the Baltic Sea region

Level of coordination	Instruments	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Supra-national level (EU, ERA)	Societal Challenges	**1666.8** (ENV – Environment (including Climate Change) 168.4, SSH – Socio-economic sciences and Humanities 71.9, KBBE – Food, Agriculture, and Biotechnology 215.0, HEALTH 551.3, SEC – Security 163.6, ENERGY 266.4, TPT – Transport (including Aeronautics) 230.3)							**1014.5** (ENERGY – Secure, clean and efficient energy 241.9, ENV – Climate action, environment, resource efficiency and raw materials 140.8, FOOD – Food security, sustainable agriculture and forestry, marine and maritime and inland water research 131.0, HEALTH – Health, demographic change and wellbeing 226.5, SECURITY – Secure societies – Protecting freedom and security of Europe and its citizens 51.8, SOCIETY – Europe in a changing world – inclusive, innovative and reflective Societies 41.9, TPT – Smart, green and integrated transport 180.5)			
	Excellent Science	**1240.1** (ERC – European Research Council 618.0, INFRA – Research Infrastructures 161.8, PEOPLE – Marie-Curie Actions 460.3)							**785.6** (ERC – European Research Council 317.2, FET – Future and Emerging Technologies 69.6, INFRA – Research infrastructures 115.7, MSCA – Marie Sklodowska-Curie actions 283.0)			
	Industrial Leadership	**1095.7** (NMP – Nanosciences, Nanotechnologies, Materials and new Production Technologies 375.2, SPA – Space 60.0, ICT – Information and Communication Technologies 660.5)							**436** (Leadership in enabling and industrial technologies (LEIT) 422.7, RISKFINANCE – Access to risk finance 0.4, SME – Innovation in SMEs 12.8)			
	SWAF	**32.3** (Science in Society)							**17.6** (CAREER – Make scientific and technological careers attractive for young people 4.9, GENDEREQ – Promote gender equality in research and innovation 3.9, GOV – Develop the governance for the advancement of responsible research and innovation 4.6,			

Level of coordination	Instruments	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Supra-national level (EU, ERA) *(Continues)*	SWAF *(Continues)*								INEGSOC – Integrate society in science and innovation 3.1, RESACCESS – Develop the accessibility and the use of the results of publicly-funded research 0.0, SCIENCE – Encourage citizens to engage in science 0.1, SWAFS-CROSST – Science with and for Society – Cross-theme 0.8)			
	Other	**404** (General Activities 11.4, Joint Technology Initiatives 220.3, Nuclear Fission and Radiation Protection 39.6, Fusion Energy 0.3, Research for the benefit of SMEs 132.5)							**42.6** (without pillars in eCORDA)			
	incl PPP (JTI)	220.3							139.5			
	incl P2P (JPI)								**8.4** (PCP 4.8, COFUND-PCP 3.6)			
	Incl P2P (Art 185)	BONUS ERA NET **3.3** (2003-2008)		BONUS+ **22**								
				BONUS EEIG **100**								
Supra-regional level	SEWP	**126.5** (INCO – Activities of International Cooperation 7.1, REGIONS – Regions of Knowledge 22.4, COH – Coherent development of research policies 1.7, REGPOT – Research Potential 95.3)							**45.9** (Era-Chairs:14.6; NCP 0.8; Twinning 11.9; Teaming 18.1; Cross-theme 0.5, NCPNET – Transnational networks of National Contact Points 0.8)			
	ERA-NETs	**29.2** (CSA-ERANET 0.2, CSA-ERA-PLUS 28.9: ENV CSA-ERA-PLUS 0.5, SOCIETY CSA-ERA-PLUS 7.8, INFRA CSA-ERANET 0.2, FOOD CSA-ERA-PLUS 1.9, General CSA-ERA-PLUS 2.5, LEIT CSA-ERA-PLUS 0.4, ENERGY CSA-ERA-PLUS 5.0, TPT CSA-ERA-PLUS 1.7, ERA CSA-ERA-PLUS 0.3)							ERA-NET-Cofund **58.6** (Excellent Science 3.2, Industrial Leadership 2.7, Science with and for Society 0.7, Societal Challenges 52.0)			
	EUSBSR	BSR InnoNet **2.4** (FP6), BSR-CBP **0.3**				StarDust **6.5+9**			BSR Stars **278.6**, INTERREG **359** (overlap 66.6 as of mid-2015)			
	INTERREG	INTERREG **302** (total programme)										
	S2E								Coordination instrument			
Meta-regional	STRING								**4.2** (additional to BSR/INTERREG)			

Level of coordination	Instruments	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Regional	CBSS	NA										
	NCM, incl NordForsk	NA (annually NORDFORSK ca 14[5])										
	BSRUN	Membership fees only (estimated annual budget 0.026)[6]										
	NOVA[7]	0.8	0.79	0.8	0.87	0.82	0.67	0.28	0.3	0.4	0.4	NA
	BOVA[8]	0.1	0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
	BUP	6.8	6.7	8.1	6.5	5.9	3.9	4.7	5.2	5.9	NA	NA

[5] Estimate based on: Nordic R&I cooperation: Achievements and Challenges – NordForsk.

[6] The budget is not available, estimate is based on annual membership fee (2017-2019) of 1000 eur and 26 signed members (although the member list on the organisation's website counts 39). http://bsrun.org/sites/default/files/uploads/warsaw_12_january_2017_steering_committee_meeting.pdf.

[7] Budgets based on annual reports 2007-2016, available at https://www.nmbu.no/en/students/nova/about/documents/annual-report.

[8] Estimated budgets are composed from member fees of 18,000-23,000 eur and fundraising activities, based on reports available at http://www.bova-university.org/about/other-public-documents.

Given these differences in the importance of foreign and especially EU funding mechanisms for RDI, a crucial issue in analysing the effectiveness of transational-cooperation-oriented RDI policy instruments and the overall policy mix is whether the locational proximity of a specific region (in this case BSR) is complemented by relational and functional proximity:

- Functional proximity implies the existence of common interests (both substantive and financial) regarding RDI cooperation in specific RDI fields, e.g. food, health, energy, transport, environment, civil security, safety, maritime affairs, science and education, culture (Figure 2). Based on the H2020 experience so far, it can be argued that the functional proximity among BSR countries is more strongly seen in "excellence-oriented" H2020 instruments compared to the "widening" instruments.
- Relational proximity entails the coherence of incentives and rationales on the organisational/programme and actor levels (e.g. whether actors share similar rationales among themselves and with funding agencies and policy makers; Etzold and Gänzle 2011; see also Liuhto 2014). For example, while instruments connected to EUSBSR and BONUS focus on the Baltic Sea as a key object of research and cooperation, in other initiatives BSR is rather a place or platform for cooperation (eligible territory) driven less by functional proximity than political and policy imperatives.[9]

Overall, the new EU initiatives assume greater functional and especially relational proximity in terms of govenance regulations and processes as, e.g., PCP and PPI Cofund activities require joint planning and evaluation of procurement activities (Table 12 in Appendix), which seem to be remaining out of the capability limits not only for Baltic States, but also for EU13 in general (see Figure 18 to Figure 23 in the Appendix).

[9] Burbridge et al. (2014), 49-50.

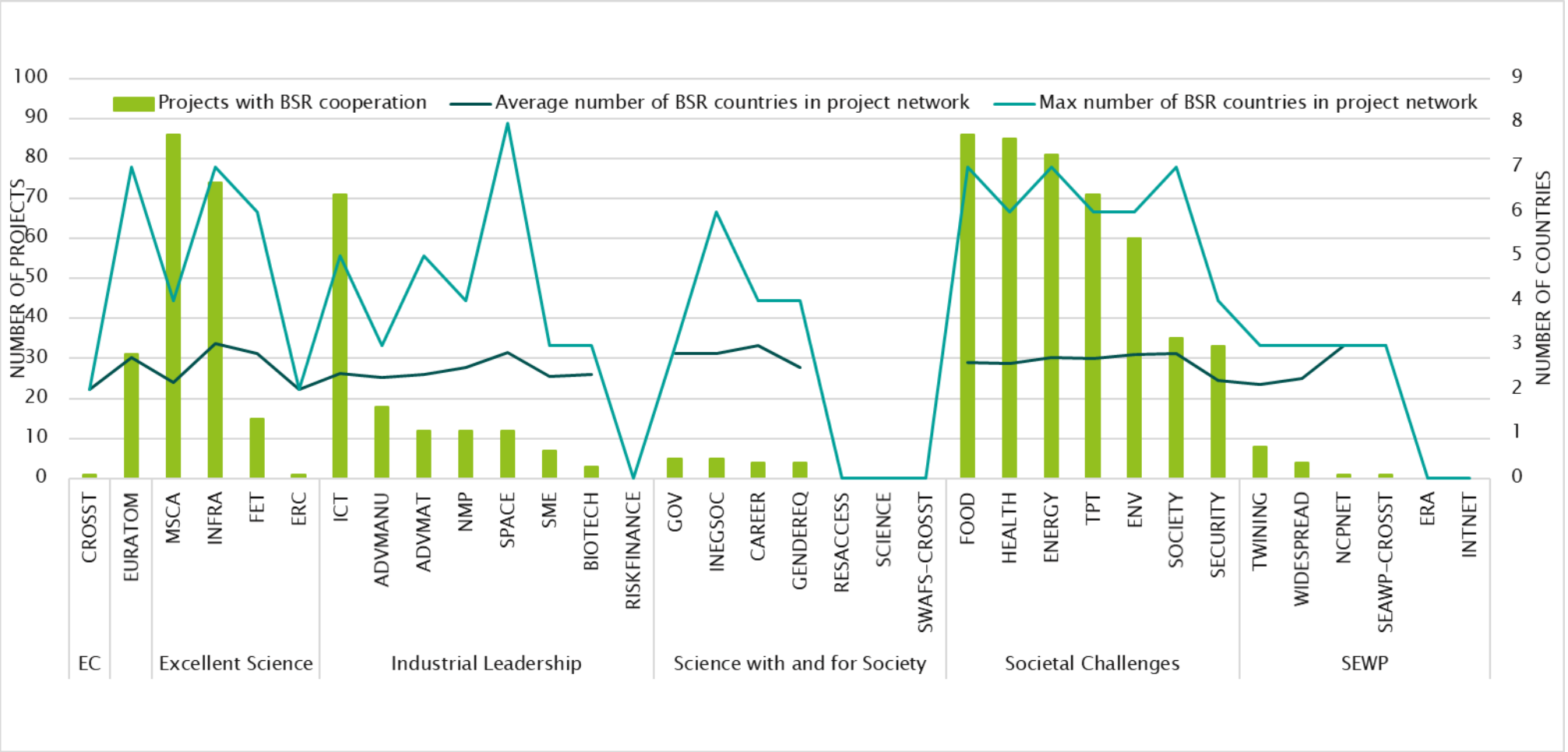

Figure 2 BSR cooperation in H2020 projects by thematic pillars

Source: Authors' calculations based on eCORDA. Note: The minimum number of BSR partners in a project is two.

In sum:

- *The dependence of National Innovation Systems of BSR countries on external funding sources is more than twice as large in EU13 compared to EU15 countries.*
- *Based on the financial volumes (and corroborated by the interviews), the EU funding and respective strategies are driving much more the BSR RDI cooperation dynamics than the meta-regional or regional instruments.*
- *The functional-proximity-based cooperation in BSR is currently realised more via the so-called "excellence-driven" EU policy instruments as opposed to the "widening" instruments, which focus on ohter rationales and incentives.*
- *Among BSR countries, orientation towards and reliance on the H2020 funding is relatively larger in Denmark and Estonia.*
- *EU funding has allowed the BSR instruments (e.g. BONUS, INTERREG) to evolve into larger and stronger commitments, which can form a potential basis for even stronger instruments (e.g. intergovernmental ones) in the future.*

2. Mapping RDI Cooperation in ERA and the Baltic Sea Region

This chapter aims to answer the following questions:

- *What countries and institutions are cooperating within the ERA and Baltic Sea instruments?*
- *How intense is cooperation and what is the role of institutions, enterprises?*
- *What factors hinder the widening in ERA and BSR activities?*
- *What factors support the creation of the ERA and BSR cooperation?*

2.1. Country-level cooperation patterns and integration of BSR

Small countries seek expertise through international networks, which is necessary for scientists in those countries to avoid insulation in increasingly specialised fields of science (Luukkonen et al. 1992). Therefore, small countries often try to integrate into international cooperation networks also more widely, which can compromise the depth of integration. As many BSR countries are small, the integration patterns vs isolation patterns are relevant. We use here the segregation indexes and their dynamics to assess whether the BSR, but especially the EU13 countries in the region, have achieved wider integration within ERA or BSR science cooperation (which they are aiming at) or not.[10] The empirical results show that the segregation of BSR countries in the H2020 programme has increased (similarly to the total participation of EU13 countries) – the dissimilarity index has increased from 0.61 to 0.64 (Table 5). The dissimilarity index measures the "evenness" of the distribution, showing the degree to which EU13 countries have concentrated in particular projects.[11] Paradoxically, this growth of segregation has emerged while participation of EU13 members in FP has grown a little – in

[10] The methodology underlying the analysis of the integration/segregation patterns is explained in Appendix 2.

[11] There are no common rules on how to judge or interpret more broadly these indices, for example Marcińczak et al. (2015) suggest adapting commonly used thresholds in ethnic segregation (D < 30 indicating low and D > 60 high segregation) to a lower level in case of socio-economic segregation, thus D < 20 indicating low and D > 40 high segregation. Following this suggestion, D values show high and growing segregation/concentration levels in EU FPs along the old-new membership divide.

FP7, the share of this group was 7.98% and, respectively, in H2020 8.45% of all participations. Thus, one can conclude that while EU13 has managed to gain more funding from FP, this has not necessarily increased the integration of these countries within ERA.

Similar results are also shown by the indexes of isolation and interaction (Table 5). The index of isolation expresses the probability to meet another member of the minority group (EU13 or BSR, respectively) within the cooperation project. It has grown between FP7 and H2020 and shows that the EU13 and BSR members have clustered into certain projects as opposed to widening participation across all types of projects or becoming critical mass members in projects they participate in. The index of interaction shows the probability of meeting (or being exposed to) another member of the majority group (EU 15 or non-BSR member, respectively). The dynamics of the index support our above claims of H2020 being much more complex in the governance forms of instruments requiring greater relational proximity, which limits the wider participation of EU13 (and hence BSR) countries.

Table 5 Segregation index values for the EU13 and BSR participations in Framework Programmes, BONUS and INTERREG

Program/Indicator		Index of dissimilarity (D)	Index of isolation (I)	Index of interaction (Int)
EU13	FP7	0.61	0.32	0.68
	H2020	0.64	0.37	0.63
BSR	FP7	0.61	0.29	0.71
	H2020	0.64	0.37	0.63
EU13	BONUS	0.37	0.32	0.68
	INTERREG	0.27	0.38	0.62
BSR	INTERREG	0.33	0.34	0.66

Source: Authors' calculations based on eCorda, BONUS and INTERREG participation databases

Integration is wider in the case of smaller and regionally/thematically focused programmes (index of dissimilarity for BONUS, INTERREG). This stems from the smaller number of participants, but also the higher participation rates of EU13 members (which in BONUS was 16.61% and in INTERREG 31.14%). However, mainly due to smaller projects and single/few participants, the probability of having other EU13 (moderate innovator) partners in the project remains low.

The segregation indexes give only a very general assessment to the integration trend, limitations of the indicators are related to the fact that the underlying segregation processes are not revealed, e.g. how much of these general trends is attributable to the lower investment in R&D (personnel, infrastructures) by some country groups, less efficient R&D systems and policies, closed networks, but also brain-drain problems due to, e.g., salary or funding gaps (Galsworthy and McKee 2013). Therefore, the thematic, behavioural but also structural participation is analyzed in subsequent sections.

The patterns of participation in H2020 vary quite significantly across country groups. In the case of BSR countries, it is evident that the EU13 countries are involved in H2020 projects where the average contribution per participant and per coordinator is lower, and they mostly participate in consortia led by other countries, rather than as coordinators (Figure 3). Different project budgets might also reflect

the varying salary levels, which, according to the interviewees, hinder taking up the role of the coordinator as well as create the feeling of discrimination among the project partners.

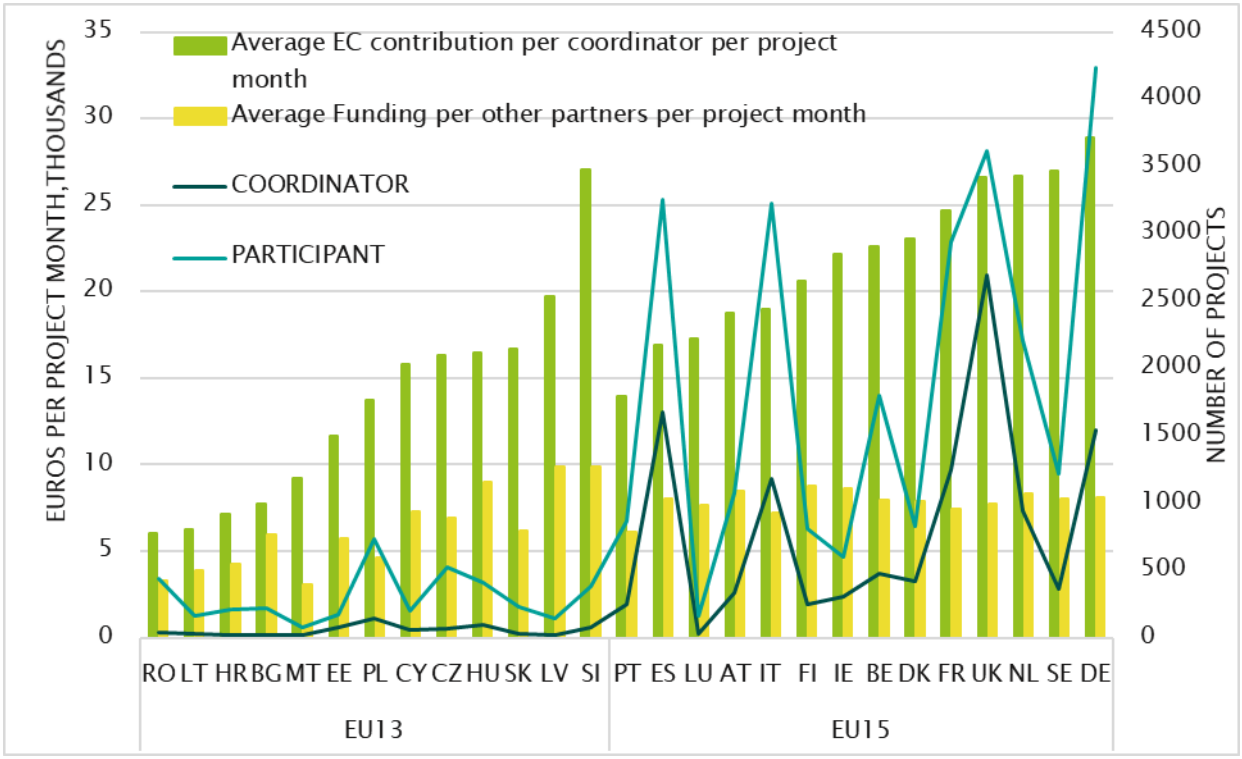

Figure 3 Average funding of participation and coordination in H2020 projects

Source: Authors' calculations based on eCorda.

It is also evident that, in general, researchers from EU13 countries are less successful in getting funding for their projects, both as participants and even more so as coordinators (Figure 4). Some countries (Cyprus, Malta, Estonia) stand out in the EU13 group as relatively more successful as coordinators, but it may be that only relatively few strong applications have been handed in. The relevance of coordinating roles is seen rather in longer and more enduring benefits as in the continuance of the networks; coordinators play a special role, because there are relatively few of them, and they are most influencial in selecting the project members. As larger countries possess higher levels of inter-country collaboration partners, their role as coordinators is reinforced.[12] Other barriers to acquire coordinator roles are discussed in Section 2.4.

In general, the number of applications in H2020 decreased in all BSR countries in 2016 (Figure 26 in the Appendix), probably mainly caused by lower success rates. Therefore, success rates alone do not describe the activity levels, which, based on the interviews, tend to be an extremely relevant factor behind the relative success of Estonia (Figure 5). The new "reality" for applicants, which was not perceived by all interviewed researchers, entails writing even more applications to be successful. Researchers do not perceive this cost as entirely wasted, as less successful applications can be used to apply for other instruments (both, domestic and international).

[12] Commission analysis of September 2011, at the request of the Polish Presidency, see http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2014728%202011%20INIT.

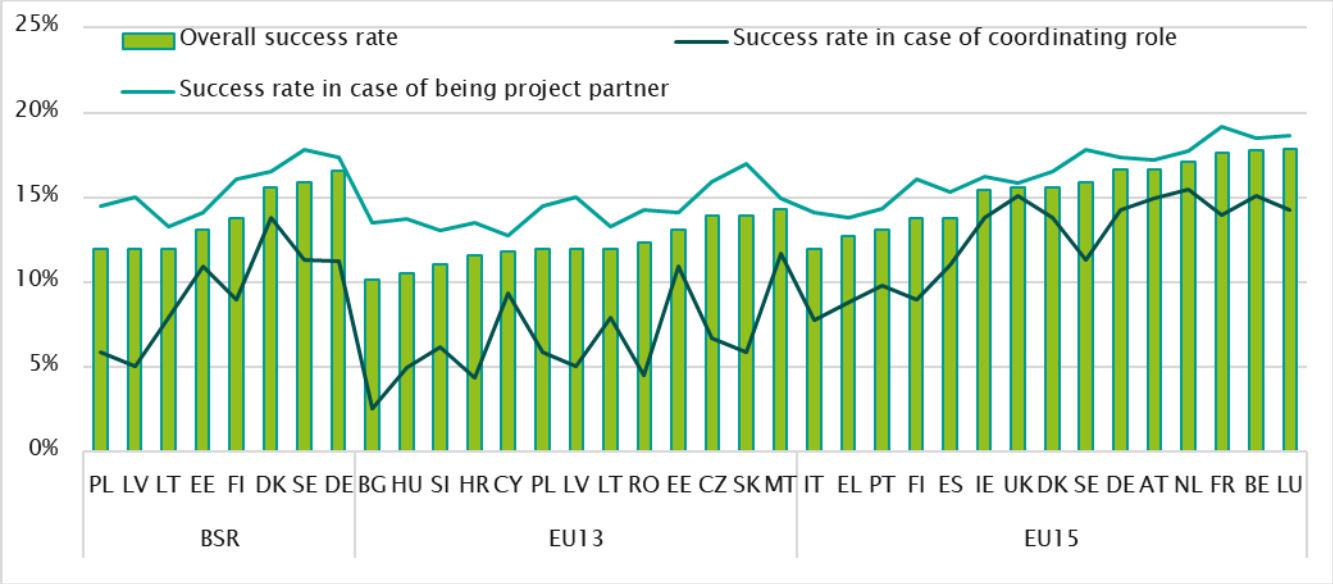

Figure 4 Success rates in H2020 (number of funded projects over applications) by country and role
Source: Authors' calculations based on eCorda.

As indicated by segregation indices, the participation of EU13 countries seems to remain isolated in thematic (BONUS) or regional (INTERREG) cooperation programmes as H2020. In the most recent period (2014-2020), in total 35 BONUS projects have been funded, and innovation leaders (Sweden, Finland Germany, Denmark) have been most active as participants and project coordinators (Figure 27 in the Appendix). Among the moderate innovators, Estonia has coordinated 4 projects (led by main universities) and Poland only one industry-led project; the participations of Latvia and Lithuania have remained much lower.

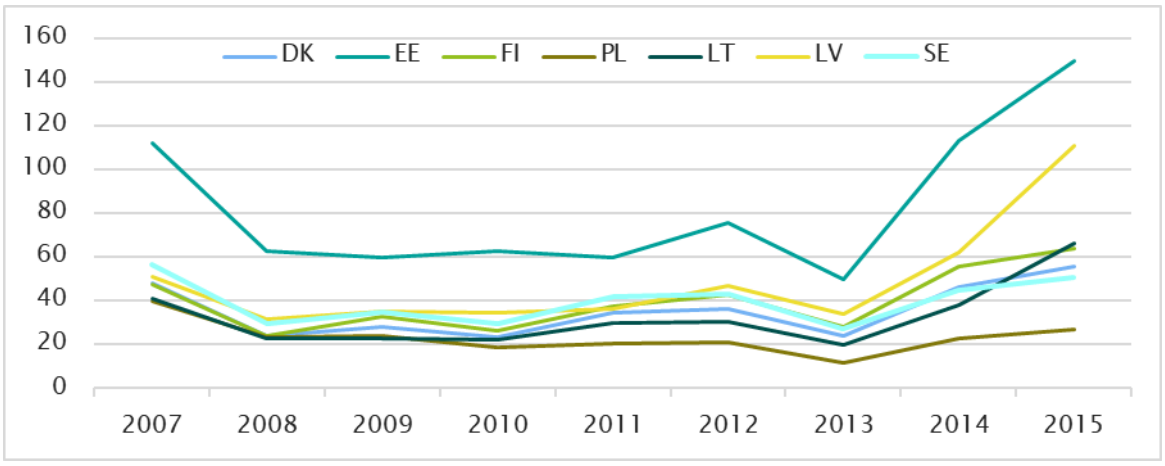

Figure 5 Number of applications to H2020 programmes per 1000 R&D employees FTE
Source: Authors' calculations based on application data from eCORDA and total R&D personnel by sectors of performance, occupation and sex [Table index: rd_p_persocc] from OECD

Recent studies of the impact of BONUS-funded activities between 2009 and 2016 have shown that the participants have achieved relatively higher visibility and productivity in their WoS-indexed publications compared to the general and pre-BONUS level of performance in their respective fields, especially marine sciences (BONUS 2017). However, as it has been generally acknowledged that international co-publication is more productive and visible, it cannot be properly judged what the

impact of BONUS programme has been, specifically in comparison to other international research cooperation programmes. It has been also shown that even in such small projects, as funded by BONUS, the share of publications from a single organisation (or country) were relatively large, pointing to the still more fragmented transnational cooperation.

The recent INTERREG programme round shows different participation patterns again. For example, Poland has been more active than Latvia, Lithuania and Estonia (i.e. 53 vs less than 20 participations in about 1.5 years; Figure 28 in the Appendix). The explanation can lie in the rather different orientations of partners (see also part 2.2) as well as financial commitments of the countries. However, considering the total funding per country, Poland receives smaller funds compared to, e.g., Finland (the largest beneficiary country of BSR). As could be expected, EU13 members, on average, receive less funding per participation (Figure 34 in the Appendix). As discussed above, ERA and BSR cooperation increasingly entails the instruments, where financial commitments backed by national funding are required (e.g. JPI, PCP etc.). Poland is the only country among BSR's moderate innovators to participate in PCP Cofund activities, which points to the greater willingness and capacity to invest in transnational cooperation. The other moderate innovators need to increase their contributions in this field to enter these cooperation activities or, alternatively, they need to catch up even more in FP9.

This brings us to the conclusion that most of the moderate-innovator countries in BSR are operating quite well in the instruments following the logic of decentralised collaboration (Table 1). Yet most of the instruments, increasingly also on the regional level (INTERREG, BONUS, STRING aimed at strengthening the meta-regional funding spaces (STRING 2012) and inter-organisational networks), are designed based on the integrated mode and require greater alignment of different actors in innovation systems. Thus, fragmentation of innovation systems might be a key structural weakness of moderate innovators for further increasing their participation in ERA activities.

In sum:

- *The intensity (relative participation activity) of BSR countries in the EU and also meta-regional activities has increased, but the aims of wider integration of BSR and EU13 into ERA have not been fully realised, in spite of the "widening"-oriented instruments. This result seems to be robust across different funding instruments.*
- *One important set of reasons for this can be the greater requirements of relational proximity that different instruments increasingly assume and which seems to be difficult for EU13 and BSR countries to achieve without structural reforms of their innovation systems.*
- *The other set of reasons is related to the limited willigness of innovation systems' actors (funding agencies, industry, public sector) to financially support and also participate in transnational cooperation initiatives together with research institutions. These differences are visible in respective instruments (e.g. EJP, INTERREG etc.) and are pronounced among EU13 countries.*
- *Higher success rates in H2020 instruments seem to be associated with higher application activity of researchers. In all BSR countries, the application rates have been increasing, but they are still very diverse in the range of 30-150 applications per 1000 FTE researchers annually.*
- *Among moderate innovators, the application rates are lowest in Poland and highest in Estonia, followed by Latvia and Lithuania.*

2.2. Cooperation patterns by thematic fields

In Table 6, the segregation indexes are calculated based on the thematic fields or priorities (as far as these have been comparable between FP7 and H2020). Most importantly, it can be seen that the projects under "Spreading excellence and widening participation" have clearly reduced overall segregation, but at the same time increased the isolation (clustering) of EU13 countries in H2020.

Table 6 Segregation index values for the EU13 participations in FP7 and H2020 by Thematic Priorities

Thematic Field / Indicator	FP7			# projects	H2020			# projects
	D	I	Int		D	I	Int	
Research infrastructures	0.43	0.21	0.79	341	0.47	0.17	0.83	153
Spreading excellence and widening participation	0.57	0.46	0.54	475	0.52	0.53	0.47	118
Leadership in enabling and industrial technologies (LEIT)	0.61	0.18	0.82	3914	0.67	0.28	0.72	2104
Health, demographic change and wellbeing	0.68	0.19	0.81	1006	0.67	0.24	0.76	547
Secure, clean and efficient energy	0.61	0.21	0.79	374	0.60	0.32	0.68	624
Smart, green and integrated transport	0.60	0.21	0.79	635	0.61	0.27	0.73	597
Climate action, environment, resource efficiency and raw materials	0.54	0.20	0.80	494	0.51	0.23	0.77	328
Secure societies – Protecting freedom and security of Europe and its citizens	0.51	0.21	0.79	319	0.57	0.27	0.73	169
Europe in a changing world – inclusive, innovative and reflective societies	0.37	0.22	0.78	253	0.47	0.26	0.74	191
Science with and for society – cross-theme	0.39	0.24	0.76	183	0.39	0.25	0.75	53

Source: Authors' calculations based on eCorda

The other thematic fields show increased (or similar) levels of segregation in the conditions of a smaller number of projects (thus confirming the results of the segregation increase on the more general level shown in Table 5). This again seems to imply that the H2020 measures have so far increased the ratio of funding allocated to EU13, but have had a more limited impact on actual integration between EU15 and EU13 countries.

The vast differences between EU13 and EU15 become even more evident once we look at the EU contributions across different thematic instrument groups (we used here the so-called "Juncker's priorities" four grouping policy instruments) (Figure 30 in the Appendix). In EU13 countries, widening instruments are more visible (Figure 31 in the Appendix) and potentially compensate the overall segregation. As shown in Figure 6, EU15 countries of the BSR seem to perform well in excellent science and societal challenges, and perhaps relatively less so in industrial leadership (compared to Poland, for instance). The Baltic States seem to gain proporatially more funding from societal-challenges priorities than from the scientific-excellence pillar.

More specifically, the widening-oriented instruments comprise a relatively larger number of projects in the EU13 countries of the BSR (especially Estonia and Poland) compared to the EU15 countries of the region (Sweden, Finland, Denmark; Germany does not appear in the BSR region, as the respective

Länder have no projects within this pillar) (Figure 32 in the Appendix). Latvia is a clear outlier here, as a single teaming project has had significant impact on the overall funding level; at the same time, Estonia has been most successful in applying for ERA chairs (Figure 33 in the Appendix).

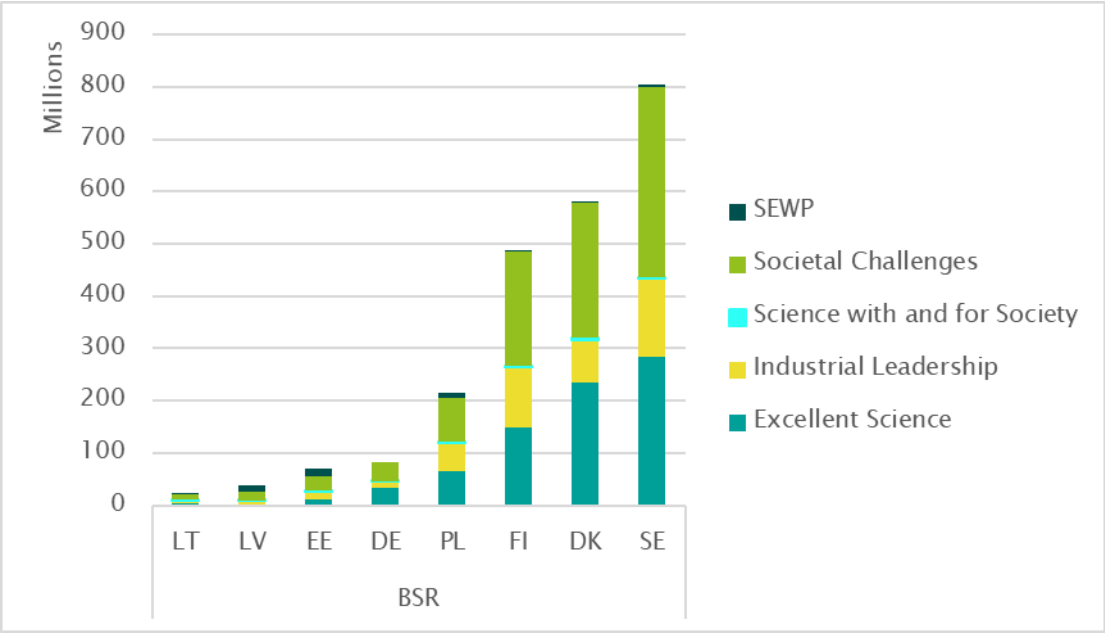

Figure 6 EC Contributions by H2020 thematic pillars, BSR

Source: Authors' calculations based on eCorda.

In the case of thematic instrument groups, the segregation of the BSR country group is highest in widening (because the innovation leaders are not actively involved in this instrument), but also in SME and LEIT instruments. At the same time, in the BSR region, cluster-based regional-innovation cooperation instruments have increased substantially (Table 4) – e.g. from BSRInno Net to BSR Stars within the EUSBSR strategy, but also INTERREG. As a general conclusion, one can argue that the BSR group has a higher degree of isolation compared to the EU13 (as it is a little smaller, too: EU13 comprises ca 17% of HRST of EU28 and BSR ca 16%; Table 7), which suggests that for the moderate innovators, cooperation with other EU13 members remains still wider in the H2020 framework. Alternatively, it shows that thematically (functional proximity) BSR is more concentrated in H2020 projects, which further highlights the need to discuss the policy tensions of small countries in wider vs deeper integration.

Table 7 Segregation index values for the Baltic Sea Region participations in FP7 and H2020 by Thematic Priorities

Thematic Field / Indicator	FP7			H2020		
	D	I	Int	D	I	Int
Research infrastructures	0.36	0.20	0.80	0.33	0.28	0.72
Spreading excellence and widening participation	0.65	0.43	0.57	0.73	0.60	0.40
Leadership in enabling and industrial technologies (LEIT)	0.50	0.24	0.76	0.55	0.32	0.68
Health, demographic change and well-being	0.47	0.24	0.76	0.50	0.32	0.68

Secure, clean and efficient energy	0.47	0.31	0.69	0.56	0.35	0.65
Smart, green and integrated transport	0.42	0.22	0.78	0.48	0.29	0.71
Climate action, environment, resource efficiency and raw materials	0.45	0.20	0.80	0.44	0.28	0.72
Secure societies – Protecting freedom and security of Europe and its citizens	0.41	0.23	0.77	0.46	0.26	0.74
Europe in a changing world – inclusive, innovative and reflective societies	0.37	0.21	0.79	0.50	0.26	0.74
Science with and for society – cross-theme	0.41	0.25	0.75	0.37	0.24	0.76
Innovation in SMEs	0.59	0.32	0.68	0.87	0.83	0.17

Source: Authors' calculations based on eCorda.

The thematic cooperation patterns showing growing segregation of thematically important fields elaborates the challenge for BSR in developing closer functional proximity within BSR (as discussed in sub-chapter 1.1). The threat that global drivers will supersede the thematic cooperation dynamics based on BSR thematic interests (energy, health, transportation, security) seems not to be realised in H2020. Based on our results, we can argue that the tension between the financial incentives of thematic cooperation via H2020 on one hand and the broader integration to the thematic knowledge base on the other seems to be solved in favour of the first motive. The internal BSR cooperation within the H2020 instruments has also not grown, as the values of isolation indexes are increasing between FP7 and H2020.

In sum:

- *While the share of funding granted to the group of EU13 countries has increased in H2020 instruments, this has had a limited impact on wider integration with the EU15 countries.*
- *In the "widening"-aimed instruments, Estonia and Poland have used relatively more and different instruments.*
- *Financial incentives of thematic cooperation seem to dominate over broader integration to the thematic knowledge base (achieving greater functional proximity).*
- *BSR cooperation within the H2020 instruments has not grown between FP7 and H2020.*

2.3. Cooperation patterns by types of institutions

The average composition of participations by institutional types across H2020 is quite different between EU15 vs EU13. On average, 33% of EU15 vs 26% of EU13 participants come from the higher-education sector (HES); in addition, while 6% of EU15 partners come from the public sector (PUB), in EU13, public-sector participants cover almost 12% of all participants. This correlates partly also with the higher relevance of societal challenges vs excellence in the EU13 projects portfolio. Further, the EU13 has received a proportionally larger share of H2020 funding from the SME instrument (European Commission 2016b; European University Association 2016). Across specific countries, the structure of participants is still quite diverse (see Figure 7), which corresponds to the different institutional set-up of the innovation systems as well as the capacities of actors to participate.

In most BSR countries, universities and enterprises are the main beneficiaries in H2020, which is also one of the characteristics of the innovation systems of these countries. Based on our interviews

among mainly EU13 countries, it is very difficult to draw conclusions for policy-making regarding the role and further potential of enterprises to participate in RDI cooperation initiatives. The firm-level reasons and modes of participation in RDI projects seem to be rather *ad hoc* and diverse, mostly to maximise bets for financing their own core interests. Further, the interviewed persons from the universities have pointed to the low capabilities and financial readiness of enterprises (especially of SMEs) and the lack of motivation (especially of larger companies) to be involved in transnational RDI cooperation projects. It was mentioned by several interviewees that public-knowledge-production-oriented H2020 does not provide a proper format for facilitating university-industry cooperation. In this context, it is also logical that enterprises prefer Single Beneficiary Schemes and good researchers more traditional Research Actions as opposed to Innovation Actions.

For example, in Estonia, only a limited fraction of companies apply for H2020 projects on a regular basis and have become well-known at the international level and are desirable partners in consortia due to the positive references. Based on the preliminary observations, it seems that the reasons for most active enterprises for participating in H2020 projects are more related to personal incentives and interests (e.g. movement of personnel from university to industry) rather than broader institutional context (e.g. finding targeted support for developing prototypes etc.). The latter is especially relevant in the context where the success of SMEs in H2020 has become increasingly dependent on whether the product innovation covered in the project was with a high technology readiness level (TRL) or not. Overall, companies seek to maximise funding, i.e. they try to game the system much in the same way as researchers to compensate for lacking domesting funding, but they are reluctant to collaborate in projects and instruments that may threaten to reveal their comparative advantages to competitors. Thus, while the overall incentives of researchers and entreprises may overlap, the selection of instruments may be rather different and inhibit further cooperation between industry and academia.

Another interesting aspect associated with greater potential for increasing enterprise-level participation emerged from the case of the publicly owned firms in Estonia: the participation in international RDI cooperation projects has been accelerated by the requirement by the owner (the state) to invest 1% of turnover into R&D activities. Overall, the reluctance of the public sector to act as an end-user in proposals still remains an important barrier to participating in and also coordinating H2020 proposals.

Engaging new partners from the business sector, especially amongst SMEs, is hindered (according to the interviewed academics) by their limited understanding of possible wider benefits of international cooperation and H2020 projects as well as their lack of understanding of what could be their own contribution in cases of lacking designated staff with direct tasks related to innovation activities. One additional difficulty for widening the number of companies involved in transnational cooperation has been identified by interviewees as the language barrier, which, especially in the case of project applications involving hosting foreign PhD students or scientists, is a discouraging factor for smaller firms to engage in international cooperation (as both written and oral communication need to be transferred to English). This challenge concerns Estonia and Poland according to the interviews, but it is potentially relevant for other moderate-innovator countries as well.

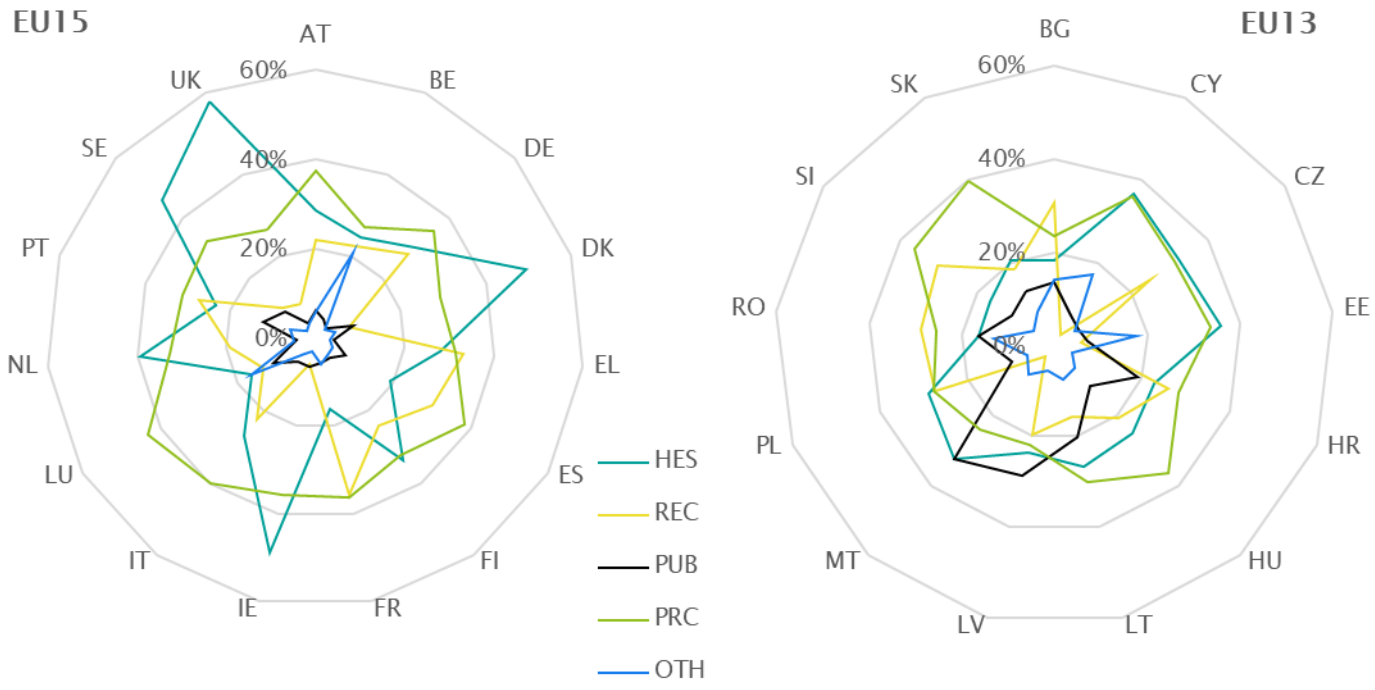

Figure 7 Average funding of participations and coordination in H2020 projects
Source: Authors' calculations based on eCorda.

A more detailed focus on BSR shows further differences between strong and moderate-innovator countries. Across H2020, 39% of participants have come from the higher-education sector (HES), 16% from research institutes (REC), 9% from the public sector (PUB), 31% from private firms (PRC) and 5% are other participants (OTH). As shown in Figure 8, among the moderate innovators in BSR, the relevance of the higher-education sector (HES) is lower than the average (from 34% in Estonia to 24% in Latvia), while among the strong-innovator countries of the BSR, the role of HES has been strongly above average (49% in Denmark and 46% in Sweden). These differences can be explained by the context specifity of respective innovation systems (e.g. while the Estonian system is dominated by universities and private firms, in Poland, public research institutes are still relevant actors). However, public and other sectors generally seem to have lower participation ratios (except for Latvia, where among generally less participation, the public sector seems more active). Of course, one has to take into account that there are very few actors in these sectors in smaller countries (especially moderate innovators). The potential of raising application activity in moderate-innovator countries is quite limited, as they already have much higher activity levels compared to strong innovators (see Figure 34 to Figure 37 in the Appendix). This is caused by the fact that there are relatively few researchers in enterprises as well as public and third sectors in those countries.

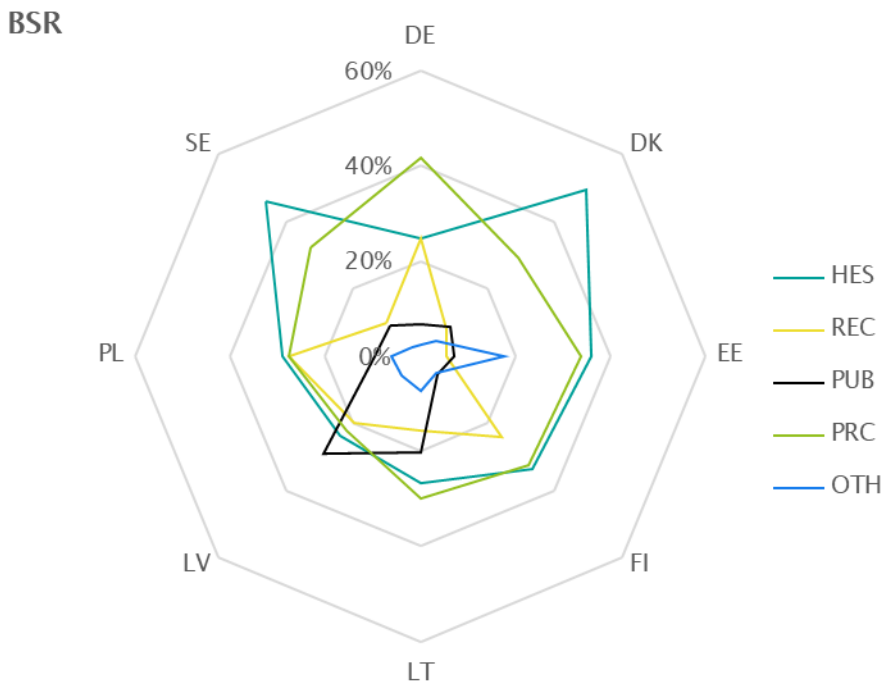

Figure 8 Average funding of participations and coordination in H2020 projects (BSR region)
Source: Authors' calculations based on eCorda.

The latter aspect becomes even more explicit in the analysis of the BONUS programme (Figure 9). It appears that public-sector institutions (PUB), non-governmental institutions (NGOs) and also professional higher-education institutions (PHE) are involved in joint projects only occasionally (single cases). Most BONUS projects have been formed by partners from universities (UNI), public-sector research institutes (REC) and private firms (PRC). Further, while in innovation-leader countries participating in BONUS projects, universities, public-sector research organisations and companies are present in partnerships, in moderate-innovator countries, few companies have been involved, and most project participants are universities (Estonia, Latvia, Lithuania) or public research institutions (Poland, also Russia). Further, the BONUS programmes show rather strong concentration effects – in 3/4 of the 2014-2020 period projects, the coordinator has formed core partnerships with partners from the same country (Table 8). This is certainly the hindering factor for moderate innovators as the fragmentation of their innovation systems is generally known.

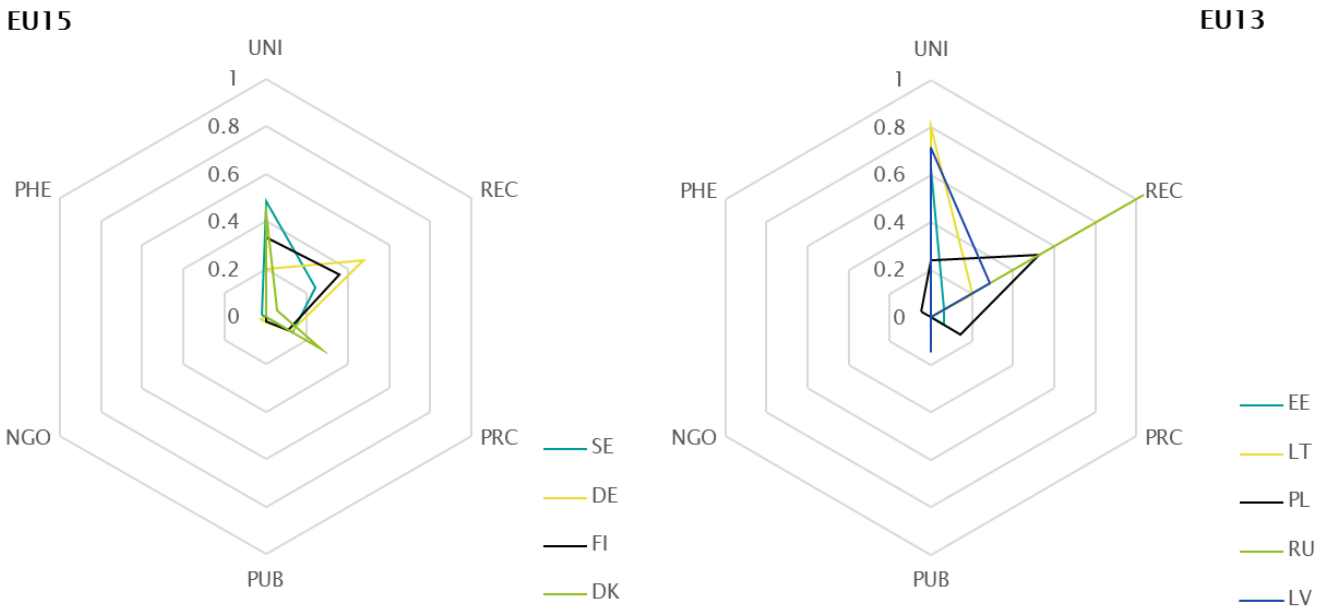

Figure 9. Share of participations by institution type

Authors' calculations based on BONUS projects (https://www.bonusportal.org/projects/)

Table 8 Institutional Partnerships in BONUS 2014–2020 Projects

	Average number of partner institutions per project	Average number of partners from coordinating country	Share of projects with single institutions from coordinating countries	Share of participations from moderate innovators
Ecosystem	11.14	2.43	0.29	0.14
Innovation	5.23	1.69	0.38	0.24
Sustainable ecosystem services	10.13	2.63	0.25	0.21
Bluebaltic	9.43	2.71	0.0	0.08
Overall	6.8	2.26	0.26	0.21

Source: Authors' calculations based on the BONUS project database

Overall, the relative lack of partners from the public sector could be one of the reasons behind the relatively low assessment by users concerning the speed of uptake of scientific knowledge of BONUS projects into policy-making and management (BONUS 2017, 7). The low public-sector RDI capabilities and willingness to invest may also explain the relatively low participation of BSR moderate-innovator countries in the INTERREG programme (see Figure 28 and Figure 29 in the Appendix), which has been geared for the 2014–2020 period towards public-sector innovation-oriented projects (see Figure 10). As this INTERREG programme is a specifically targeted one, the participation pattern cannot be compared to the H2020 and BONUS programmes.

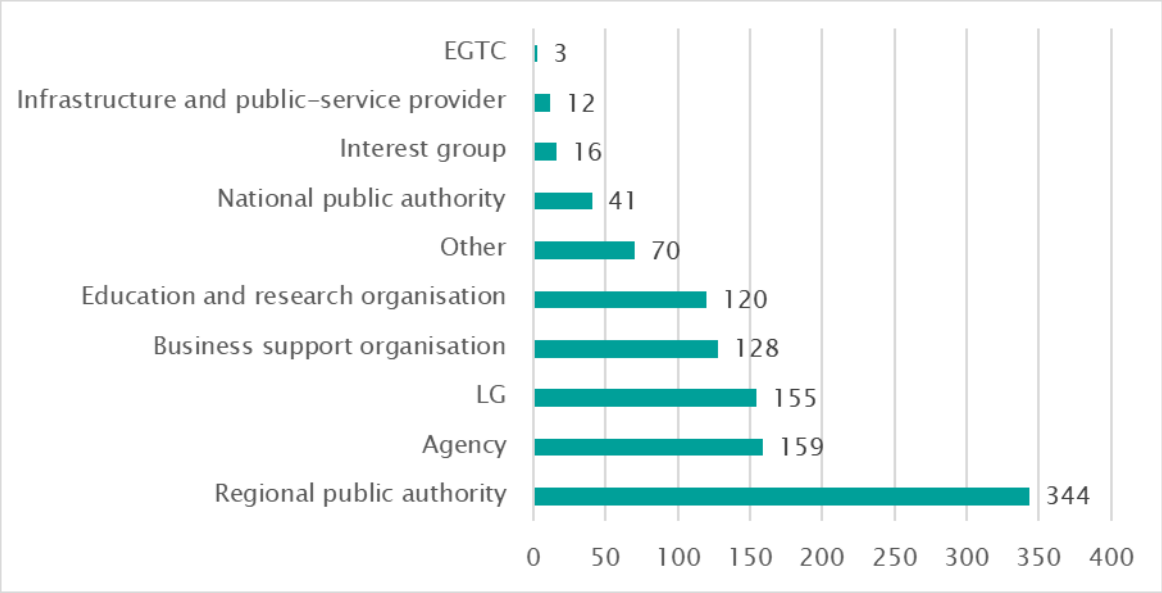

Figure 10. Number of of participations by institution type
Authors' calculations based on INTERREG projects

One university-sector-specific issue in BSR concerns the orchestration of the inter-institutional networks towards more synergy and wider BSR interests. Currently there are several networks, for instance BUP (Baltic University Programme); BSRUN (Baltic Sea Region University Network); NOVA (The Nordic Forestry, Veterinary and Agricultural University Network) and BOVA (The Baltic Forestry, Veterinary and Agricultural University Network). On one hand, this contributes to the institutional richness of the region, but on the other hand, considering the limited capabilities of the few actors in smaller countries, the integraton potential of those networks is under-utilised, especially concerning research arctivities (as our interviews with scientists revealed, they have tried to engage in research activities using these networks, but not successfully – the main focus of these networks has remained in higher-education and management activities). As the universities of moderate innovators increasingly engage in the activities of EU-wide university networks (LERU, GUILD, EUA) and these networks assume commitments from top-level management of universities, there can be a potential danger in weakening BSR cooperation (as can be noticed in the case of BSRUN – in 2010 it involved 39 members, which has decreased to 26 members today). The inteviews with those university managers that have withdrawn from BSRUN pointed to this problem of having to be selective, as the human and financial resources are limited.

In sum:

- *Most of the international RDI collaboration of BSR takes place through universities and enterprises that form the majority of participants in H2020 and BONUS. This reflects the structure of the innovation system of these countries, where research institutes are not so dominant.*
- *The rationales and interests of industry from especially EU13 countries seem to be relatively ad hoc and difficult to generalise: companies seek to maximise funding, but are reluctant to collaborate in projects and instruments that may threaten to reveal their comparative advantages to competitors.*

- *As many funding instruments demand the inclusion of innovation users in projects, this poses a problem for widening the participation of moderate-innovator countries because of the fragmentation of their innovation systems and low capabilities of actors outside the academic sector for international cooperation. The weakest links in all moderate innovators seem to be public-sector institutions, and their low participation is especially visible in the INTERREG, a public-sector-oriented programme.*
- *Limited capacities force the participants to be selective in cooperation projects, which implies that creating new cooperation forms may substitute for the old ones.*

2.4. Barriers to RDI cooperation in BSR and ERA: the perceptions of RDI performers

As can be seen from the analysis above, there still seem to be many barriers to RDI cooperation between the EU15 and EU13 countries and their respective RDI performers. While relying on different methods and varying in their specific focuses, prior studies have rather commonly argued that as the EU13 countries have focused less on reforming their RDI activities and capabilities than the EU15, the key reasons for the low participation of EU13 in the EU funding schemes (FP7, H2020) tend to be structural in nature.[13] This has also been visible in the BSR, where some of the EU15 countries (Germany and Scandinavia) seem to dominate regional cooperation mechanisms (ERA-NETs, EUSBSR, Bonus), and the EU13 countries remain as underrepresented as in H2020 in general.[14]

In the context of BSR cooperation, the BSN as already mapped the main barriers to research cooperation in BSR and defined the main challenges to be tackled[15]:

1. The purpose of research cooperation is to achieve excellent results or solve concrete problems – not cooperation or capacity-building for its own sake.
2. Lack of knowledge about and overview of existing, successful research BSR cooperation projects.
3. The landscape of potential funding opportunities is too crowded and confused – leading to a "where to start?" paralysis.
4. The high level of administrative burdens and lack of flexibility in general when it comes to application for funding and compliance with reporting requirements.
5. Insufficient local support for researchers to deal with administrative issues (from projects' cradle to grave).
6. BSR cooperation often depends on a few key individuals with long experience, personal networks and personal commitment, which makes BSR cooperation as such more vulnerable than, e.g., EU cooperation.

[13] For recent studies, see: *Issue Paper* … (2017), 50; European University Association (2016), 39: *Ex-Post Evaluation …* (2016), 17; European Commission (2016b), 84-85, 90, 100; European Commission (2016c), 6; European Commission (2016c); *Performance of SMEs* … (2014), 96; MIRRIS Interim Report (2014); Schuch (2014); EU-13 – Net4Society (2014); Rauch and Sommer-Ulrich (2012).

[14] On BSR specific studies, see: Tõnurist and Kattel (2016), 9; Bengtsson (2009), 6-7; Gänzle (2017), 4; Kern and Gänzle (2013); Stead (2014), 333; *Evaluation of Joint Programming* … (2016), 24.

[15] Danish Agency for Science and Higher Education (2017). This overlaps rather well with prior studies on Joint Programming Initiatives and other cooperation measures of FPs, i.e. Svanfeldt (2009); *Updated Policy Brief* … (2016), 13-23; European Commission (2016a), 39; *Evaluation of Joint Programming …* (2016), 57; Makarow et al. (2014), 47.

7. Lack of institutional memory and political commitment to follow through with concrete initiatives and sufficient funding to enhance the levels of BSR research cooperation.
8. Insufficient national research funding in general.
9. Existing structures/programmes such as NordForsk and BONUS cover only part of the BSR or only selected research topics.

In general, the previous studies largely concur with the challenges brought out by the BSN study. Though in our reading, the previous analyses have emphasised 4 main structural barriers inhibiting wider EU15-EU13 cooperation in RDI:

First, *insufficient R&D investments in the EU13 countries*. Analyses of FP participation commissioned by the EC (Commission Analysis of September 2011) have concluded that participation is correlated with the national research investments and R&D personnel. The insufficiency of national funding is perceived as the key factor determining the capacity of research performers to design and pursue excellent research projects at the European level (Cressey 2017). In BSR countries (Figure 11), the total R&D investments have recently decreased in Estonia and Finland because of both public- and private-sector investment dynamics, which can even pose a threat to the sustainability of innovation systems (OECD 2017). Looking at the more recent successful countries in H2020 (e.g Portugal), it becomes even more evident that in times of economic crisis and instability, stable and contracyclically moving R&D investments help to avoid "institutional drift", or even exhaustion, within the system (Pinto 2016). According to the recent data, only Estonia and Latvia (in contrast to, e.g., Finland) stand out as countries where declining national funding seems to not have impacted the success rate too significantly, but this has been strongly influenced by the impact of the specifically EU13-targeted "widening" measures (Teaming, ERA chairs; European University Association 2016, 39).

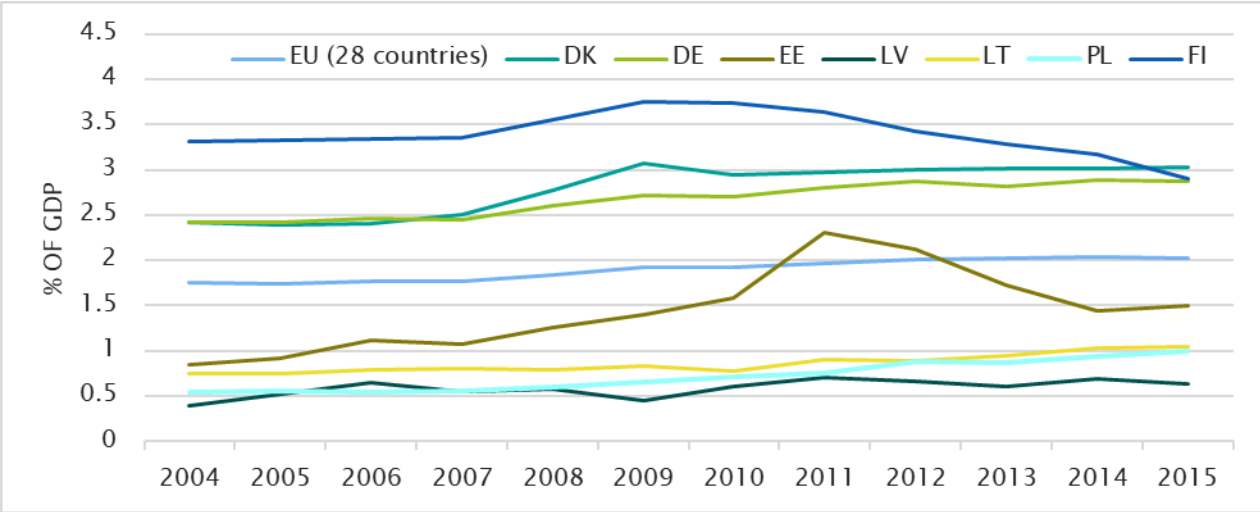

Figure 11 Share of GERD as % from GDP
Source: Authors' calculations based on EUROSTAT

Second, *the gap in variation of wages, even if corrected by the purchasing power, seems to be a major reason why the level of EU research funding from FP per country varies*. In fact, it can account for up to 80% of the total variation in financial returns from FP (Commission Analysis of September 2011). The low salary level is a major reason for dissatisfaction (and source of brain drain) as well as low motivation to take up the role of coordinator in H2020. For instance, the MORE2 study found that

satisfaction with salary and benefits is low among all Estonian, Latvian and Lithuanian researchers, irrespective of their career stage. Considering all other aspects of the work satisfaction, the differences to other EU countries were not pronounced. In fact, regarding the "opportunities for advancement" (highest among EU countries in Estonia) and "mobility perspectives" (highest among the EU countries in Latvia) these countries measure up quite well with other EU members (MORE2 2013). However, it has also been found that in some BSR countries (Estonia, Latvia), mobility patterns are more balanced in terms of in- and outgoing researcher flows, but still more relevant movement from South to North is observable (Schumacher 2016).

Third, *lack of sustainable and functional synergies between national research systems and EU research foci*. Rather surprisingly, EU13 participation has remained lower than that of EU15 even in FP areas with lower competition and sufficient financing, where weaker performers could find possibilities for disproportionally higher funding. In this context, it has been debated whether the predominantly soft ERA support mechanisms (mobility of researchers, transfer of scientific knowledge) will be enough without structural reforms of national R&D strategies and systems to bridge the gap between EU15 and EU13.

Fourth, *insufficient access to existing networks and limited experiences with project applications and management.* It is argued that repeated participation and project coordination experience leads to higher participation rates and success. It has also been stated that "the lower share of EU – 13 is therefore caused not by a bias against the new EU Member States, but rather by a comparably high number of weak proposals submitted by, or with partners from the EU – 13." In other words, EU13 countries should put extra efforts into encouraging their research groups to apply for EU projects, even if in the first stage this will only have learning effects. For example, many universities in smaller countries and EU15 have tried to tackle the gap in participation between EU13 and EU15 by teaming up with more experienced universities in EU15 countries to build solid consortia; however, it is also recognised that entering already established consortia is a significant barrier (European University Association 2016, 24-25).

The stakeholder interviews carried out in the framework of this study confirmed most of the arguments given in prior studies as well as the interpretations of our own analysis of participation dynamics in FPs.

First, the researchers almost unanimously argued that for the EU13 researchers FP projects are needed predominantly for financial survival; however, it is also recognised that success in FP projects functions as a quality or excellence indicator for individual research groups (in applying for some national funds) and researchers (for career advancement). At the same time, the increasing competition of different instruments has meant that even in the case of very good or excellent projects, the final selection of projects has taken the form of a lottery. This may in the long term have a negative effect on the stakeholder motivations to keep applying for funds and to invest into relatively time-consuming attempts to coordinate such projects. As a result, the substantive importance and content of projects may become secondary, next to "gaming" the rules of different funds. Even now, many researchers from social sciences to ICT claim to know situations where already finalised project proposals are "traded" between different types of actors from different countries to increase the probabilities of success. It is fairly obvious that such gaming will be detrimental to

functional cooperation as well as substantive research progress. From the perspective of industry stakeholders, while SMEs seek both finances and some form of tangible results from international projects (to develop new or improved tools, methods, techniques), larger companies seem to emphasise the "technology-watch" function of ERA projects, i.e. participating in EU and regional cooperation projects to stay ahead of the latest S&T developments by establishing networks to gain access to knowledge and expertise; at the same time, faith in the feasibility of the direct commercialisation of results from such research projects seems to be limited (see also European University Association 2016; Astrom et al. 2012, 28-29; *Performance of SMEs …* 2014, 23, 65; Polt et al. 2009, 28-29; European Commission 2016c, 5-7).

Second, regarding the logics of putting together transnational research consortia, researchers from most fields recognise that in H2020 applications, the geographical coherence or logic of projects does not matter for application success as much as the applicability and diffusion of research results. For EU13 research groups, this has created an additional challenge of finding appropriate industry-/market-partners, and while SMEs and public-sector organisations can be found locally, collaboration with larger industry actors often takes place transnationally. While this may be beneficial for ERA-wide knowledge and technology diffusion and networking, finding such partners internationally tends to be an additional barrier for the EU13 research groups and especially for new entrants to the transnational cooperation arena.

Third, regarding BSR-based cooperation, it also seems clear the locational proximity itself is an insufficient driver for RDI cooperation, and BSR-level cooperation is highest in areas with strong functional proximity (e.g. maritime research focusing on the Baltic Sea), i.e. thematic overlaps and joint challenges are important drivers of cross-border RDI cooperation. In other areas, the representatives both from universities and the business sector *do not see broader BSR partnerships within specific projects as a plausible strategy for increasing the success rate in FPs*.

In other words, BSR functions as a uniting platform for collaboration in two ways:

1. The Baltic Sea as *a **thematic joint-interest area*** (e.g. next to marine sciences also other BSR-specific issues where functional proximity could be high, e.g. respondents proposed areas such as near-zero-energy buildings in specific climate conditions, cyber security, bioeconomy, etc.[16]). However, in the context of FPs, these topics need to be sufficiently critical or large enough for the EU to find its logical place. Some scholars argued that by now even the Baltic Sea is not an issue that sufficiently big and critical enough to merit specific focus in FP-funded projects.
2. BSR as a "***common service area***" to engage different actors in common diffusion or application-oriented activities (e.g. joint-development digital textbooks by Finnish and Estonian researchers) or to treat BSR as a "test bed" for global market entry. This perspective would match the H2020 aim to test the projects on a large enough scale.

Fourth, regarding the EU13-focused policy goal of "spreading excellence, widening participation" in ERA, most researchers seem to interpret these measures as political tools that partly contradict the

[16] See also other studies of the BSN that seek to define such common topics.

"normal" ways of transnational cooperation that are predominantly based on scientific excellence, international reputation and long-term network-building. Of course, researchers living under strong financial pressures and constraints are willing to accommodate their behaviour with such funding mechanisms, but they also recognise that this may not be a sustainable way forward if sufficient basic RDI capabilities are lacking both in academia and the market. This seems to be especially crucial for the EU13 countries that would often need stronger investment into infrastructure and basic research capabilities than soft mechanisms of network building, such as COST, Twinning etc. The same seems to apply to the EU's PPP and P2P schemes and similar joint initiatives where top-up funding is needed. Thus, the effectiveness of these measures for EU13 seems to depend to a large extent on the strategic choices and commitments by policy makers: researchers are likely to follow, but not lead, such choices, as entrance to exiting networks requires significant policy-level commitment and financial commitments. Overall, while such soft instruments are necessary for networks building and sustaining ERA, these are not the primary needs of EU13 countries that would need to first invest into their own basic RDI capabilities and allow the RDI systems to mature.

In sum:

- *The widening barriers overlap with general cooperation barriers.*
- *Insufficient R&D investments in the EU13 countries, but also a lack of sustainable and functional synergies between national research systems and EU research foci seem to be the main barriers for widening research cooperation in BSR.*
- *Research performers do not see broader BSR partnerships within specific projects as a plausible strategy for increasing the success rate in FPs. Rather, the basis for alliances could and should be in joint-interest areas or common-service areas in BSR.*
- *Researchers do not perceive widening-instruments as a sustainable way forward if sufficient basic RDI capabilities are lacking both in academia and the market: moderate innovators should invest into R&D basic capabilities as a precondition for wider research collaboration in FPs.*

3. Policy Instruments to Increase Transational Cooperation in BSR and ERA

This chapter aims to answer the following questions:

- *What new programmes are needed to encourage RDI partnerships in BSR?*
- *What instruments could improve the participation capabilities of moderate innovators?*
- *What kinds of instrument designs and managerial practices may be best suited?*

3.1. Stocktaking of recommendations for increasing transnational RDI cooperation in BSR and ERA

One of the key preconditions for achieving active, systemic and wide participation in transnational RDI cooperation is about *stable funding*, as it lowers the dominance of "muddling through" and survival-oriented "maximisation" strategies by researchers and organisations, especially in austerity-driven national innovation systems of the EU. It is necessary for the moderate innovators to embrace

the fact that the welfare of those countries in the longer term is contingent upon the investments into knowledge-based economy (including R&D investmets).

Analysts have brought out several key lessons, which can be suggested to all countries to improve their participation in H2020 (Commission Analysis of September 2011):

- participation should not be increased at any price, overly concentrating on the *juste retour* of finances should not be the goal;
- all research areas cannot be addressed simultaneously, a selective and strategic approach to participation is seen superior;
- a clear national strategic plan is needed, the countries cannot expect immediate results;
- a robust NCP system is needed to support the applicants;
- incentive systems for participants should be based on achievements;
- appropriate alignment of EU and national objectives and synergetic use of ESIF is needed to build advantages.

While the specific policy instruments for increasing transnational cooperation may differ in their rationales, intervention logics, institutional set-ups, scale and scope, we deploy an analytical framework that provides certain coherence for mapping and analyzing such practices. The most common approach for analyzing policy instruments is the typology proposed by Verdung:[17]

1) **regulatory instruments (*the sticks*)**: highest level of state intervention aimed at changing the behaviour of agents either via formulated rules and directives or via so-called "soft laws" such as different non-binding policy documents, strategies, action programmes, etc.;
2) **economic and financial instruments (*the carrots*)**: material incentives (e.g. subsidies, grants) to change the behaviour of agents in the systems;
3) **informative instruments (*the sermons*)**: aiming to change or prevent a certain type of behaviour via transfer of knowledge, communication of reasoned arguments and persuasion (e.g. research-funding to generate new knowledge, but also exchange of information and best practices, knowledge transfer, benchmarking).

Based on Verdung's typology, we provide a taxonomy (see Figure 12) for analyzing the instruments of transnational RDI cooperation. We divide potential cooperation activities between those with potentially high vs low functional proximity while also taking into account that some of these cooperation activities evolve in a bottom-up way and others tend to be driven or mandated by top-down policy initiatives. In this section, we have supplemented the information derived from the expert interviews with the secondary information pooled from the websites of national agencies/ministries and other relevant reports (national roadmaps, previous studies by BSN (Danish Agency for Science and Higher Education 2017) etc.). We try to distinguish "best practices" that the EU13 countries could learn from EU15 countries as well as from each other in tackling the structural barriers for transnational RDI cooperation in BSR and ERA in general.

[17] Bemelmans-Videc et al. (2010), 9-16; for Verdung's implications for innovation/regional policy, see also Borras and Edquist (2013); Uyarra et al. (2017), 604; also Nauwelaers and Wintjes (2002), 209; Colomb (2007).

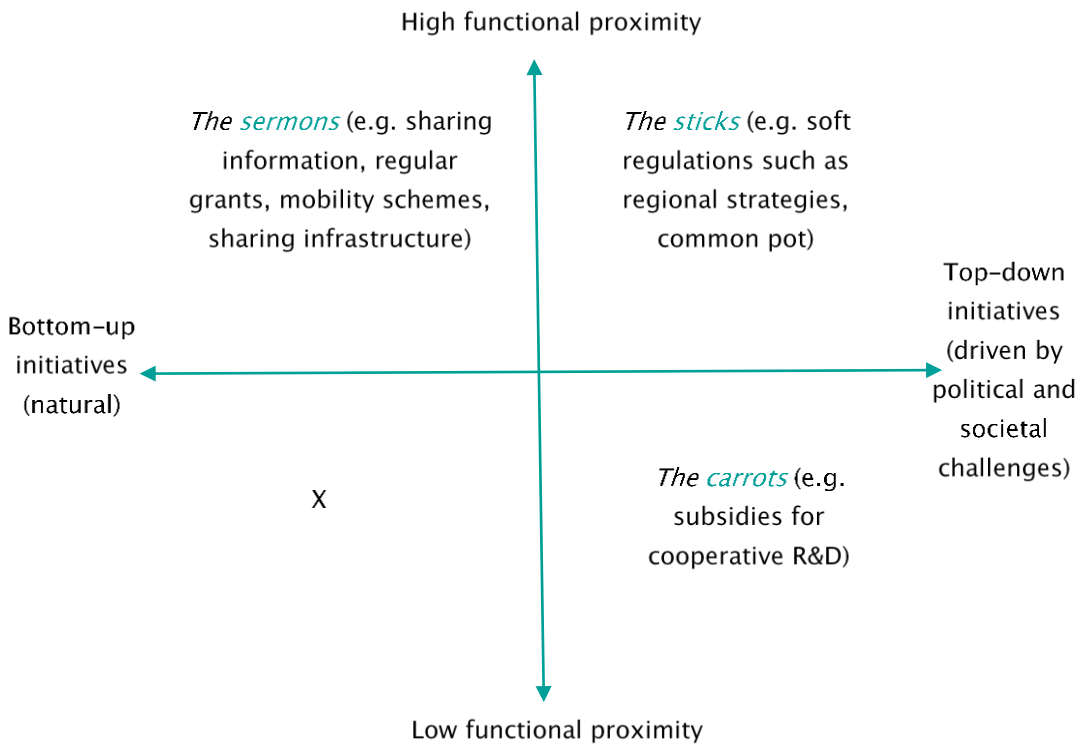

Figure 12. Taxonomy of policy instruments for transnational cooperation in BSR
Source: Authors' compilation

The sticks (regulatory and strategic instruments)

First, it can be argued that greater integration of EU13 into ERA could benefit *from better priority-setting on the national level,* especially in the areas where one can demonstrate unique capacities with sufficient critical mass in terms of infrastructure, data, and scientific specialisations etc. As the existing RDI networks of ERA may constitute considerable barriers to entry (Commission Analysis of September 2011), higher prioritisation is needed regarding the strategic aims for FP participation or internationalisation more broadly (especially in Estonia, Latvia, Lithuania; Klincewicz 2015; Kulikovskis 2015; Ruttas-Küttim 2015; Paliokaitė 2015), along with developing action plans with specific aims and commitments to funding. The attempt to cover as wide a range of networks as possible without sufficient financial and policy-level commitment is not seen as a viable strategy by national experts and may lead to a negative image and perception of the EU13 countries in the transnational cooperation networks, as well (Danish Agency for Science Higher Education 2017).

As a good example, Ireland has set specific strategic aims and operational targets per each pillar of H2020, which makes it possible to communicate national aims to researchers, but also to secure the necessary funding for supporting these activities, assess and give tailored advice to achieve the targets (Technopolis 2016). Also, innovator countries from BSR seem to emphasise a high level of prioritisation and scientific excellence as a prime underlying rationales, often going beyond BSR and ERA, both in terms of thematic and financial rationales.[18] In fostering transnational cooperation,

[18] E.g. The web-page of the Innovation Fund Denmark, https://innovationsfonden.dk/en/investment/international-collaborations; European Commission (2017a), 6; *Finland as a Part …* (2016); information retrieved from expert interviews.

strong emphasis is given here to the areas that are related to the long-term core national R&D competences, e.g. the Danish national programmes Grand Solutions, or Innobooster, and the provision of (big) national grants for "virtual research centres" to support the creation of critical mass in interdisciplinary research areas.[19] As the latter programme was established before H2020 (together with a strong focus on horizontal issues), it has provided an additional basis to support the country's competitiveness in H2020 afterwards.[20] Another noteworthy common practice of the innovator countries of BSR concern the support for participation in the EU initiatives via cross-sectoral collaboration projects, e.g. transnational cluster-to-cluster projects[21], which in certain cases are eligible also to apply for H2020 preparatory grants.[22]

The above-discussed approach assumes, **first**, the establishment of policy-making processes at the national level to legitimately agree upon national priorities and strategic agendas. In most innovator countries of BSR, this seems to be, firstly, achieved by embedding relevant stakeholders into the processes of strategic priority-setting at national levels (see Vinnova 2013). Secondly, this process needs to be complemented by appropriate financial and institutional mechanisms for creating/upgrading capacities in these priority areas. Thirdly, policy makers need to leverage these efforts with sufficient transnational policy coordination, e.g. focused participation (by national representatives with negotiation and decision-making authority) in relevant programme committees of H2020 and regional cooperation mechanisms. It was highlighted by our expert interviews that tighter cooperation during the development phase of different instruments (e.g. FP9) allows for better preparation for participation as well as timely notification about possible barriers. At the same time, the researchers interviewed from EU13 felt that their national representation in such activities is rather *ad hoc* and non-strategic. In general, however, it should be highlighted that BSR (innovator) countries – which perceive themselves as small countries in the EU – have only had a limited role in representing the region in the strategy formulations processes at the EU level so far.

Secondly, *the identification of the intersections of FP with other strategies is highly relevant for building up appropriate strategies for transnational cooperation.* It is suggested that moderate-innovator countries should try to map more sytematically the intersections of H2020, their national/regional smart-specialisation focuses (especially in Estonia, Latvia, Lithuania), ESIF, but also their BSR strategic aims. However, one has to acknowledge that the task of co-ordinating national and EU policies is a complex and multi-level challenge. It has been suggested that EC needs to

[19] The web-page of the Danish Ministry of Higher Education and Science Agency for Science, Technology and Innovation, http://ufm.dk/en/research-and-innovation/international-cooperation; the web-page of the Danish Council for Independent Research, http://ufm.dk/en/research-and-innovation/councils-and-commissions/the-danish-council-for-independent-research; the web-page of the Innovation Fund Denmark, https://innovationsfonden.dk/en/investment/international-collaborations. See also the web-page of Vinnova, http://www2.vinnova.se/en/EU-and-international-co-operation/; the web-page of Swedish Research Council, https://www.vr.se/inenglish.4.12fff4451215cbd83e4800015152.html; the web-page of TEKES, https://www.tekes.fi/en/funding/research_organisations/; the web-page of Academy of Finland, http://www.aka.fi/en/funding/our-funding-opportunities/.

[20] Information retrieved from expert interviews.

[21] *Norwegian Ministry of Education and Research, Strategy for research and innovation cooperation with the EU Horizon 2020 and ERA*. Available at https://www.regjeringen.no/contentassets/4c96155c697f47cabc2c4ea23e0507ec/strategy-for-research-and-innovation-cooperation-with-the-eu-horizon-2020-and-era.pdf, 11-12; *Danish Roadmap for the European Research Area 2016-2020*. Available at http://ufm.dk/en/publications/2016/files/danish-roadmap-for-the-european-research-area-docx.pdf, 37.

[22] The web-page of TEKES, https://www.tekes.fi/en/funding/research_organisations/.

harmonise FP/ESIF rules, but one also needs to take into account the climatic, economic etc. differences between countries (which would also mean strengthening the common BSR strategies in climate, security and similar areas in the EU instruments), but also avoid the establishment of mutually exclusive goals. Especially for the moderate-innovator countries, setting targets and reducing fragmentation is suggested. As the policy mixes, but also the regulatory environments of combining ESIF and FP funding, are still quite different (meaning also wider relational proximity for cooperation), the policy analysts have suggested more tailor-made instruments and solutions. For example, in the case of Estonia and Lithuania, the more recent shifts from "hard" measures to "soft" measures is perceived not to be enough, and accommodation of different regulations (e.g. state aid, cost models, sizes of grants, eglibility etc.) is needed. In moderate innovators, mostly the harmonisation (sometimes also simplification) of principles, rules and regulations for co-funding is suggested.[23] The interviewed experts from Estonia brought out significant discrepancies between ESIF and FP rules (the former being even more complex to follow). This observation is also in line with the policy recommendations of the report by Kallas (2017, 28) that "the guiding principle should be that projects financed by ESIF should not receive more restrictive treatment than similar projects under central EU management" (European Union 2017).

More generally, some actors we have interviewed were not aware of the shift towards innovation that has occurred in H2020 compared to FP7. Based on our analysis, but also according to other suggestions, it is necessary to promote and evaluate institutions based on the higher impact on society and innovation (mentioned especially in the cases of Estonia and Latvia), but also recognise more generally the wider role of universities in society. Also, at the level of universities, the societal engagement and innovation needs to be improved, which could lead to a greater readiness of moderate innovators for innovation-oriented H2020 and BSR instruments. We would additionally stress here that it is extremely important to aim at achieving better synergies rather than creating additional (separate) instruments in moderate-innovator countries. Otherwise these instruments will crowd out the international cooperation activities.

As our analysis showed, the wider awareness about different instruments available for different actor types varies and is generally lower about newer instruments of H2020. Therefore, it is especially relevant on the BSR (in areas with common interest), national, but also institutional (university) levels to promote joint PCP & PPI funding opportunities. In some countries (e.g. Latvia), the policy reports bring out the need to adopt the legislation for enabling the participation of actors in these instrument types. Our analysis has showed that in moderate-innovator countries overall, there is hardly any participation experience, which makes us conclude that the problem of legislation alignment probably concerns a wider set of countries. The other problem concerns the mistmatch between the EU-level "lump sum" funding and local accountancy rules in moderate-innovator countries (e.g. Estonia), which already causes problems in COST scheme, but will presumably do so even more in the future.

The sermons (informative and capability-building instruments)

As there are many thematic focuses, which intersect different action types and a bulk of new instruments in H2020, *clarifying the FP operations and giving timely information about instruments and application deadlines, conditions, etc.* is extremely important for engaging a wider set of

[23] European Commission (2014).

researchers. One way would be to develop roadmaps connecting national support mechanisms and processes to FP and mechanisms for specific fields and institution types and to keep them updated in one place (here a good example could be the web page of Enterprise Estonia (Ruttas-Küttim 2015) bringing together different EU, national, regional instruments for the applicants from companies, universities and public sector in both the national language and English). In the BSR context, developing roadmaps connecting national support mechanisms and processes to FP processes and mechanisms in specific research fields would also be appropriate. At the intermediary levels, infomational materials/guides, developing *guides for BSR cooperation opportunities* (also in national languages) are appropriate. For the universities, developing guides matching institutional policies would be welcome to bring out the existing carrots for their researchers.

We also suggest that the *EC could publish, update and prognosticate the success rates across instruments* (as done by the National Institutes of Health (NIH) in the US). It is necessary to publish and communicate to the member states the success rates of programmes/calls/action types, as they form the basis for decision-making of researchers, institutions and policy-makers. Therefore, it is also relevant to estimate success rates (as currently researchers cannot follow and operationally find this information and decide accordingly). To make the instruments of BSR more attractive, the respective funding bodies and national intermediaries need to communicate relatively higher success rates of BSR instruments to encourage the wider set of participants. Also, comparing and communicating success rates of national and international cooperation instruments would be relevant.

At the level of moderate innovators, the key suggestions concern the improvement of information, communication, advice and training services (Commission Analysis of September 2011). As the instruments of transnational cooperation evolve towards greater complexity, the communication systems need to work well. Here, the EU sees NCPs as part of a key solution for supporting applicants. It is proposed that the EC should fund the NCPs to achieve uniform standards and service provision among the NCPs or to emulate the systems with strong NCP network such as in Austria (Ibid.). Regarding informative instruments at the national level, the innovation leaders of BSR have gone far beyond the mere establishment of national/regional structures for NCPs, as set out in the *NCP Guiding Principles*.[24] In most countries, there are policy instruments in place to facilitate the professionalisation of support services for international cooperation as well as mentor systems at different levels, e.g. development of in-house support systems in universities; an informal peer group of EUTI (especially for project coordinators) to share best practices; Eurocenter's "*train the trainer*" program; the Innovation Fund Denmark assistance in finding H2020 partners all over the world; training sessions for ERC interviews by the Swedish Research Council; mutual exchange of experience and collaboration for better administrative support for H2020 by the associations of higher-education institutions (e.g. NARMA), etc.[25]

[24] *Minimum Standards and Guiding principles for setting up systems of National Contact Points (NCP systems) under Horizon 2020*, http://ec.europa.eu/research/participants/data/support/20131125_NCP%20Minimum%20standards.pdf.

[25] The web-page of the Danish Ministry of Higher Education and Science Agency for Science, Technology and Innovation, http://ufm.dk/en/research-and-innovation/international-cooperation; the web-page of the Innovation Fund Denmark, https://innovationsfonden.dk/en/investment/international-collaborations; The web-page of Swedish Research Council, https://www.vr.se/inenglish.4.12fff4451215cbd83e4800015152.html; Vinnova (2013); *Norwegian Ministry of Education and Research, Strategy for research and innovation cooperation with the EU Horizon 2020 and ERA*,

Thus, the NCP systems of the moderate countries may need to be shifted away from focusing mostly on providing consultancy to different single actors (including information days) towards a stronger emphasis to train, develop and equip in-house support units at universities that can work closer and more directly with research groups. The advancement of in-house capacities at universities is crucial for providing proper support for the management-related issues (from project proposals to running the projects). It has also been proposed that the third party involved in the preparation and management processes should be "*a motivated party*" (i.e. a performance-based model whereby successful submission of proposals is also essential for assessing in-house support structures). The greater assistance in the issues that can be transferred from one project to another (such as ethics, privacy, data management, open data, etc.) or building a mentor system, where senior (even retired) scholars could provide mentoring to junior scholars in entering the FP system, were also suggested.

Previous BSN studies have also highlighed the demand for more systemic mapping of strengths and specialisations of BSR states to support finding the best potential partners in the region (Danish Agency for Science and Higher Education 2017). For moderate innovators, the improvement of the intregration of marginal (regional) actors by developing their capabilities would be very important to improve the bottom-up activity level in transnational cooperation. For individual countries, this implies empowering a wider range of actors besides universities and companies. Regional colleges, public agencies, professional HEIs, industry alliances etc. need to be both persuaded but also enabled to participate in transnational cooperation.

For BSR, it would be important to map and empower regional (thematic) actors and different actor types to identify those with the most advanced resources and capabilities, but also to map their strategic aims and aspirations towards transnational collaboration. It has often been suggested to integrate national research communities, which require the creation of forums for exchanging experience (the interviewed experts saw this as an opportunity for the universities as well as companies and public-sector participants). It is important to bring together the actors with the most advanced resources and capabilities, but also to attract established researchers with extensive international networks. For increasing bottom-up participation in transnational cooperation, promoting awareness and participation culture more generally is suggested. This implies (thematic) information-sharing, partner-finding events, but also building mentoring systems based on successful applicants/other knowledgeable persons related to a specific technology or institution.

The experience from FP7 and H2020 has shown that larger-sized projects can be problematic for small countries and new actors who are joining the projects (Commission Analysis of September 2011). Similarly, coordinating the participation in advisory groups, but also coordinating/creating/empowering/timing joint representation of interests in EU institutions, advisory groups etc. related to the complexity of these "carrot"-based cooperation systems, poses additional complications for moderate-innovator countries with fragmented innovation systems and weak cooperation traditions and capabilities. Here we suggest the joint efforts of BSR (alternatively to the existing inter-institutional networks) based on the example of the Mediterranean Universities

https://www.regjeringen.no/contentassets/4c96155c697f47cabc2c4ea23e0507ec/strategy-for-research-and-innovation-cooperation-with-the-eu-horizon-2020-and-era.pdf; information retrieved from expert interviews.

Union (UNIMED), which is a network of universities and research centres, active in promoting Euro-Mediterranean academic cooperation, involving several thematic sub-networks, and which, in 2016, started to organise UNIMED weeks in Brussels to achieve wider discussion, but also visibility.[26]

Finally, *networking and mobility schemes in their different formats and aims* (starting from the coverage of membership fees in international R&D organisations to inward/outward mobility of researchers, students and international experts/consultants) has gained equally strong attention in both innovator and moderate-innovator countries of BSR. Overall, there seem to be three common challenges for the future: 1) greater focus on results and impact of mobility (publishing as a natural element of mobility schemes); 2) developing systemic full-cost mobility schemes to encourage visits to leading international R&D centres (e.g. Mobility Plus Programme in Poland)[27] or to host international researchers/experts (e.g. FiDiPro Programme by TEKES)[28]; 3) standardisation or special agreement regarding salaries, taxation, pension issues for developing R&D capacities in moderate-innovator countries while preventing brain drain (Danish Agency for Science and Higher Education 2017). The question here is whether and on which terms common regional standards could be feasible (there are already examples where a special taxation scheme has been developed for international experts, especially in countries with high taxation rates).[29] Among moderate innovators, Lithuania seems to stand out for a wide range of policy instruments for internationalisation and networking, e.g. instruments fostering the visibility of national research by supporting the publication and dissemination of the research in high-level scientific journals; funding of scientific events to facilitate international research relations; attracting international experts with special grants in specific research areas (e.g. interdisciplinary studies on facilitating modernisation processes of Lithuania).[30] The latter is particularly relevant in the context where innovator countries of BSR remain more reluctant towards mere capacity-building initiatives for cooperation: "BSR research cooperation works best when it is driven by excellence (as opposed to by concerns related to capacity building), focusing on concrete solutions and specific impact, and is based on accessible networks" (Danish Agency for Science and Higher Education 2017, 27).

The carrots (economic and financial instruments)

Overall, while the EU13 countries face more issues and criticism regarding the quality of projects proposed etc., it seems that *support measures and mechanisms to facilitate participation in the EU programmes have gained relatively higher and more systemic attention in innovator vs moderate-innovator countries of BSR.* In other words, many Nordic countries, but also Poland, have introduced policy instruments to transfer the preparatory risks of transnational cooperation projects from RDI performers to the national level. There are different *ex-ante* support measures introduced for drafting applications (covering payroll, external assistance, travel, meeting costs etc.) not only for H2020, but also for other EU programmes, such as BONUS, EUROSTAR. Some of the examples are listed below:

[26] The web-page of Mediterranean Universities Union, http://www.uni-med.net/en/about-us/.

[27] Institute of Fundamental Technological Research, Polish Academy of Sciences, http://www.kpk.gov.pl; the Ministry of Science and Higher Education, http://www.nauka.gov.pl/en/;

[28] The web-page of TEKES, https://www.tekes.fi/en/funding/research_organisations.

[29] Information retrieved from expert interviews.

[30] Research Council of Lithuania, http://www.lmt.lt/en/about.html; Agency for Science, Innovation and Technology (MITA), http://www.mita.lt/en.

- *SHOK programme and funding for large H2020 project preparation in Finland* (H2020 project preparation (writing phase) presented as a normal TEKES project together with the requirements that the project should aim to broaden its future scope into international activities and have a significant impact on Finland and/or a Finnish partner having a substantial role in the project);[31]
- *EUopSTART in Denmark* (grants funding preparatory activities in drawing up applications under H2020, etc. for Danish research institutions, enterprises and SMEs, whereas eligible costs cover payroll costs for staff; relevant travel expenses; expenses on hosting meetings, seminars; external assistance, etc.);[32]
- *PES2020 scheme in Norway* (disbursed as a lump-sum based on the funding pledge awarded to the applicant; additional support for H2020 proposals getting over the threshold also possible);[33]
- *Granty na Granty (also for SMEs) in Poland* (supports Polish R&D institutions to apply/improve their proposals for EU funding, limited to potential coordinators in the consortia. The organisations that received funding to prepare their proposal, but have not been assigned with a grant, can still apply for funding from this scheme in order to improve their proposal),[34] etc.

The Baltic States seem to be more oriented towards *ex-post* support measures rewarding some level of partial success. For example, in Estonia, there is a support fund introduced for SME and ERC schemes for the proposals crossing the threshold but failing to receive funding from the EU, as well as "bonuses" for coordinating proposals that pass the quality threshold in H2020.[35] More specifically, the preparation support for H2020 (including COST) and the Baltic BONUS projects in Estonia (in the size of €3600 for a consortium coordinator, €2400 for participation in an individual project, €1200 for the WP manager and €1000 for Baltic BONUS; Ruttas-Küttim 2015) was unanimously positively highlighted by interviewees. All interviewed researchers suggested to give this kind of support to all projects evaluated above the threshold to cover the preparation costs. An additional opportunity on the country level is to use the funding model of "Seal of excellence"[36], which is done in some BSR countries (Poland, Finland), but not in the Baltic countries. Securing baseline funding for relevant groups with future potential is recommended for Estonia and Latvia for different reasons. Both the high project-based funding level in Estonia and the generally low overall funding level in Latvia create overly high uncertainty for researchers. Similarly, on the institution level, securing top-up funding from baseline funding for researchers participanting in H2020 is recommended. Finally, *the*

[31] The web-page of TEKES, https://www.tekes.fi/en/funding/research_organisations/.

[32] Call for applications for EUopSTART (May 2017), http://ufm.dk/en/research-and-innovation/funding-programmes-for-research-and-innovation/find-danish-funding-programmes/euopstart/euopstart-opslag-may-2017-uk.pdf.

[33] The web-page of Research Council of Norway, https://www.forskningsradet.no/en/Funding/PES2020/1254012082844?lang=en.

[34] Institute of Fundamental Technological Research, Polish Academy of Sciences, http://www.kpk.gov.pl; MIRRIS good practices, http://www.mirris.eu/Good%20Practies/Experiences_and_Tools_Grants%20_for_SMEs.pdf.

[35] The web-page of Estonian Research Council, http://www.etag.ee/en/. Here one can draw an additional parallel to the Swedish practice on SME instrument to "*runner-up*" companies, see the web-page of EASME, https://ec.europa.eu/easme/en/news/sweden-builds-sme-instrument-support-its-innovation-champions.

[36] This is an option where basically the projects evaluated with high scores of excellence, but left without funding, are additionally funded via special national calls. Opportunities for Seal of Excellence holders, http://ec.europa.eu/research/soe/index.cfm?pg=opportunities_msca.

incentives to promote participation at the institutional/individualal level in Estonia (e.g. the substitutability with ESIF) but also in Lithuania may *need to be revised*. For example, good incentives are in place in the Finnish R&D funding system, where the distribution of basic funding for an institution is topped up with 80% of the EU contribution over the course of three years (on one hand this will provide incentives to apply, but on the other hand also lower the risk and co-funding issues).[37]

For enhanced international connectivity and networking, strengthening career-related standards (carrot) can be employed (mentioned, e.g., for Estonia), but also the wider use of peer review and international evaluation of competitive projects to familiarise applicants with the FP standards (in the case of Latvia). At the individual level, perhaps the strongest example of a "carrot" is in place in the Netherlands, where H2020 project coordination is related to the tenure track of professors. While speaking about incentive structures at the level of single researchers, however, one should remain cautious not to violate the balance between the workload vs bringing in more projects. For encouraging the "coordinator" role, it is suggested to create specific top-up funding for the coordination role (national), create/promote support functions (legal advise, finance etc.) for coordination (at the university level). It would also be important to create national co-funds and risk funds in moderate-innovator countries, as the low margin for error in audit-led evaluation discourages participation in Latvia, Estonia, and Lithuania. The lack of support for project management is also brought up as the main reason why coordination may not be desirable.

Most of the suggestions reviewed in this chapter address relational proximity, while ignoring the relevance of functional proximity. Therefore, we propose the instruments for achieving greater functional proximity within BSR in chapter 3.3.

In sum:

- *Policies at different levels should be developed towards a more systemic approach, including mapping and positioning the explicitly interconnected and/or additive aims of EU, transnational, regional and national policies.*
- *Harmonised and simplified rules and regulations, including more flexibility within national legislations, would further reduce barriers and enhance cooperation possibilities between actors from different countries.*
- *Timely and systemic support and communication of relevant information, tailored for different actors, is needed.*

[37] Review of the Finnish funding system is in Estermann et al. (2013); focus group results.

For the European Commission:

- *As "sticks", EC needs to allow for more bottom-up and innovative initiatives while supporting the harmonisation of the rules and conditions of research funding across member states.*
- *Additional investments as "carrots" should serve to correct the low and varying success rates of different instruments and pay more attention to lagging thematic areas, which would reduce the "gaming" activities pursued currently by the applicants.*
- *As "sermons", the mix of policy instruments needs to be supported by better and more systematic information-sharing and communication strategies targeted to the individual agents (researchers, universities, enterprises).*

For the BSR:

- *As "sticks", joint research interests need to be identified and defined in order to adequately represent the region also at the level of EU strategy formulation.*
- *As "sermons", common ground inside and common imago outside the BSR country group should be communicated through focus-area roadmaps containing timely and systematic information throughout the relevant (national, regional, supra-regional) instruments together with joint promotion and joint representation at the EU level.*
- *Novel instruments for speeding-up bottom-up cooperation, such as BSN challenges, prizes; 2nd best funding (ERC, H2020); virtual service centres and shared service centres can serve as "carrots" for this purpose. Better top-down steering of RDI cooperation could be based on novel instruments, such as a joint funding mechanism for funding BSR societal challenges; a joint BSR breakthrough accelerator; the development of common service areas (via IT-solutions), which would support the imago of BSR as an innovative, but resilient region.*

For individual countries:

- *Priority setting as a key "stick", together with making sure that national legislation, accounting and auditing practices, participation rules and regulations are harmonised to a degree that supports and widens research performers' incentives to take on international projects.*
- *As "carrots", countries could shift the risks of participating in and especially coordinating international projects with a wider range of partners from research performers to the national level.*
- *As "sermons", countries could audit their support and communication systems and develop roadmaps connecting national support mechanisms and processes to FP across specific fields and institution types and to keep them easily accessible and updated. In addition, national NCP systems could be empowered to take on wider training and consultancy activities.*

Instead of a summary, the the above-proposed instruments are collected in the following three tables:

- *Instruments for increasing participation in moderate and strong-innovator countries*
- *Instruments for improving the cooperation capabilities in moderate-innovator countries*
- *Mechanism design and synergies with EU and regional instruments*

Table 9 Instruments for widening participation in moderate- and strong-innovator countries

Policy Challenge	*Policy instruments on different levels*			
	EC	*Macro-regional*	*National*	*Institutional*
Improvement of the intregration of marginal (regional) actors (developing capabilities).	*Providing higher attention to increase the participation activity in the areas lagging behind and not belonging under the priority areas (traditional fields in particular, e.g. forestry in Estonia).*	*Mapping and empowering regional (thematic) actors (actor types).*	*Empowering a wider range of actors in National Inovation Systems for international cooperation (Regional Colleges, Public Agencies, Professional HEIs, Industry Alliances etc.).*	*Embrace international RDI cooperation in institutional development strategies and build the respective capabilities, e.g. such as developed in Lithuania.*
Identification of actors with most advanced resources and capabilities and fostering synergies between them.	*Providing more room for bottom-up innovative initiatives.*	*Mapping and empowering actors in common-interest areas (e.g. societal challenges in BSR and/or high-risk interdisciplinary fields, such as cyber security, big data, smart cities, bioeconomy).*	*Mapping and bringing together important actors and their aims, e.g. a good example here virtual research centres in Denmark.*	*Set aims of internationalisation to actors (e.g. to public firms, colleges).*
Awareness about different instruments available for different actor types.	*Publishing and communicating to MSs the success rates of programmes/calls/action types, as these are the basis for decision-making. Prognosticating success rates.*	*Promoting Joint PCP & PPI in areas with common interest. Communicating the success rates of BSR instruments.*	*Promoting PCP & PPI (if needed, adopting the legislation: Latvia). Comparing and communicating national and international success rates (Estonia, Lithuania).*	*Promote PCP & PPI.*
Awareness about shift towards innovation in H2020 compared to FP7.			*Promoting and evaluating institutions based on higher impact on society and innovation (Estonia, Latvia).*	*Promote societal engagement & innovation.*

Policy Challenge	*Policy instruments on different levels*			
	EC	*Macro-regional*	*National*	*Institutional*
Selective encouragement of the participation activity, appropriate alignment of EU and national objectives.	*Revising the current funding system for R&D projects, where the increasing numbers of high-level applications/projects remain out of funding (too much openness contributing to the higher intensity of competition as a considerable side effect vs setting higher entry barriers, e.g. in FET).*	*Providing higher attention to strategic cooperation during the development phase of different instruments (e.g. FP9).*	*Developing strategic aims together with higher prioritisation and commitments to funding (Estonia, Latvia, Lithuania).*	*Developing action plans with specific aims.*
Reviewing the incentives for institutions/individuals to promote participation.	*Increasing the funding to match increased competition (to achieve success rates between 15 and 20%[38]).*	*Introducing BSR 2nd best funding.*	*Review incentives: Estonia (substitutability with ESIF), Lithuania. Developing further preparation support measures for H2020, while widening the scope of the existing ones and establishing new ones to mitigate the related risks ex ante (incl. support to develop the early stages of prototypes (H2020 oriented & on wider testing and dissemination).*	*Providing incentives for support structures to increase their motivation in relation to application and project-management processes. Providing career-related incentives at the individual level.*
Clarifying the FP operation, timely information about instruments and application deadlines, conditions etc.	*Revising the horizontal nature of calls and the variety and lack of synergy between ERA instruments and initiatives.*	*Coordinating the participation in advisory groups in common interest areas.*	*Developing roadmaps connecting national support mechanisms and processes to FP processes and mechanisms for specific fields/institution types, keeping them updated in one place (Estonia).*	*Developing roadmaps connecting national support mechanisms and processes to FP processes and mechanisms in specific research fields.*
Coordinating support services to promote participation.	*Supporting further development of a more cohesive NCP system.*	*Developing common platforms to share information, experience and*	*Facilitating the professionalisation of support services for international cooperation at the national*	*Facilitating the professionalisation of support structures for international*

[38] European Commission (2017b).

Policy Challenge	*Policy instruments on different levels*			
	EC	*Macro-regional*	*National*	*Institutional*
		facilitate cooperation between organisations for support services (NCP, university associations) in BSR.	*level together with strengthening the NCP networks, good examples here, e.g., EUTI in Finland, Eurocenter in Denmark.*	*cooperation as well as mentor systems for project applicants/managers.*
Coordinating/creating/empowering joint representation offices in Brussels.		*Creating joint representation offices and activities (Mediterratean example).*	*Creating joint representation offices (Mediterratean example).*	*Creating joint representation offices (Mediterratean example).*
Infomational materials/guides.	*Better equipment of calls with a more comprehensive range and precise key words.*	*Developing guides for BSR cooperation opportunities.*	*Developing guides in national language.*	*Developing guides matching institutional policies.*
Encouraging the "coordinator" role.		*Promoting BSR as role model in advancements of specific (niche) research areas.*	*Creating specific top-up for the coordination role.*	*Creating/promoting support functions (legal advise, finance etc.) for coordination.*
Creation of co-fund and risk-fund.	*Leveraging private-sector investment as much as possible (together with MSs instruments like tax credits and innovative public procurement). Creating co-funding mechanisms with industry, countries, foundations and other sources of funding.*		*Creating co-fund and risk-fund (low margin for error in audit-led evaluation discourages participation) (Latvia, Estonia, Lithuania). Alternatively creating top-up national funding to H2020 (Finnish example).*	

Table 10 Instruments for improving the cooperation capabilities in moderate-innovator countries

Policy Challenge	*Policy instruments on different levels*			
	EC	*Macro-regional*	*National*	*Institutional*
Integrating national research communities.		*Creating forums for exchanging experience.*	*Creating forums of exchanging experience.*	*Creating forums of exchanging experience.*
Bringing together the actors with the most advanced resources and capabilities.	*Creating equal salary conditions for EU13 as this would help to hire top-level researchers and motivate transnational cooperation.*	*Considering standardisation or developing special agreements regarding salaries, taxation, pension issues, etc. in the region to support networking vs brain drain[39].*	*Developing full-cost mobility schemes to facilitate inward and outward mobility of high-level (inter)national experts.*	*Attracting established reseachers with extensive networks.*
Promoting awareness & participation culture.		*Conducting information-sharing events, (thematic) partner-finding events.*	*Conducting information-sharing events. Conducting partner-finding events.*	*Conducting information-sharing events. Conducting partner-finding events*
Building mentoring systems based on successful applicants/other knowledgeable persons.		*Creating specific technology-mentor groups.*	*Creating national mentor groups.*	*Creating institutional mentor groups.*
International connectivity & networking.		*Providing up-to-date thematical information about the state of existing expertise in knowledge and capacities (including infrastructure) as well as mapping different value chains and smart specialisations in BSR.*	*Creating personal networks internationally (Estonia). Establishing measures to foster the visibility of national research at the international level and/or to facilitate international research relations, a good example here: Lithuania.*	
Use of peer review and			*Introducing peer review and*	

[39] Danish Agency for Science and Higher Education (2017).

Policy Challenge	Policy instruments on different levels			
	EC	Macro-regional	National	Institutional
international evaluation of competitive projects to familiarise applicants with the FP standards.			international evaluation practices of projects (Latvia).	

Table 11 Mechanism for designing synergy between EU and regional instruments

Policy Challenge	Policy instruments on different levels			
	EC	Macro-regional	National	Institutional
Co-ordinating national and EU policies.	Harmonising FP/ESIF rules. Considering climatic, economic and physical differences between countries. Avoiding setting mutually exclusive goals.	Reviewing strategies & creating aims/targets to FP participation.	Reviewing strategies & creating aims/targets to FP participation, reducing fragmentation (Estonia, Latvia, Lithuania).	Reviewing strategies & creating aims/targets to FP participation.
More tailor-made solutions.		Developing tailor-made solutions for mutual complementarities/filling in the gaps in national innovation systems within BSR partners.	Developing tailor-made solutions (Estonia, Lithuania), shift from "hard" to "soft" measures is not enough.	
Supporting networks for coordinating and promoting participation.	Paying specific attention to the consortia if the coordinator is not the best in the field to remedy systemic barrier for moderate innovators.	Developing joint network capacities.	Developing and supporting network capacities (Estonia, Latvia, Lithuania).	Developing and supporting network capacities. Developing strategic partnerships for participation.
Reviewing the capabilities of different actors for participation.		Reviewing the (thematic) strong actors and topics/fields. Paying attention to the mutual complementarities.	Reviewing and expanding the bulk of actors (private, public sector, professional higher education). Considering and expanding support funds.	Reviewing and supporting the capabilities. Considering and

Policy Challenge	*Policy instruments on different levels*			
	EC	*Macro-regional*	*National*	*Institutional*
				expanding support funds and incentives.
Identification of the intersections of FP with other strategies.	*Communicating better that the hierarchy of different measures is needed to understand the logic of sequence and synergy between them.*	*Mapping the intersections with smart specialisation.*	*Mapping the intersection with smart specialisation, ESIF (Estonia, Latvia, Lithuania).*	
Aligning principles, rules and regulations of public support & co-funding.	*Promoting co-funding with ESIF, align FP and ESIF rules.*	*Considering the harmonisation of principles, rules and regulations for BSR co-funding[40].*	*Alignment and harmonisation (sometimes simplification) of principles, rules and regulations for ESIF and FP co-funding[41] (Estonia, Latvia).*	*Developing internal processes to acommodate different funding principles, rules and regulations.*
Securing stable baseline funding for relevant groups.		*Considering novel instruments for second-best applications.*	*Securing baseline funding for those with future potential (Estonia, Latvia).*	*Securing top-up from baseline funding.*

[40] European Commission (2014).

[41] European Commission (2014).

3.2. Novel policy instruments and measures to improve RDI cooperation in BSR and ERA

When we think about transnational RDI cooperation in regions, such as BSR or ERA in general, we should distinguish between two types of transnational RDI cooperation policies (see here also Figure 13, relying upon Verdung's typology discussed above):

1) **Policies that can speed up bottom-up transnational cooperation initiatives.** Such initiatives emerge in areas with strong functional proximity and from the bottom-up initiatives and networks of RDI performers. As these kinds of activities tend to be independent from political push-and-steer mechanisms, the soft measures rather than strong interventions may be more suitable and sufficient.

2) **Policies that try to initiate and steer new types and forms of transnational RDI cooperation** either in *new domains* (of research, societal challenges) and/or between *new partners* (from different regions, economies etc.). These policies often depart from territorial and/or relational proximity and try to increase functional proximity through policy interventions.

In both cases, the intra-regional differences (i.e. between EU13 and EU15 in BSR) may necessitate additional policy efforts that support the development of complementary RDI capabilities and specialisations, but these should be treated and analysed as preconditions for transnational RDI cooperation.

The "speeding-up" policies could provide additional leverage to tackle common BSN challenges, especially as BSR has already established several incentives/funding schemes for fostering transnational research and innovation in the region and cooperation in the specific areas of scientific excellence, but also supporting further utilisation of R&I infrastructure and mobility. As specific incentive mechanisms, we can propose the following instruments and initiatives:

- **Virtual service centres** to provide up-to-date thematical information about the state of existing expertise in knowledge and capacities (including infrastructure) as well as mapping of different value chains and smart specialisations in BSR that could extend the support for bottom-up cooperation from research towards testing and diffusions.
- **Shared service centres** (with cross-border rotation of staff) could be developed for capacity-building of NCPs, university associations, etc., to provide them with tools how to equip in-house support structures of different actors on the nation-state levels, but also to facilitate cooperation between the respective institutions in BSR. In essence, one of the previously covered best-practice measures, "*train the trainer*", is suggested to be implemented in the transnational context (i.e. to bring together the key competences in BSR to train, develop and equip those more moderate and/or share knowledge about the latest trends, best practices, etc. together with an orientation on intermediary actors).
- **BSR 2nd best funding facility** for the project proposals that receive very good evaluations and are evaluated as highly relevant for the region, but fail to receive the funding from two-phase programmes of H2020 (e.g. ERC, SME, Teaming). The criteria, the selection committee, etc. as well as the institutional set-up could be worked out at the level of BSN.

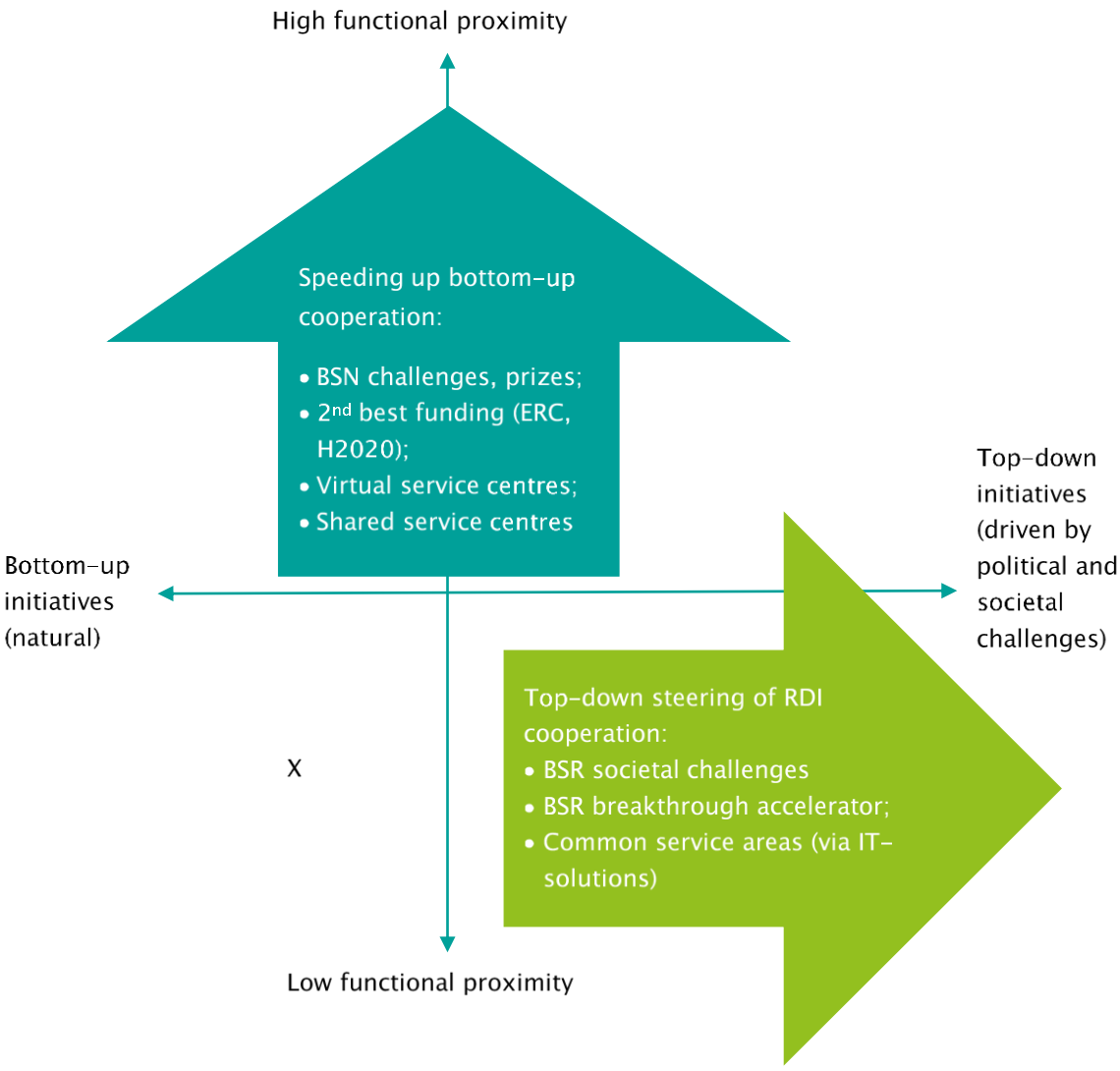

Figure 13. Novel policy instruments for transnational cooperation in BSR
Source: Authors' compilation

In the case of top-down policies aimed at wider BSR challenges, where the mere reliance on bottom-up initiatives for cooperation may be insufficient, the following mechanism could be considered:

- **BSR societal-challenges initiatives** (e.g. in environment, energy, health): either joint thematic grants or regionally (BSR level) designed and coordinated but nationally and sub-regionally implemented policy initiatives and projects, i.e. providing and managing different but complementary (as agreed and coordinated) RDI focuses and types of funded activities in different countries or regions of BSR (think of how Airbus planes are built and assembled);
- **BSR breakthrough accelerator**: RDI grants for cooperative exploratory and/or high-risk and high-return projects in new upcoming interdisciplinary fields, such as cyber security, big data, smart cities, bioeconomy, etc., where cooperation at the level of BSR would be essential to create critical mass to compete globally (could be again jointly organised grants with common pot or topic-level coordination of different national policy initiatives and instruments);
- **BSR as a "common service area"** to engage different actors in common diffusion or application-oriented activities (e.g. grants for feasibility studies to map the potential needs

as well for the development of ICT tools/applications that are oriented on the provision of certain (public) services across different countries in the region).

The developments in the aforementioned areas would potentially promote BSR as role model in advancements of specific (niche) research areas, building the specific institutional capacities and scientific excellence.

In sum:

- *Relying on Verdung's typology of policy instruments, we have suggested two types of transnational RDI cooperation policies to "nudge" the incentives of RDI performers for improved RDI cooperation in BSR and ERA in general.*
- *First, policies that can speed up bottom-up transnational cooperation initiatives in areas with strong functional proximity and that could provide an additional leverage to tackle common BSN challenges, especially as BSN has already established several incentives/funding schemes for fostering transnational RDI in BSR.*
- *Second, policies that try to initiate and steer new types and forms of transnational RDI cooperation, either in new domains (of research, societal challenges) and/or between new partners (from different regions, economies etc.). The respective interventions concern BSR societal challenges, where the mere reliance on bottom-up initiations for cooperation may be insufficient (e.g. in environment, energy, health), but also fostering exploratory and/or high-risk and high-return RDI projects in new upcoming interdisciplinary fields (such as cyber security, big data, smart cities, bioeconomy).*

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Appendix 1 Overview of the main instruments and their logic to support cooperation in ERA and BSR

Level of coordination	Main instruments	Key examples	The mode of governance and level of integration	The main rationale for cooperation	Funding mechanisms
Global level	Not explored in this study				
Supra-national level	The EU, incl. the ERA	FP7 and H2020	Supranational state model	The biggest EU Research and Innovation programmes	Directly funded from the EU budget
		PPP Partnerships: JTI[42]	Vertical convergence → large-scale multinational collaboration, most of the EU funding for PPP go to JTIs	High integration of national research programmes to address progress in the selected key areas essential to European competitiveness and societal challenges	Implementation through dedicated legal entities – Joint Undertakings – that organise their own research agenda and award funding for projects on the basis of open calls
		P2P Partnerships: JPI[43]	Coordination, whereas MSs develop and implement joint Strategic Research Areas (SRAs), whereas the EU acts as a facilitator. Duration not determined	Coordination and integration of national research programmes to address societal challenges in the selected areas	Variable geometry basis, requires high political endorsement. National funds as the main source, top-up of the EU funding possible but not guaranteed; PS! Member State can rely upon the EU Structural Funds in their financial contributions
		P2P Partnerships: Art. 185 BONUS and BONUS+[44]	Vertical convergence and coordination → article 185 initiatives represent the closest and long-term (duration 10 years, typically) integration of	Integration of national research programmes, together with a strong thematic focus (incl. jointly agreed Strategic Research Agenda for the Baltic)	Close to a "real" common pot; beneficiaries have agreements and receive payments from both BONUS EEIG and national funding agencies (dual money flow).

[42] The EU official web-page of Horizon 2020: http://ec.europa.eu/programmes/horizon2020/en/area/partnerships-industry-and-member-states; the web-page of ERA-LEARN 2020: https://www.era-learn.eu/public-to-public-partnerships/other-instruments-and-other-initiatives/joint-technology-initiatives-jti.

[43] *The Issue Papers for the High-level Group on Maximising the Impact of EU Research and Innovation Programmes* (2017), 9; the web-page of ERA-LEARN 2020: https://www.era-learn.eu/public-to-public-partnerships/joint-programming-initatives; Burbridge et al. (2014).

[44] Burbridge et al. (2014); *The Issue Papers for the High-level Group on Maximising the Impact of EU Research and Innovation Programmes* (2017), 9; European Commission. (2016a), 22.

Level of coordination	Main instruments	Key examples	The mode of governance and level of integration	The main rationale for cooperation	Funding mechanisms
			national and EU programmes		Cash or in-kind contributions; multiannual financial commitments to which the EU contributes with matching funds. Management by a dedicated implementation structure (EEIG), whereas implemented by National Funding Agencies within BSR.
		P2P Partnerships: Era-Nets[45]	Coordination (multi-directional), whereas financial integration has increased, implementation structure lacks continuous support. Duration no longer than 5 years	Mutual learning and building of partnerships → coordination of national research programmes together with a strong thematic focus	Variable geometry and a virtual common pot; Member States launch and implement a joint call with top-up EU funding (not more than 33%); Member State can cover the costs from the ERDF. Programmatic cooperation between national research funding bodies, who act as financial contributors and programme owners.
		Widening Participation, e.g. ERA-Chairs, Twinning, Teaming[46]	Cooperation/coordination (strongly unidirectional); Duration max 5 years	Emulation and lesson-drawing → orientation on lower-performing Member States, esp. research capacity and institutional networks, together with staff exchanges, expert advice and assistance	Implemented under CSA Actions (Twinning: Horizon 2020 funds 100% of the eligible costs); in other cases, commitments from the interested national or regional authorities to provide the necessary financial resources required. Member State can cover the costs from the ERDF

[45] Lepori et al. (2011); Burbridge, P. R. et al. 2014; *The Issue Papers for the High-level Group on Maximising the Impact of EU Research and Innovation Programmes* (2017), 29; European Commission. (2016d), 24; the web-page of Estonian Research Council: http://www.etag.ee/en/funding/partnership-funding/; https://www.era-learn.eu/public-to-public-partnerships/test.

[46] The EU official web-page of Horizon 2020: http://ec.europa.eu/programmes/horizon2020/en/h2020-section/spreading-excellence-and-widening-participation; the web-page of Estonian Research Council: http://www.etag.ee/en/funding/partnership-funding/; European Commission (2014).

Level of coordination	Main instruments	Key examples	The mode of governance and level of integration	The main rationale for cooperation	Funding mechanisms
Supra-regional level	The macro-regional cooperation in the EU[47]	The EU Strategy for the BSR – EUSBSR. 25 EUSBSR flagship projects implemented via INTERREG[48]; BONUS has contributed to EUSBSR via a flagship project BSR Stars	A two-tier construction of coordination/multi-level governance: a) the role of the Commission as a "watchdog" in monitoring implementation; and b) the Member States/key organisations (incl. HELCOM, VASAB) responsible for the implementation and management of various priority areas	Trans-national problem-solving in the BSR area, together with a strong thematic orientation: 1) maritime issues; 2) Baltic Sea as an EU internal-sea; 3) a test-bed for territorial rescaling in the EU	Does not have a self-funding scheme, funded by the European (incl. ERDF), national and regional budgets and programmes.
		INTERREG, incl. Transnational Programme for the BSR[49]	Some level of vertical convergence due to reliance on the EU Structural Funds. This instrument also has strong synergy with the EUSBSR, especially in the current programming period.	Strong focus on the Baltic Sea as a territorial platform for transnational cooperation. In INTERREG, maritime and environmental issues, crucial esp. in later programmes. The priorities, funding conditions and territorial coverage (the geographical scope has been widening) have been changing under each of the INTERREG programme since the 1990s.	Primarily ESIF (ERDF), also the European Neighbourhood Instrument (ENI) and Instrument for Pre-Accession (IPA). The programme co-funds up to 85% for partners from Estonia, Latvia, Lithuania and Poland. Managed by the coordinating bodies at the programmes level.

[47] European Commission (2013).

[48] The web-page of INTERREG Baltic Sea Region: https://www.interreg-baltic.eu/about-the-programme/eusbsr/contributions-2014-2020.html; the web-page of BONUS: https://www.bonusportal.org/programme/funding_development; Bengtsson (2009), 2, 6-7; Lindholm (2011); Gänzle (2017); Kern and Gänzle (2013), 10-11.

[49] Stead (2014), 328-330.

Level of coordination	Main instruments	Key examples	The mode of governance and level of integration	The main rationale for cooperation	Funding mechanisms
		EC Smart Specialisation S3 Baltic Sea Region, including the project *Stairway to Excellence (S2E)* aimed at EU13 (complementarities between ESIF, H2020 and other EU funding programmes)[50]	Vertical convergence (harmonisation → RIS3 as an ex-ante conditionality for the EU Cohesion Policy in the 2014-2020 programming period) This instrument has strong synergy with the EUSBSR, especially in the current programming period.	Sector, cluster-based orientation; place-based economic transformation	Primarily, ESIF Variable geometry, albeit on a subnational level. Managed by national funding agencies.
Meta-regional level		STRING[51]	Collaboration (multidirectional) between sub-national actors	Cross-border cooperation for joint politics at the meta-regional level; the geography of partners crucial → making it also potentially attractive as an eligible region to benefit from EU funds	Has a coordinating body – STRING Secretariat; the funding sources come from the EU and INTERREG

[50] The European Commission's web-page on smart specialisation platform: http://s3platform.jrc.ec.europa.eu/s3-in-baltic-sea-region; Sörvik et al. (2016); Tõnurist and Kattel (2016), 4.

[51] The web-page of STRING: http://www.stringnetwork.org/string-partners/string-partners/#.WSQWIKISB-1.

Level of coordination	Main instruments	Key examples	The mode of governance and level of integration	The main rationale for cooperation	Funding mechanisms
Regional level	Inter-governmental cooperation and transnational policy-making networks	The Council of the Baltic Sea States (CBSS) & the Nordic Council of Ministries (NCM) (incl. NordForsk)[52]	Collaboration/coordination (multidirectional); horizontal/vertical convergence. Governmental actors from the national and sub-national level	The main distinction between NCM and CBSS is the former's strong reliance on different agencies in the field of research and innovation	NordForsk: variable geometry principle/common pot (managed by a supranational agency), together with top-up funding from NordForsk (1/3) and participating countries (2/3). Participation is voluntary, whereas at least 3 countries must participate. CBSS acts as a policy forum without a general budget or project fund. Has a coordinating structure. Its projects, such as Baltic Science Network and Baltic TRAM, implemented under the umbrella of EUSBSR and via INTERREG Baltic Sea Region, see above.
	Inter-organisational cooperation and networks in the region, incl. bi- and multilateral collaboration programmes	The Baltic Sea Region University Network (BSRUN); NOVA University Network, BOVA University Network; Baltic University Programme (BUP)[53]	Collaboration and horizontal convergence (multidirectional), national universities as the dominant actors	Thematic cooperation in education and research-related activities, incl. mobility	Participation costs from member higher-education organisations; managed by a coordinating structure. In case of BUP, funding provided also e.g. by the Swedish Government, SIDA, Uppsala University, Nordic Council of Ministers, next to membership fees.

[52] The web-page of NORDFORSK: http://www.nordforsk.org/en; the web-page of CBSS: http://www.cbss.org/council/; Sepposen et al. (2015); Technopolis (2011), 8.

[53] The web-pages of the respective university networks: http://bsrun.org/; http://www.bova-university.org/; https://www.nmbu.no/en/students/nova; http://www.balticuniv.uu.se/index.php/about-us.

Level of coordination	Main instruments	Key examples	The mode of governance and level of integration	The main rationale for cooperation	Funding mechanisms
		E.g. EEA and Norwegian-Estonian Research Cooperation[54]	Collaboration and horizontal convergence (unidirectional), national states as the dominant actors	Strong focus on emulation → the limited circle of beneficiary countries (Central-Eastern European (CEE) and Baltic countries)	Ad-hoc collaboration between national funding agencies; implemented jointly by the EEA Financial Mechanism and Norwegian Financial Mechanism; the share of top-up funding by participating organisations rather small.
		E.g. bilateral Estonia-Latvia cross-border cooperation[55]	Collaboration (multidirectional)/coordination (some level of vertical convergence) → cooperation programmes under the EU territorial cooperation goal	Cooperation between neighbouring countries to feed into the cohesive growth and development in the EU	Financed from INTERREG; some part of the implementation and monitoring transferred to a supranational level – Joint Secretariat; management and implementation at the national government level.

[54] The web-page of EEA and Norway grants: http://eeagrants.org/Where-we-work/Estonia; http://www.etag.ee/en/funding/partnership-funding/eeanorway-grants/.

[55] The web-page of INTERREG Estonia-Latvia: https://estlat.eu/.

Appendix 2: Methodology for Segregation Indexes

We employ here the indexes of segregation, which are commonly used quantitative measures describing social separation. “People get separated along many lines and in many ways. There is segregation by sex, age, language, religion, colour, taste, comparative advantage and the accidents of historical location. Some segregation results from the practices of organisations; some is deliberately organised; and some results from the interplay of individual choices that discriminate. Some of it results from specialised communication systems, like different languages” (Schelling 1971, 143).

The total number of participations is T, and M represents the participations from the EU13 country group (0 < M < T). The overall fraction of EU13 country participations is P=M/T. In case there are n projects, the $p_i = m_i/t_i$ is the fraction of EU13 participants in the particular project *i*. We calculate first the index of dissimilarity (D) (originating from Duncan and Duncan 1955, but in this version adopted from Baroni and Ruggieri (2015):

$$D = \frac{1}{2 \cdot P \cdot (1-P)} \sum_{i=1n} \quad \frac{t_i}{T} \cdot |p_i - P|, \qquad (1)$$

where 2P(1−P) is a normalisation factor to place the index in the range between 0 and 1. The dissimilarity index would be at its minimum when the distribution of participants from EU13 countries is uniform over the projects. (The similar measures of the Theil and Gini indexes could be calculated here, too; Duncan and Duncan 1955).

Secondly, we calculate the isolation index, which is defined as the likelihood of a participant from EU13 countries being exposed to another member of the same country group in a project. For the particular project i, this is estimated as the product of the likelihood that a member of the EU13 countries is in the project (m_i/M) divided by the likelihood that she is exposed to another EU13 participant in the unit (m_i/t_i, or p_i), assuming that the two events are independent:

$$I = \frac{1}{M} \cdot \sum_{i=1}^{n} m_i \cdot p_i \qquad (2)$$

The isolation index runs over the range from P (overall fraction of minority group participation) to 1, whereby higher values denote higher segregation. Again, the minimum value is reached where p*i* = P; the maximum value is reached where there is only k, such that m_k=t_k =M, which means the unit contains all EU15 members and no EU13 member.

A complementary measure is the interaction (or exposure) index, which is the likelihood that a member of the minority group is exposed to a member of the majority group in a unit, which is the following:

$$Int = \frac{1}{M} \cdot \sum_{i=1}^{n} m_i \cdot (1 - p_i) \qquad (3)$$

The index of interaction measures how the majority group dominates (or shares, if the index value is lower) the project participations; it runs from P−1 to 0, where higher values show higher domination. It is clear from (2) and (3) that I + Int = 1. As the totals of T and M cannot be so easily detected from the data, but also participants can join several projects, we use here $T = \sum_{i=1}^{n} t_i$ and $M = \sum_{i=1}^{n} m_i$, thus the size of the total population of participations is by definition the sum of the sizes of the unit (project) populations, and similarly for the minority group (Baroni and Ruggieri 2015).

Appendix 3: Statistical Data

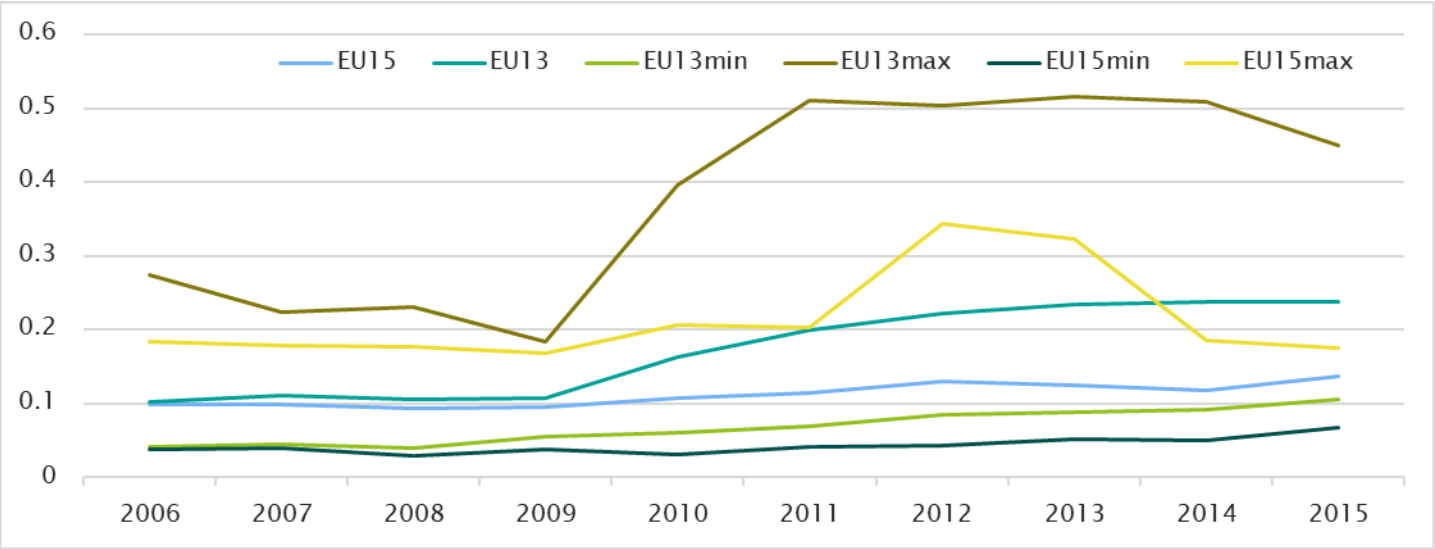

Figure 14 Share of funding from abroad in total R&D expenditure by country groups

Source: Authors' calculations based on EUROSTAT.

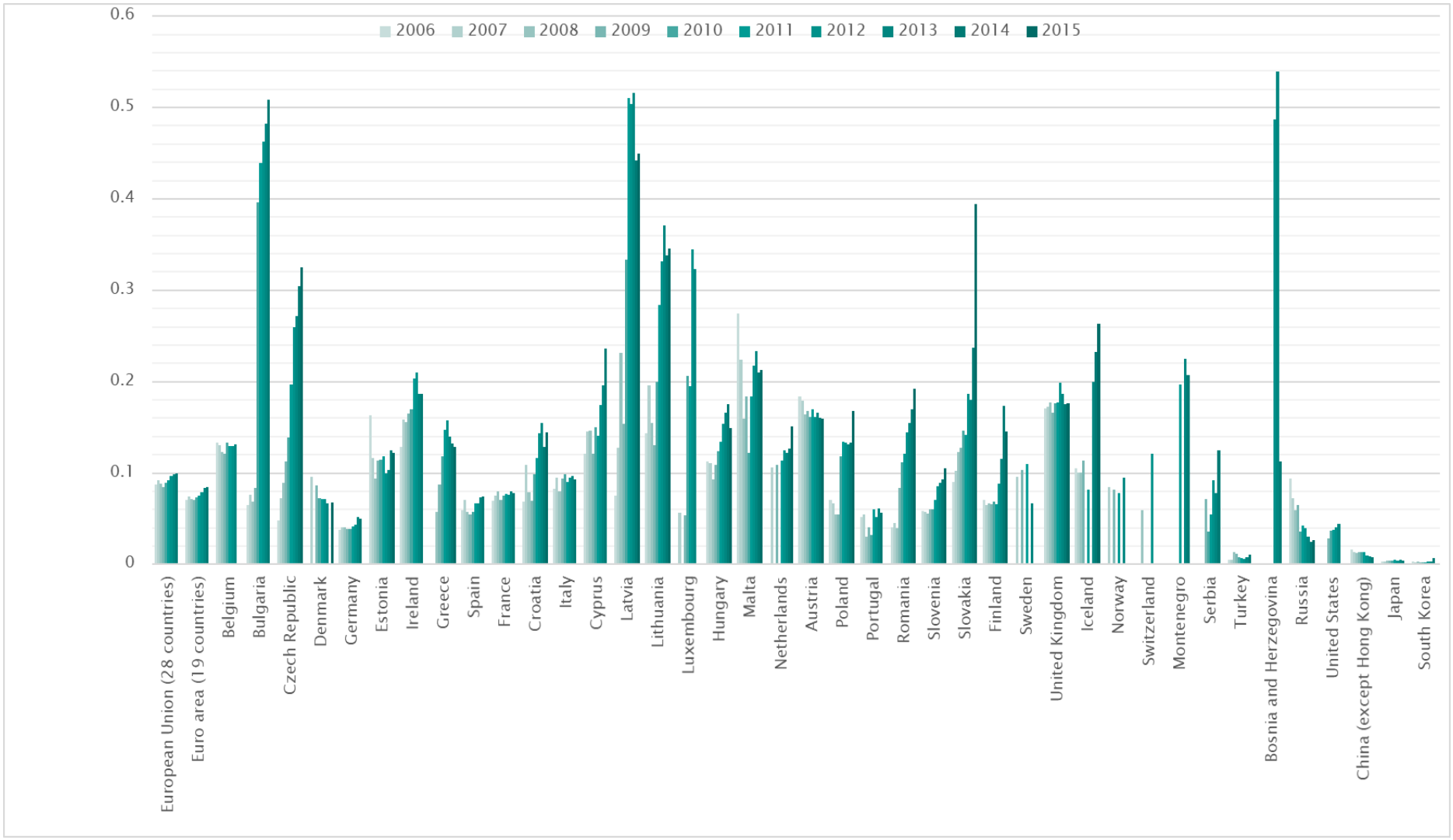

Figure 15 Share of funding from abroad in total R&D expenditure by country

Source: Authors' calculations based on EUROSTAT.

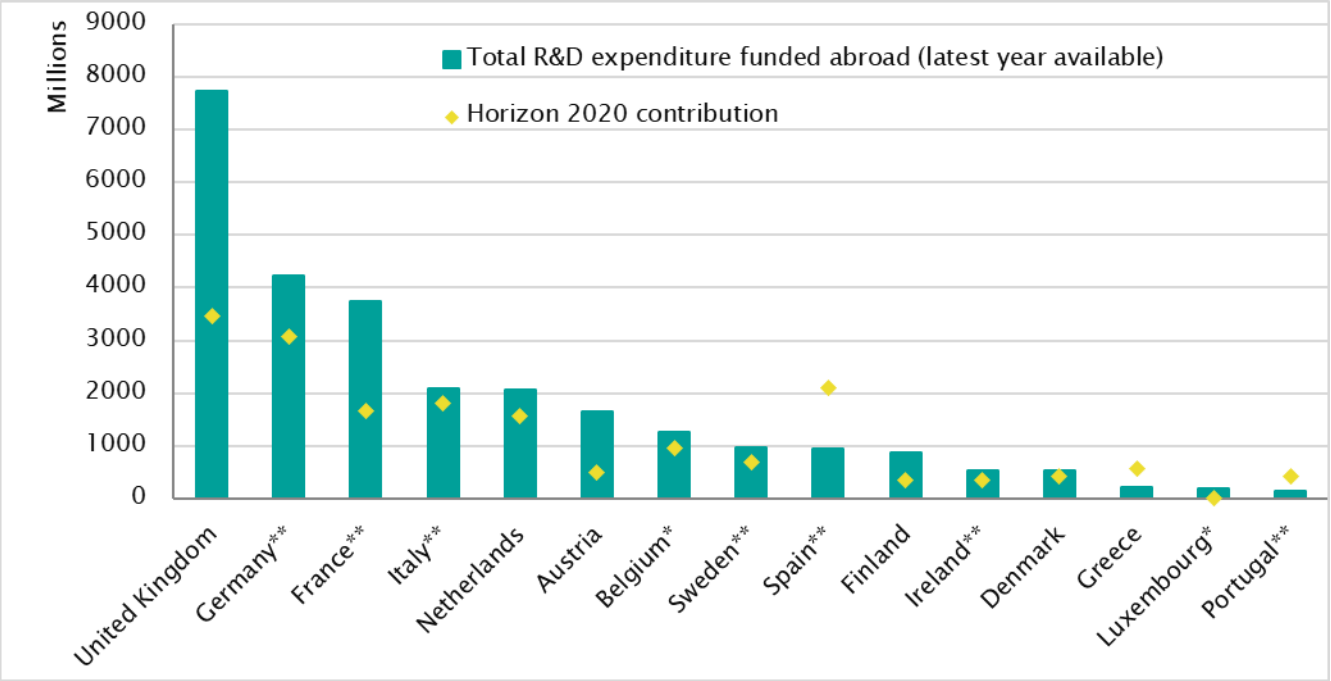

Figure 16 Total R&D expenditure funded abroad and Horizon2020 contribution in EU15

Source: Authors' calculations based on eCorda and Horizon mid-evaluation (as of 1 January 2017, 66)

Note: Latest year is 2015 unless indicated with *2014 and **2013.

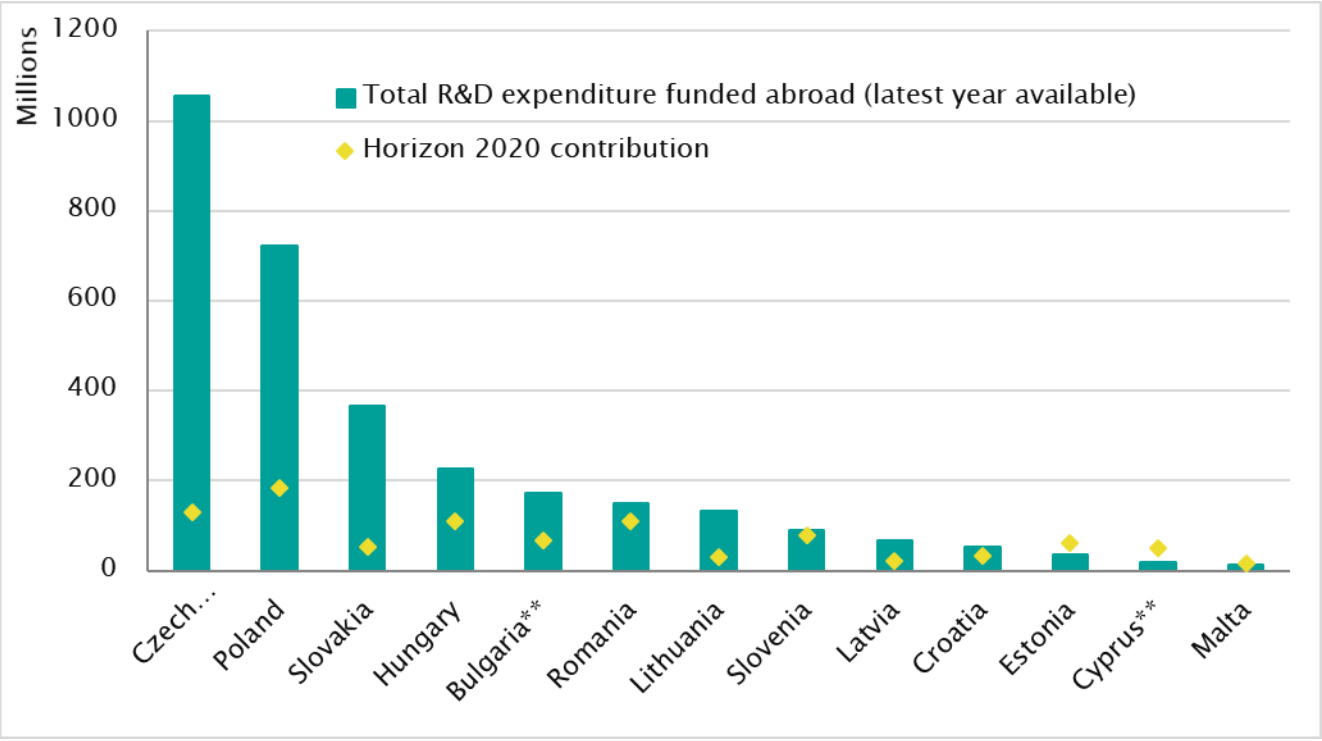

Figure 17 Total R&D expenditure funded abroad and Horizon2020 contribution in EU13

Source: Authors' calculations based on eCorda and Horizon mid-evaluation (as of 1 January 2017, 66)

Note: Latest year is 2015 unless indicated with *2014 and **2013.

Table 12 Explaining Action Types in H2020

Type of Action	Code	Number of Applicants	Types of Applicants	EU Funding Rate	Description
ERA-Net Cofund[56].	ERA-NET-Cofund	Min 2 legal entities from different MS/AC	Research Funders	33%	Instrument for supporting public-public cooperation in joint calls and joint activities across all H2020 priority areas with national funding and H2020 top-up funding
Pre-Commercial Procurement	PCP	Min 3 independent legal entities from different MS/AC	Public procurers	70%	
Pre-Commercial Procurement Cofund Action[57]	PCP COFUND	Min 2 independent legal entities (public procurers) from two different MS/AC	Public procurers	70%	Instrument for procuring innovative goods and services, group of public buyers with one lead procurer, joint call for tender, joint evaluation of offers, awarding in the name of the group
Public Procurement of Innovative Solutions	PPI	Min 3 independent legal entities from different MS/AC	Public procurers	20%	
Public Procurement of Innovative Solutions (PPI) Cofund actions[58]	COFUND-PPI	Min 2 independent legal entities (public procurers) from two different MS/AC	Public procurers	20%	Instrument for procuring innovative solutions – joint tender, joint evaluation but awarding can be individual (as well as through lead procurer)

[56] http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-d-eranet-cofund_en.pdf.

[57] HORIZON 2020 - WORK PROGRAMME 2016-2017 General Annexes, D. Types of action: specific provisions and funding rates: Pre-Commercial Procurement (PCP) Cofund actions https://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-d-cofund-pcp_en.pdf.

[58] Public Procurement of Innovative Solutions (PPI) Cofund actions http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-d-cofund-ppi_en.pdf.

Type of Action	Code	Number of Applicants	Types of Applicants	EU Funding Rate	Description
European Joint Programme[59]	EJP COFUND	Min 5 from MS/AC	Including research funders is obligatory (ministries/regional authorities, research councils, funding agencies)+others	70%	Joint programming instrument for coordinated national research activities designed for research funding bodies
Coordination and Support Action[60]	CSA	1 legal entity		100%	Research and co-ordination support services (standardisation, strategic planning, awareness-rising, networking, policy dialogs, etc.
ERC Grants	ERC	1 legal entity		100%	Frontier research of the highest quality
Research and Innovation Action	RIA	Min 3 legal entities from 3 MS/ACs		100%	Basic and applied research
Innovation Action	IA	Min 3 legal entities from 3 MS/ACs		70%	Planning and design of new or improved products, processes and services
MSCA Cofund	MSCA COFUND	1 legal entity		50%	Co-funding of national and international doctoral and fellowship programmes

Source: Adopted from: http://www.sfi.ie/international/european-research-area-era/h2020/horizon-2020-calls-explained.html.

[59] HORIZON 2020 - WORK PROGRAMME 2016-2017 General Annexes, D. Types of action: specific provisions and funding rates: European Joint Programme (EJP) Cofund actions http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016_2017/annexes/h2020-wp1617-annex-d-ejpcofund_en.pdf.

[60] http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-d-csa_en.pdf.

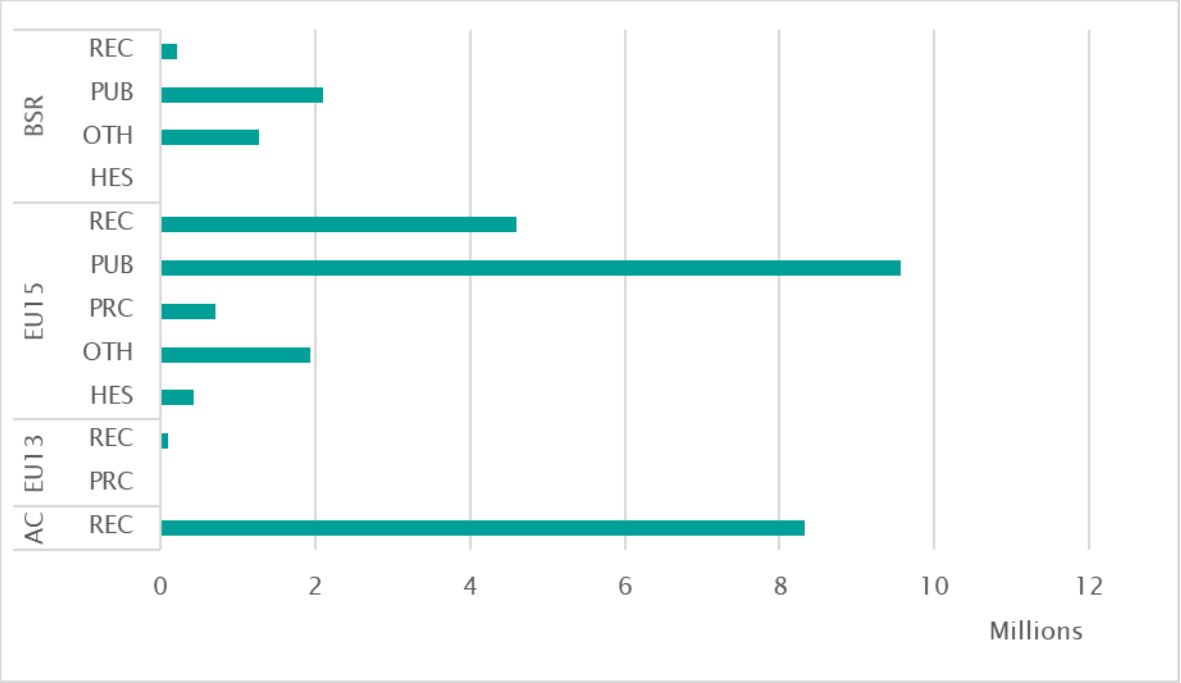

Figure 18 EC Contribution for PCP Cofund actions

Source: Authors' calculations based on eCORDA.

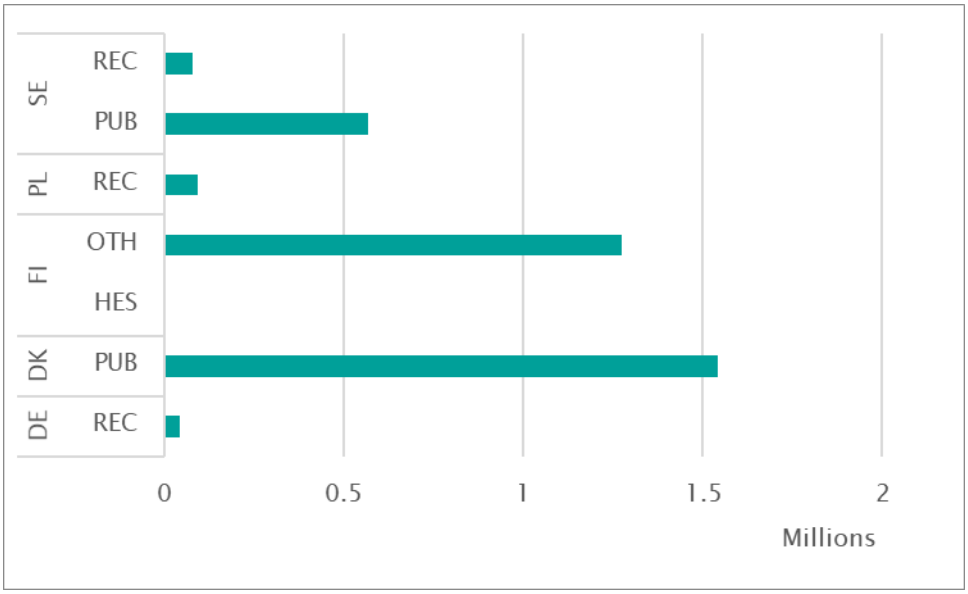

Figure 19 EC Contribution for PCP Cofund actions in BSR

Source: Authors' calculations based on eCORDA.

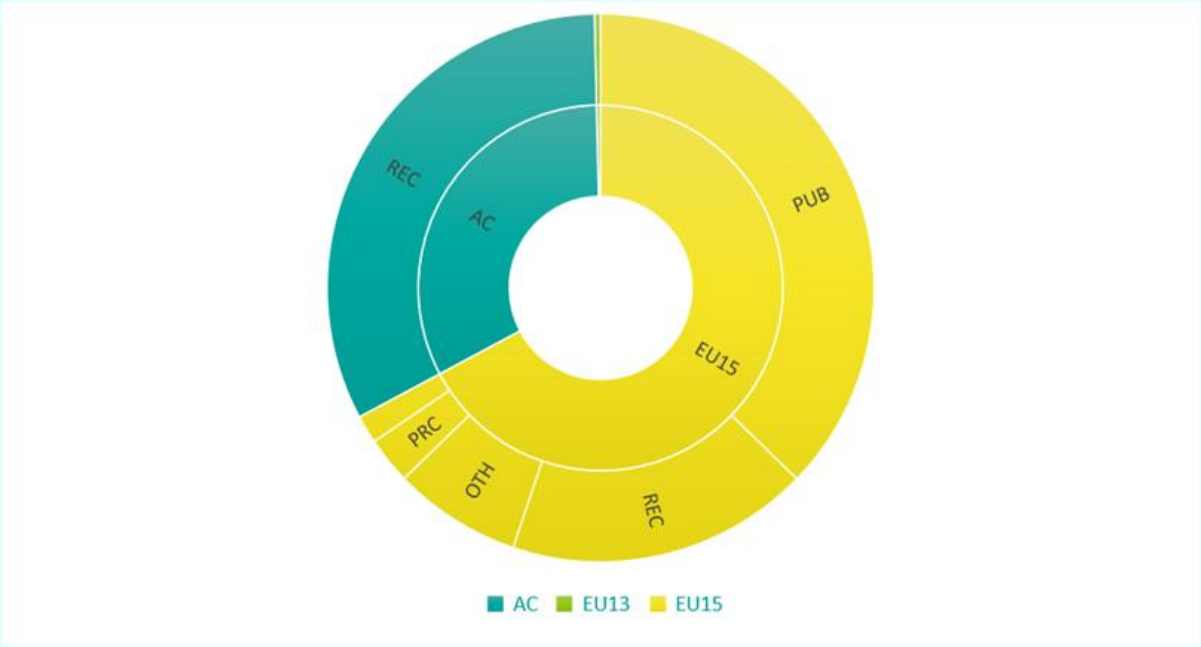

Figure 20 Share of EC Contribution for PCP Cofund actions by Membership Status and Type of Organisation

Source: Authors' calculations based on eCORDA.

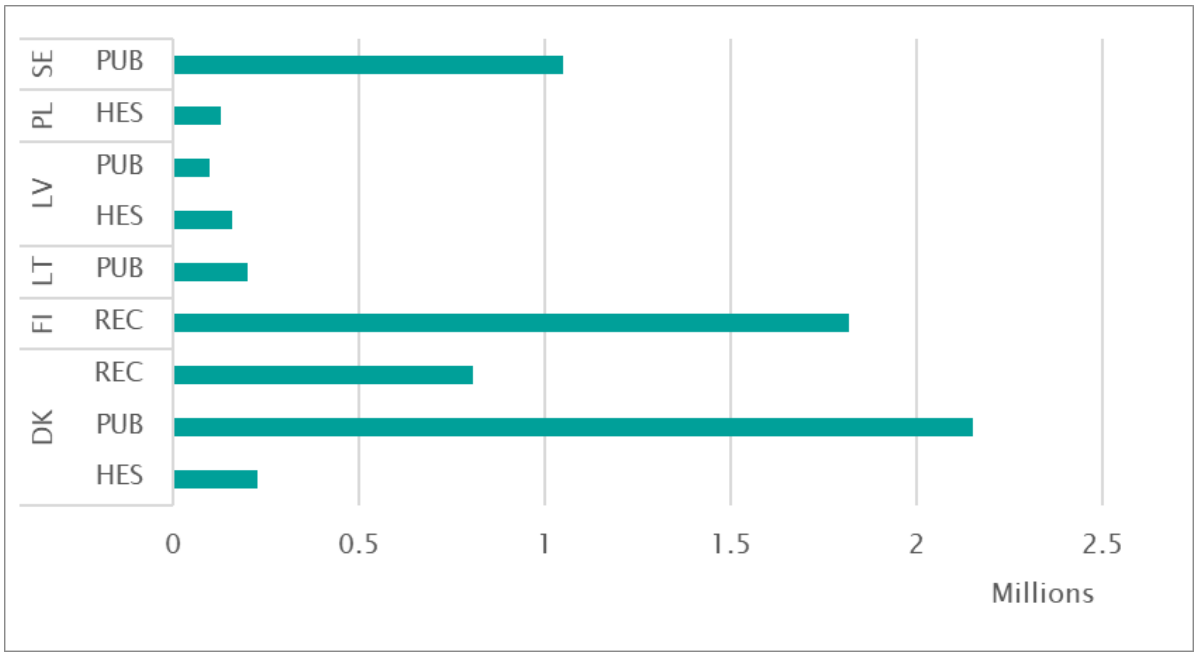

Figure 21 EC Contribution for EJPs in BSR

Source: Authors' calculations based on eCORDA.

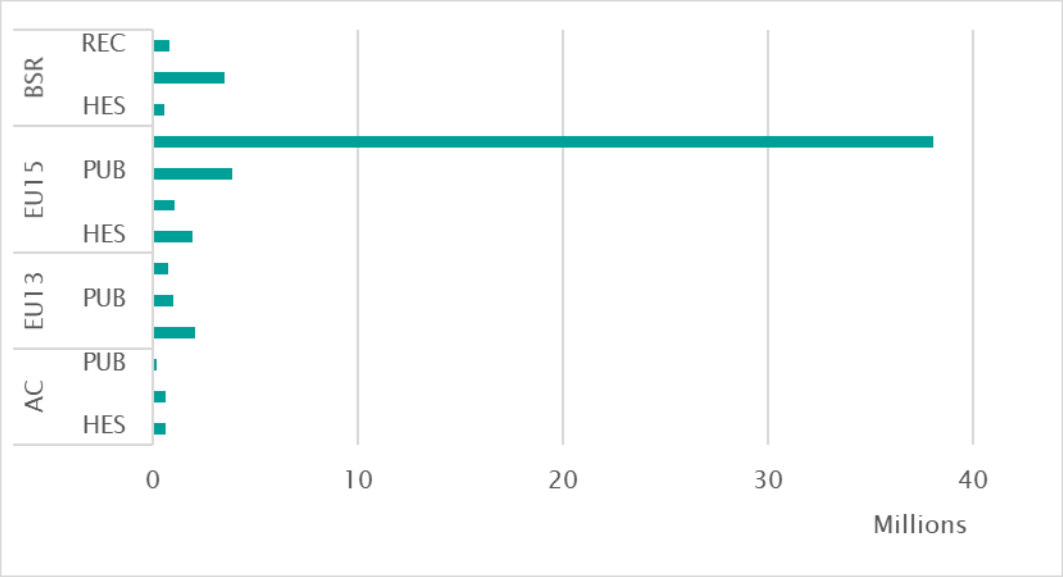

Figure 22 EC Contribution for EJPs

Source: Authors' calculations based on eCORDA.

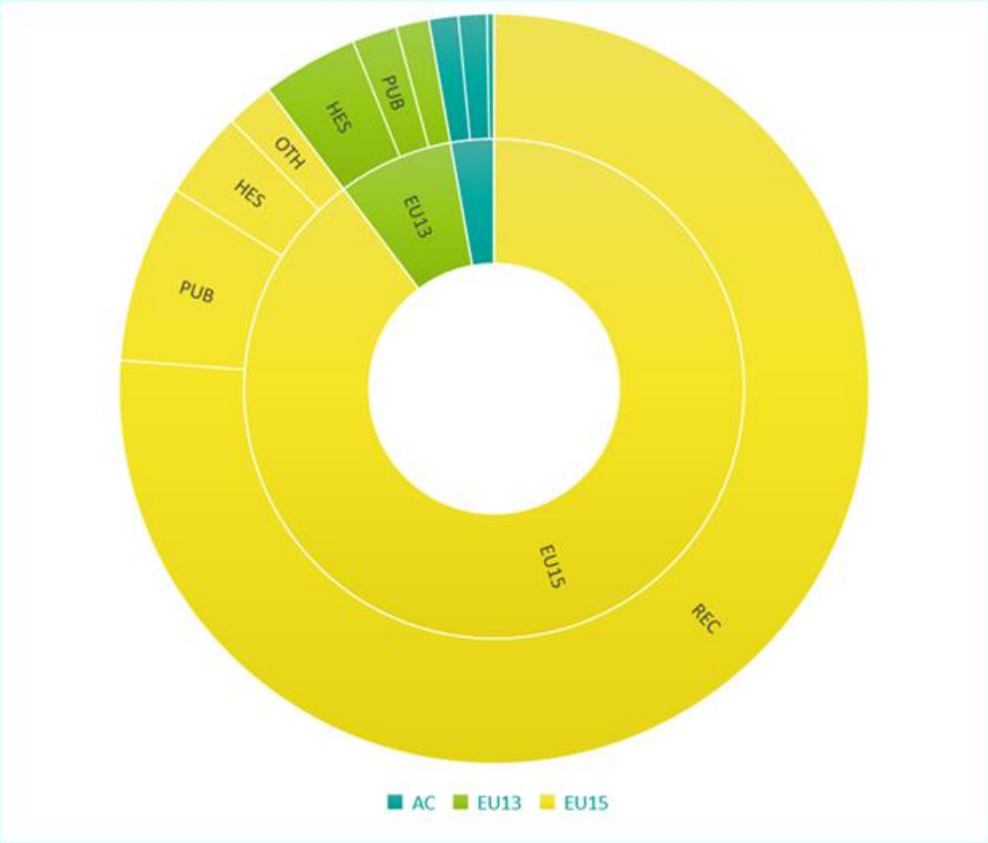

Figure 23 Distribution of EC Contribution for EJPs

Source: Authors' calculations based on eCORDA.

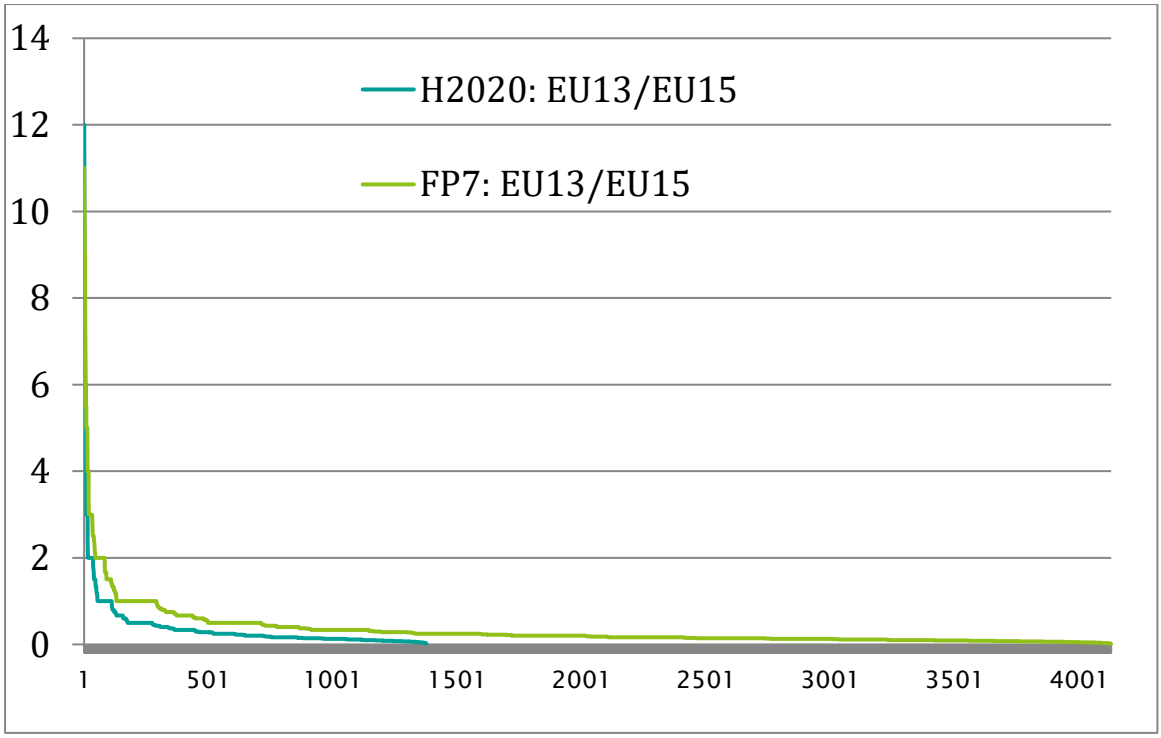

Figure 24 Ratios (Tolerance) of EU13/EU15 Participants in Granted Projects

Source: Authors' calculations based on eCORDA. Note: The 0-values are truncated, and the total number of projects in FP7 is 25,205 and H2020 is 10,966.

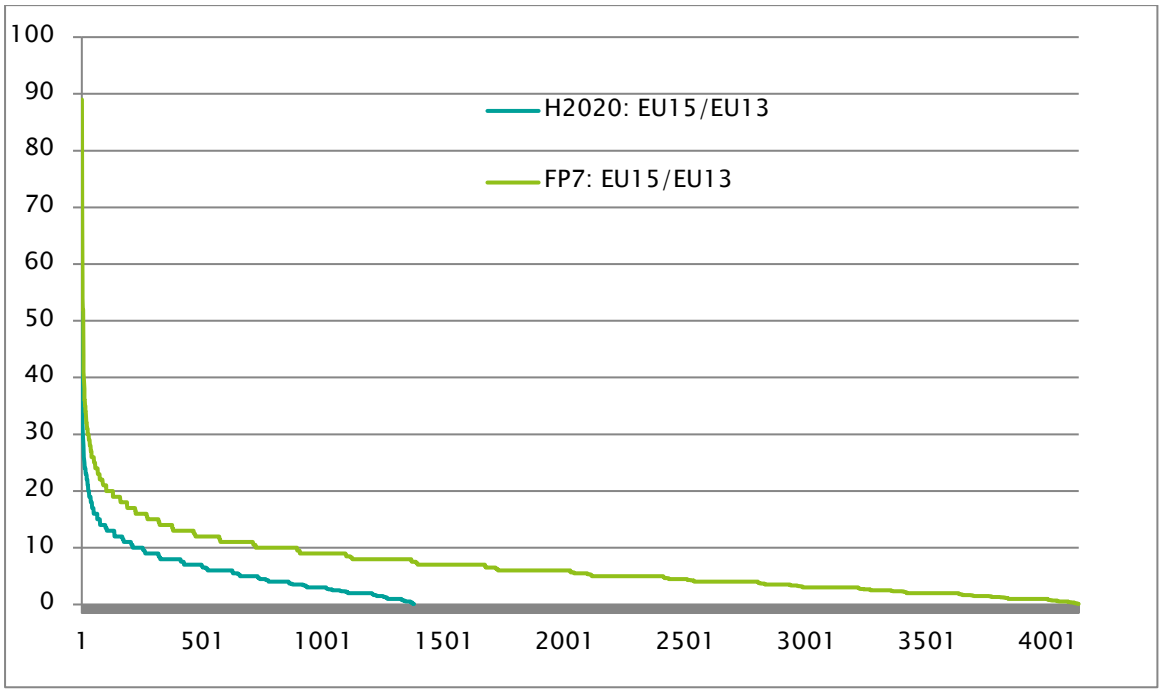

Figure 25 Ratios (Tolerance) of EU15/EU13 Participants in Granted Projects

Source: Authors' calculations based on eCORDA. Note: The 0-values are truncated, and the total number of projects in FP7 is 25,205 and H2020 is 10,966.

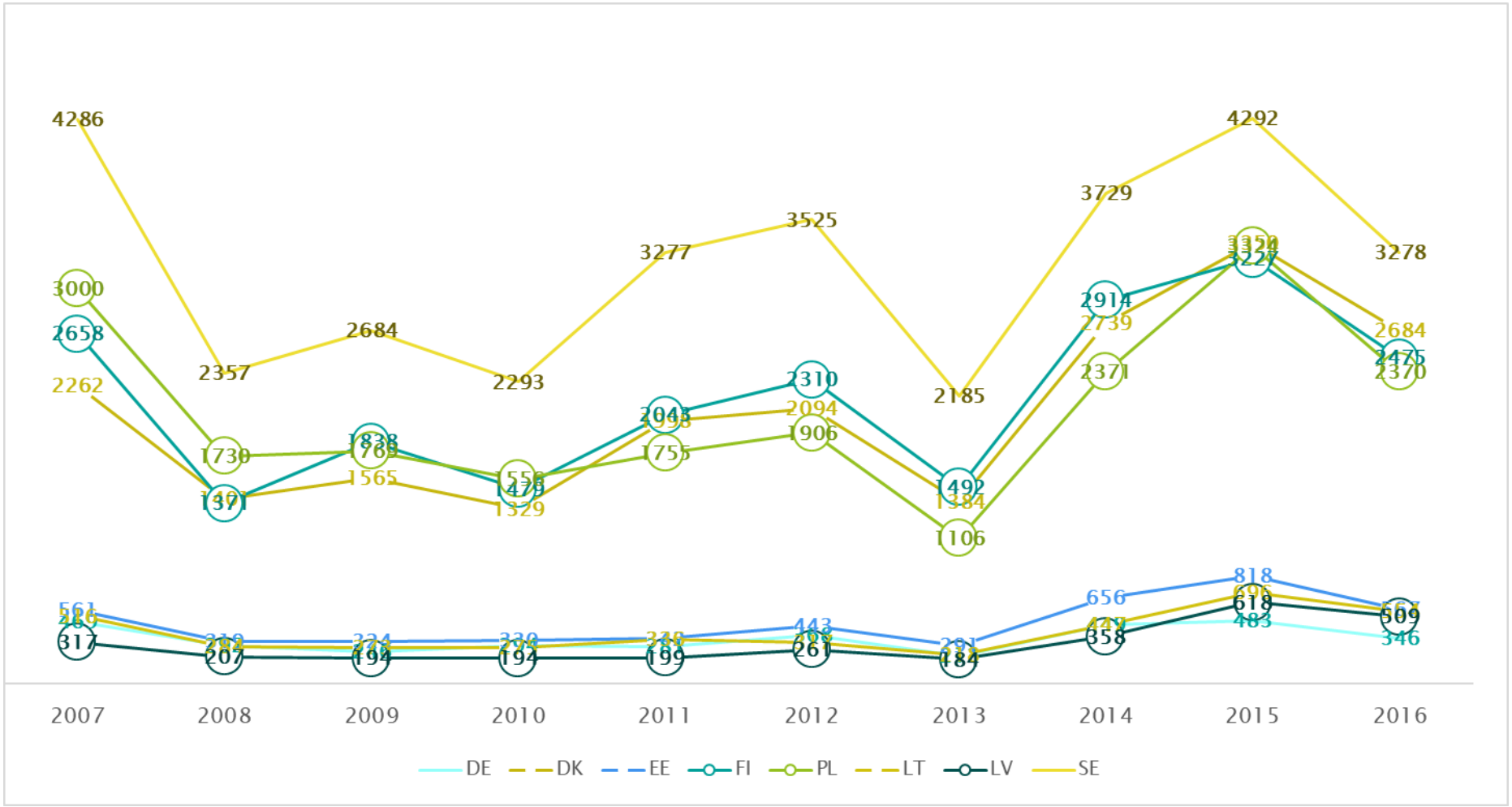

Figure 26 Number of Project Applications per year (2007-2013 FP7, 2014 Sum of FP7 and H2020, 2015-2016 H2020)

Source: Authors' calculations based on eCORDA.

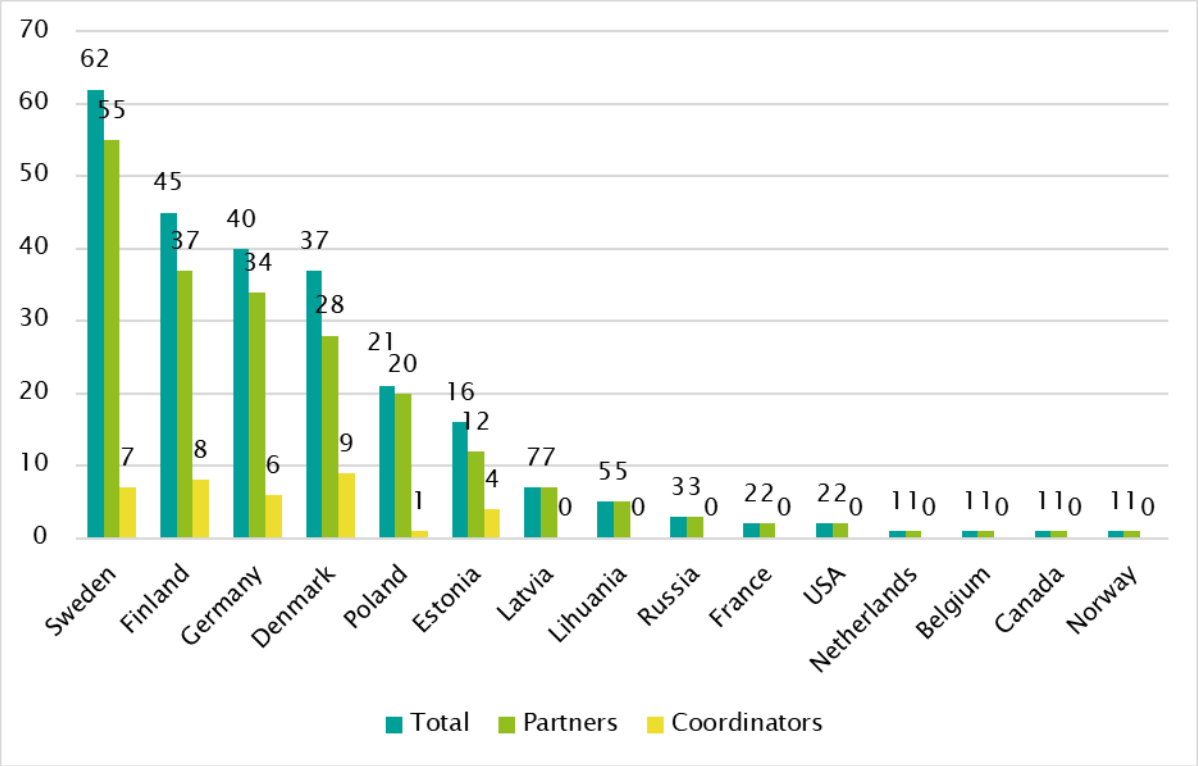

Figure 27 Participations in BONUS 2014–2020 projects by countries

Source: Authors' calculations based on BONUS projects (https://www.bonusportal.org/projects/).

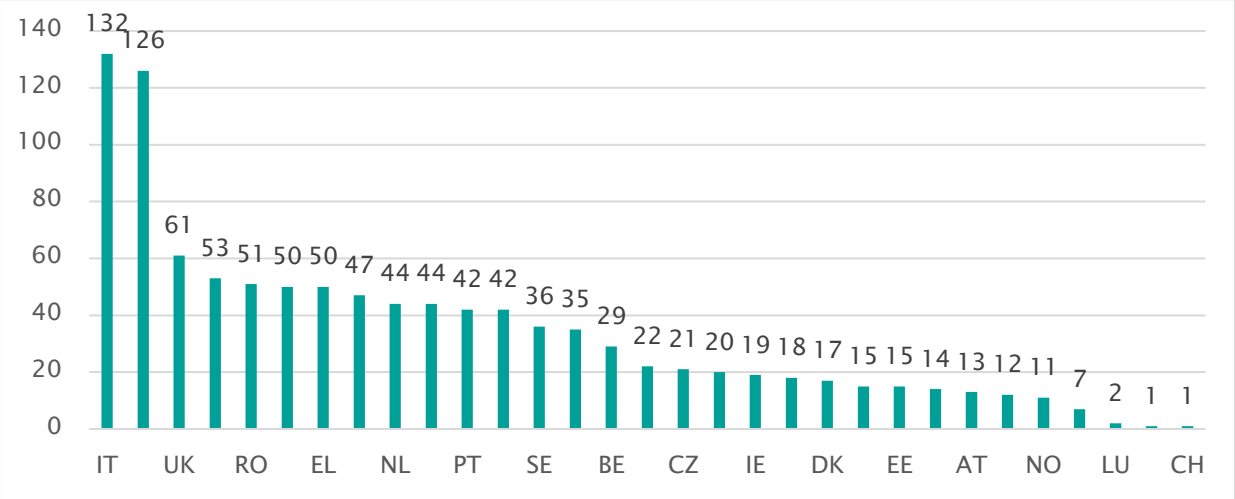

Figure 28 Participations in INTERREG 2016–2017 (as of September) projects by countries

Source: Authors' calculations based on INTERREG projects database.

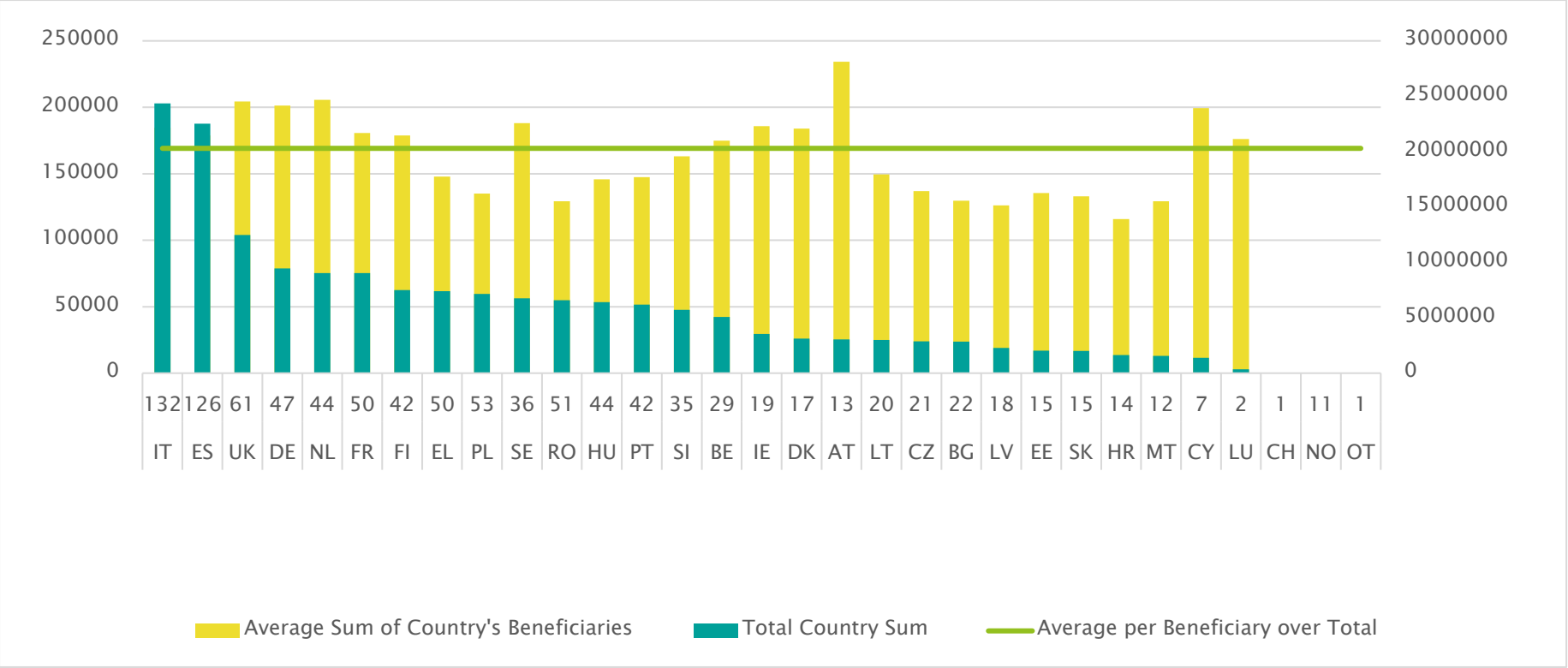

Figure 29 Funding of INTERREG 2016-2017 (as of September) Projects by Countries (total funding on the left axis and average on the right axis).

Source: Authors' calculations based on INTERREG projects database.

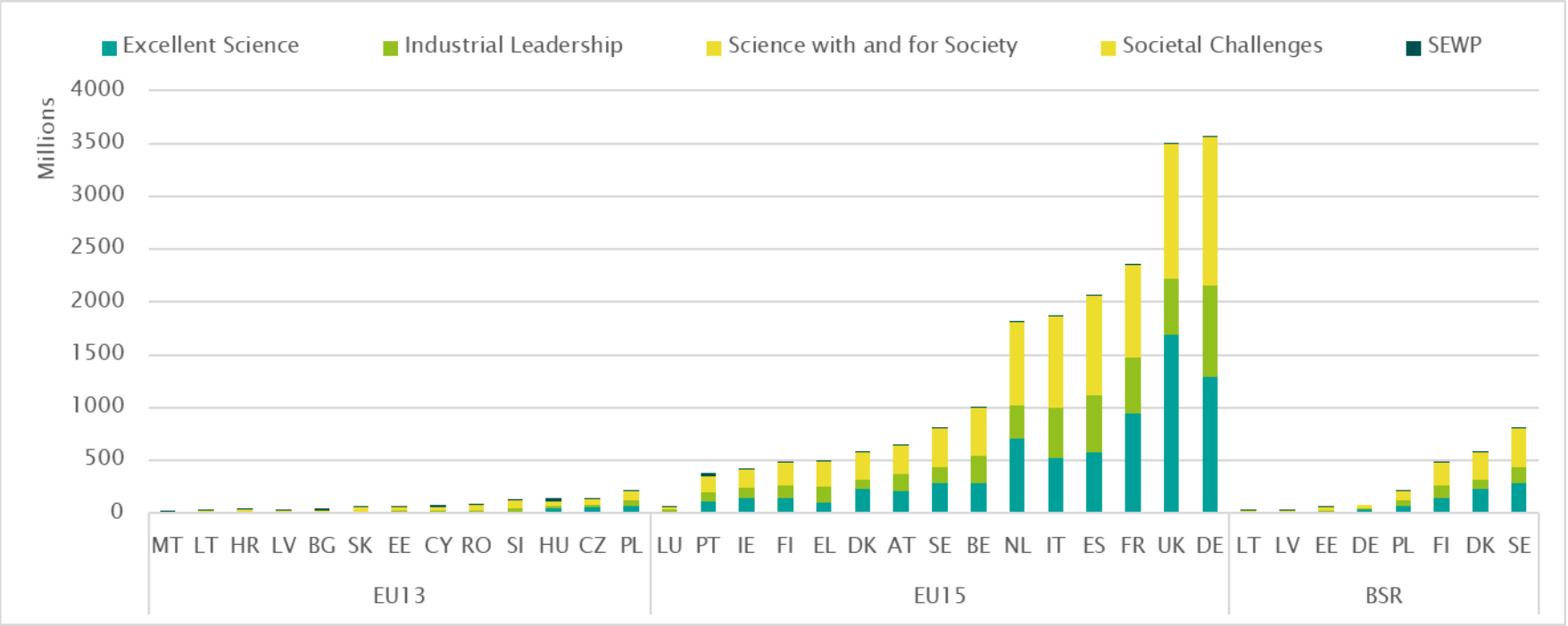

Figure 30 EC Contributions by H2020 Thematic Pillars

Source: Authors' calculations based on eCorda.

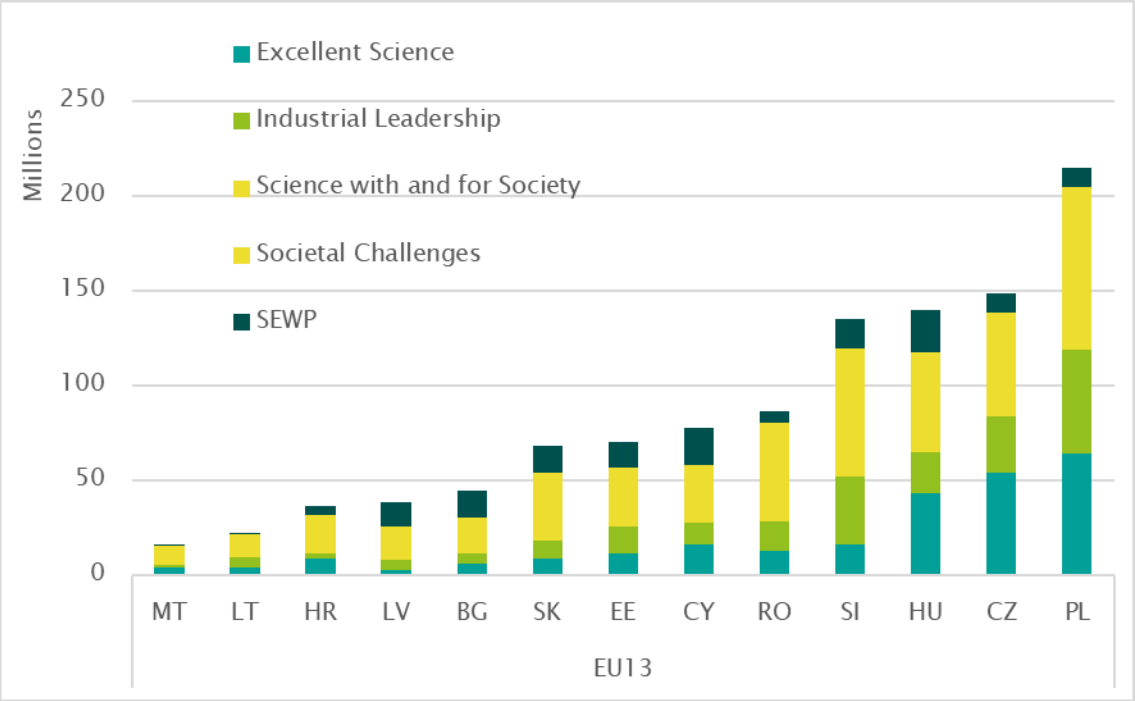

Figure 31 EC Contributions by H2020 Thematic Pillars, EU13

Source: Authors' calculations based on eCorda.

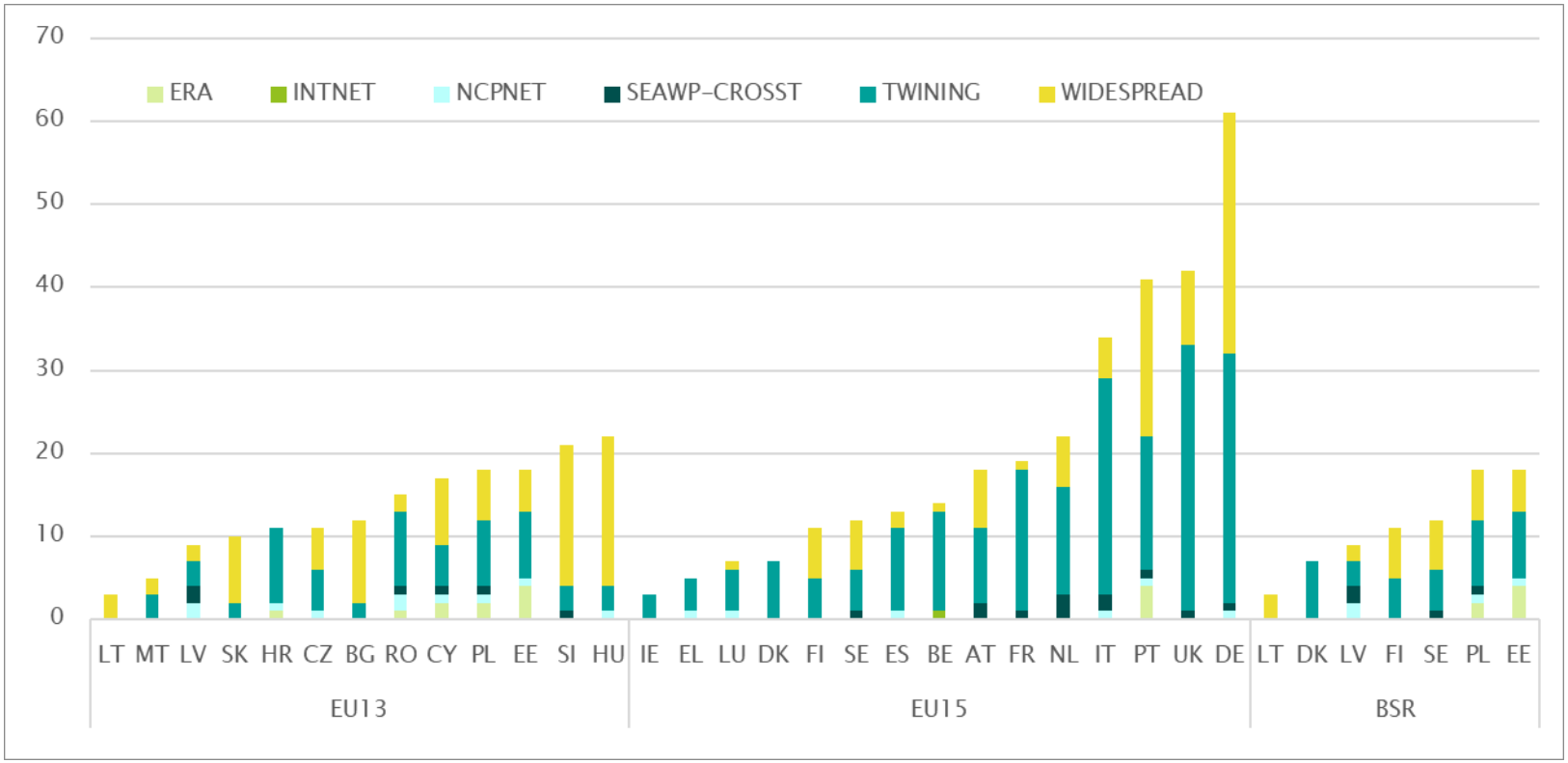

Figure 32 Numbers of Projects in H2020 Widening Pillars

Source: Authors' calculations based on eCorda.

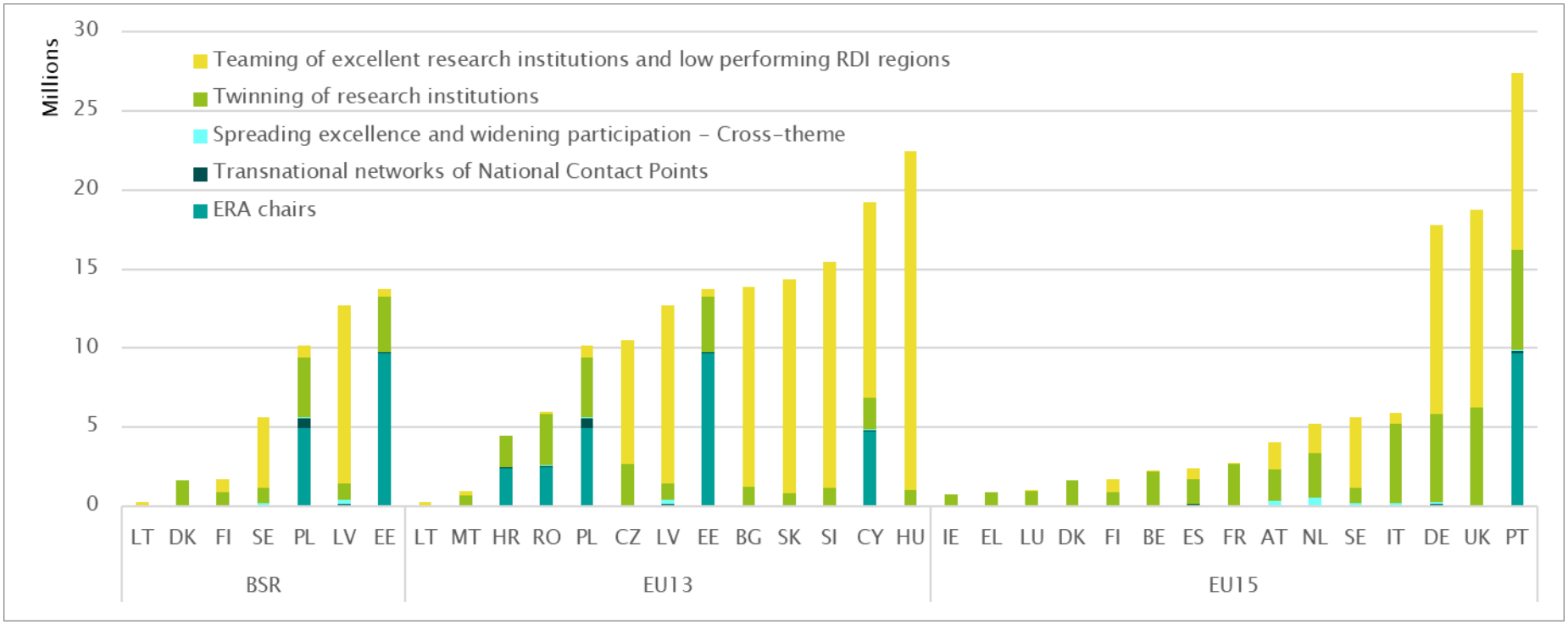

Figure 33 EC Contributions in Spreading Excellence and Widening Participation Pillar

Source: Authors' calculations based on eCorda.

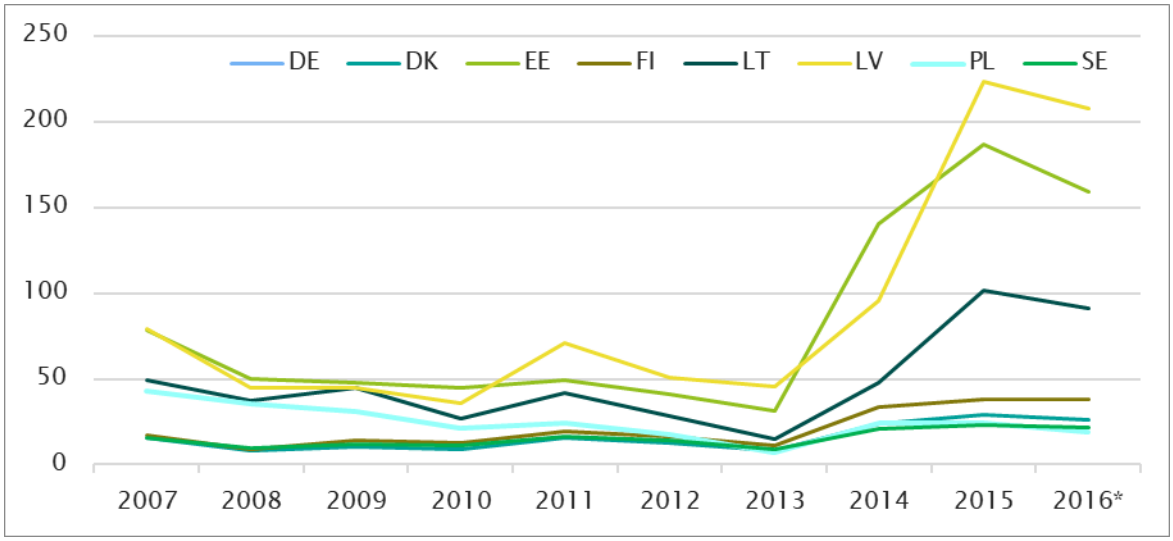

Figure 34 Applications of PRCs per 1000 R&D FTE in Business Enetrprise and Private Non-Profit Sectors

Source: Authors' calculations based on application data from eCORDA and Total R&D personnel by sectors of performance, occupation and sex [Table index: rd_p_persocc] from OECD.

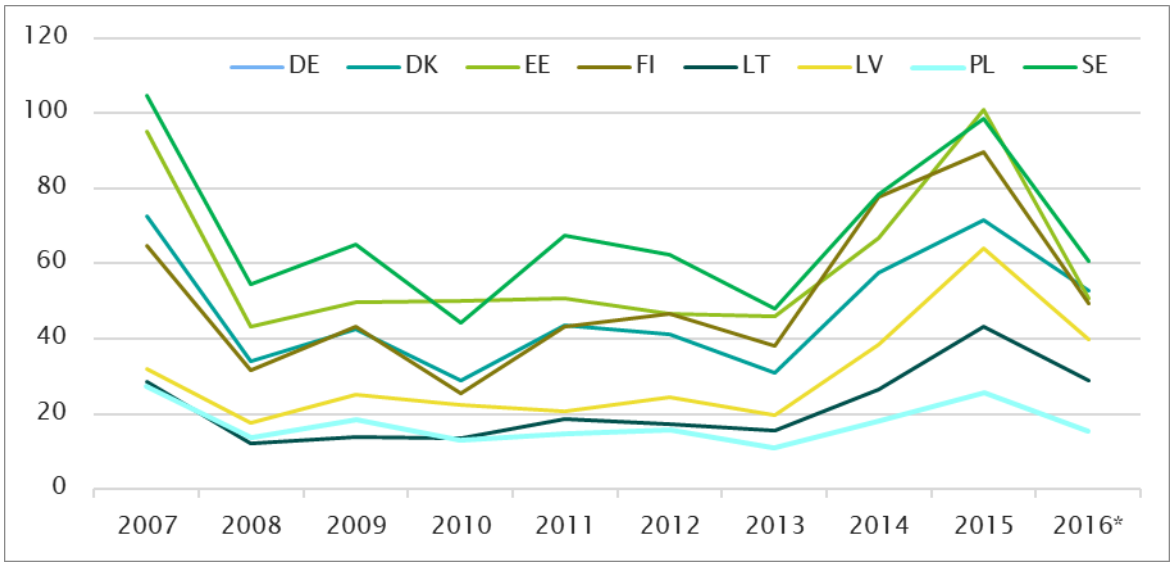

Figure 35 Applications of HES per 1000 R&D FTE in Higher Education Sector

Source: Authors' calculations based on application data from eCORDA and Total R&D personnel by sectors of performance, occupation and sex [Table index: rd_p_persocc] from OECD.

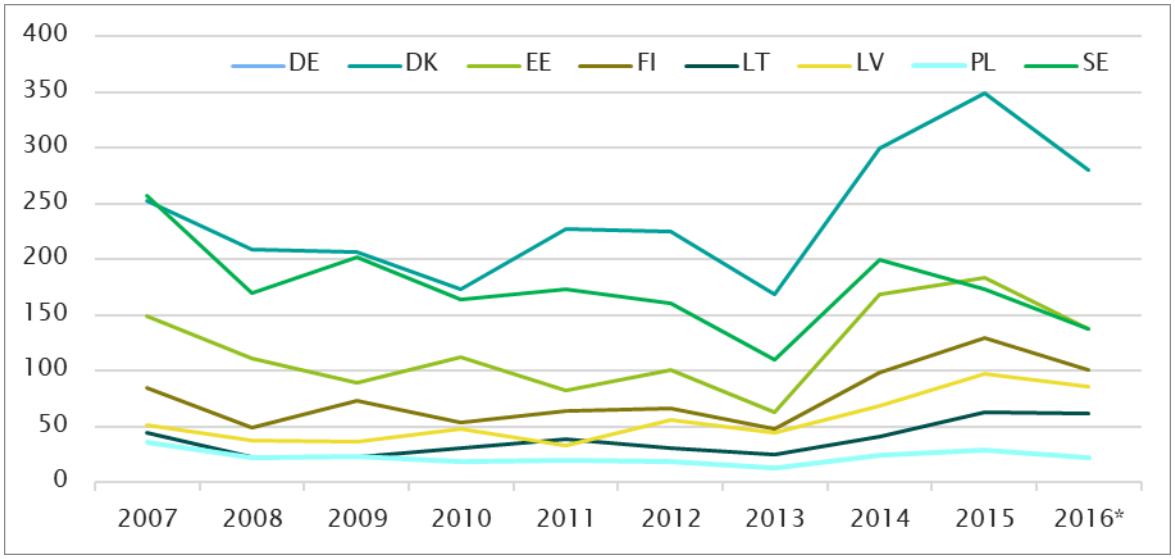

Figure 36 Applications of PUB and RECs per 1000 R&D FTE in Government Sector

Source: Authors' calculations based on application data from eCORDA and Total R&D personnel by sectors of performance, occupation and sex [Table index: rd_p_persocc] from OECD.

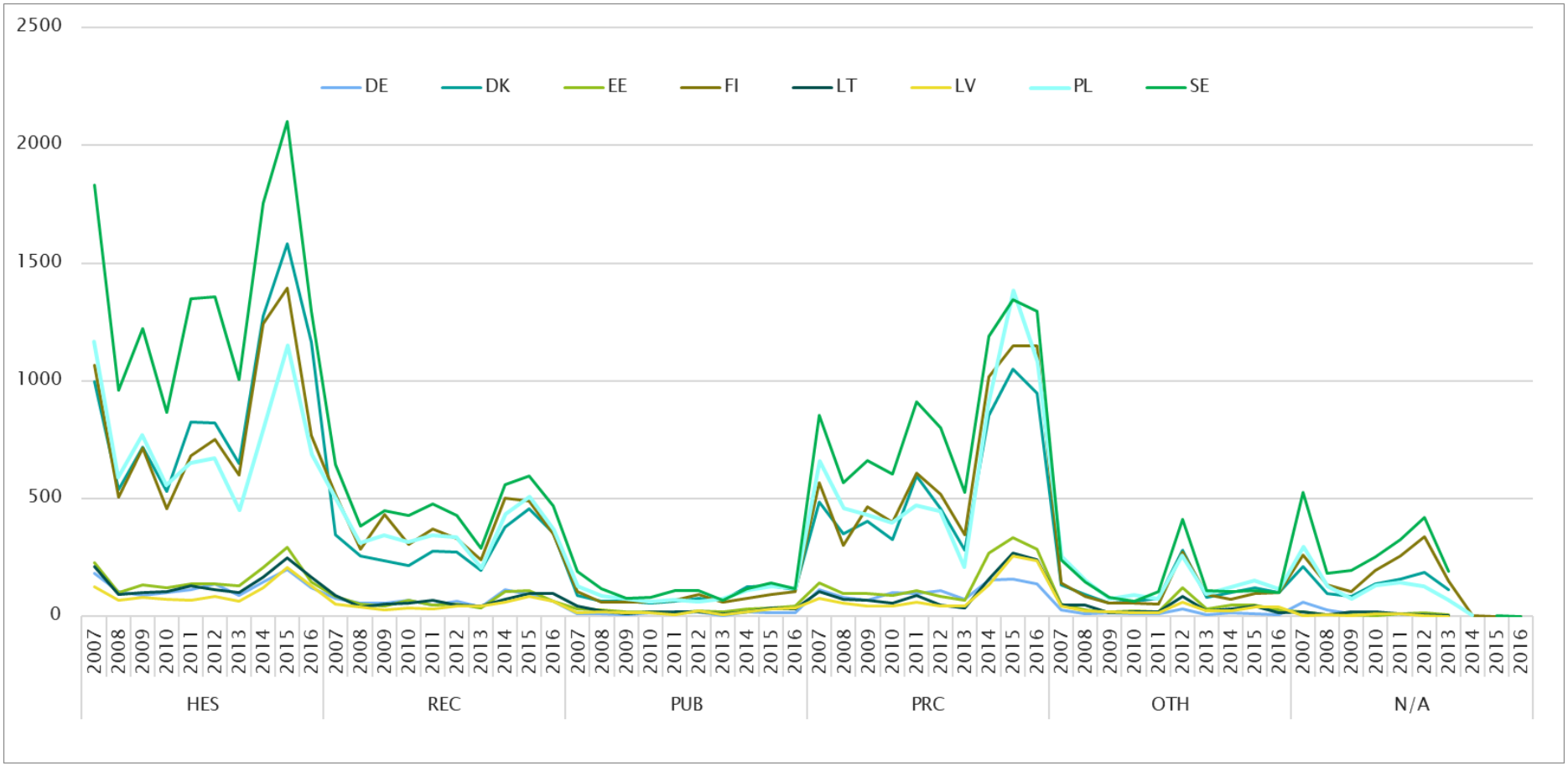

Figure 37 Number of Applicationsby Types of Institutions

Source: Authors' calculations based on eCORDA.

Appendix 4: List of Interviewed Scientists, Entrepreneurs, Government Officials and Policy Makers

Target Group	Date	The representative
NATIONAL LEVEL		
UNIVERSITIES	10 April 2017	A focus group with Dr. Malle Krunks (Director and Lead Researcher) and Dr. Maarja Grossberg (Senior Researcher), School of Engineering, Department of Materials and Environmental Technology, TTÜ
	12 April 2017	A focus group with Prof. Jüri Elken and Prof. Urmas Lips, School of Science, Department of Marine Systems, TTÜ
	21 April 2017	A focus group with Prof. Gert Jervan, Prof. Jaan Raik and Prof. Maarja Kruusmaa, School of Information Technologies, Department of Computer Systems / Department of Computer Engineering, TTÜ
	25 April 2017	Dr. Kai Pata, Senior Researcher, School of Digital Technologies, Centre for Educational Technology, Tallinn University
	25 April 2017	Prof. Ellu Saar, School of Governance, Law and Society/previously Institute of International and Social Studies, Tallinn University
	17 May 2017	Prof. Erkki Truve, School of Science, Department of Chemistry and Biotechnology, TTÜ
	19 May 2017	A focus group with Prof. Jarek Kurnitski and Prof. Targo Kalamees, School of Engineering, Department of Civil Engineering and Architecture, TTÜ
	2 June 2017	A focus group with Prof. Maaja Vadi and Prof. Urmas Varblane, School of Economics and Business Administration, University of Tartu
	20 June 2017	Dr. Marco Kirm, Vice Rector of Research, University of Tartu
	22 June 2017	Prof. Ülle Jaakma, Vice Rector of Research, Estonian University of Life Sciences
NCPs	30 May 2017	A focus group with Ülle Must (Chief Specialist, Joint Research Centre, other forms of International collaboration, incl. COST), Margit Ilves (Senior Advisor Financial Aspects, SMEs, EIT), Ülle Napa (Senior Advisor on Climate Action, Environment, Resource Efficiency and Raw Materials)
ENTERPRISES		
	28 April 2017	Rene Jõeleht, CEO, Optofluid Technologies OÜ
	5 May 2017	Dr. Peeter Laud, Scientific Director, Cybernetica AS

Target Group	Date	The representative
	23 May 2017	Silver Toomla, Managing Partner / Senior Consultant, Invent Baltics OÜ
	13 June 2017	Dr. Jako Kilter, Power System Expert, Elering AS / Associate Professor, School of Engineering, Department of Electrical Power Engineering and Mechatronics, TTÜ
	29 May 2017	Dr. Peep Küngas, CEO of SOA Trader OÜ, Senior Research Fellow at University of Tartu, Institute of Computer Science.
INTERNATIONAL (REGIONAL) LEVEL		
	19 June 2017	Skype interview with Mr. Jakob Just Madsen, Head of office, DANRO (The Danish EU Research Liaison Office)
	26 April 2017	Interview with Mr. Leif Eriksson, Swedish Research Council
	26 April 2017	Interview with Mr. Andreas Mahlzahn, Ministry of Social Affairs, Health, Science and Equality, Schleswig Holstein
	26 April 2017	Interview with Mr. Klaus von Lepel, Ministry of Science, Research and Equalities, Hamburg
	28 March 2017	Focus group with Prof. Jarmo Kortelainen and Dr. Petri Kahila, University of Eastern Finland

Appendix 5: List of Abbreviations

Abbreviation	Description
Art. 185	Article 185 of the Treaty on the Functioning of the European Union (TFEU) enables the EU to participate in research programmes undertaken jointly by several Member States, including participation in the structures created for the execution of national programmes.
BONUS	BONUS is a joint Baltic Sea research and development programme producing knowledge to support development and implementation of regulations, policies and management practices specifically tailored for the Baltic Sea region.
BOVA	The Baltic Forestry, Veterinary and Agricultural University Network
BSN	Baltic Science Network
BSR	Baltic Sea Region
BSRUN	Baltic Sea Region University Network
BUP	Baltic University Programme
CBSS	Council of the Baltic Sea States
CEE	Central and Eastern Europe
CEF	Connecting Europe Facility
COFUND-EJP	European Joint Programme Cofund
COSME	European Union Programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises
COST	European Cooperation on Science and Technology
CSA	Coordination and Support Action
EC	European Commission
EEA	European Economic Area
EEIG	European Economic Interest Grouping
EIP	European Innovation Partnership
EIT	European Institute for Innovation and Technology
ERA	European Research Area
ERA-NET	European Research Area Net
ERC	European Research Council
ESIF	European Structural Investment Funds
ETP	European Technology Platform
EU	European Union
EU13	BG – Bulgaria, CZ – Czech Republic, CY – Cyprus, EE – Estonia, HR – Croatia, HU – Hungary, LT – Lithuania, LV – Latvia MT – Malta, PL – Poland, RO – Romania, SI – Slovenia, and SK – Slovakia
EU15	AT – Austria, BE – Belgium, DE – Germany, DK – Denmark, EL – Greece, ES – Spain, FI – Finland, FR – France, IE – Ireland, IT – Italy, LU – Luxembourg, NL – Netherlands, PT – Portugal, SE – Sweden and UK – United Kingdom
EUA	European University Association
EUSBSR	EU Strategy for Baltic Sea Region

FET	Future and Emerging Technologies
FP	Framework Programme
FP7	7th Framework Program
FTI	Fast Track to Innovation
GUILD	Guild of European Research-Intensive Universities
GVCs	Global Value Chains
H2020	Horizon 2020
HEI	Higher Education Institution
HELCOM	Baltic Marine Environment Protection Commission – Helsinki Commission
HES	Higher or secondary education institution
IA	Innovation Action
ICT	Information and Communication Technologies
INTERREG	Community initiative which aims to stimulate interregional cooperation
JPI	Joint Programming Initiative
JRC	Joint Research Centre
JTI	Joint Technology Initiative
KIC	Knowledge and Innovation Community
LEIT	Leadership in Enabling and Industrial Technologies
LERU	League of European Research Universities
MSCA	Marie-Skłodowska-Curie Actions
NARMA	Norwegian Network for Administration and Research Management
NCM	Nordic Council of Ministries
NCP	National Contact Points
NOVA	The Nordic Forestry, Veterinary and Agricultural University Network
OTH	Other institution type
P2P	Public to Public Partnership
PCP	Pre-Commercial Procurement
PPI	Public Procurement of Innovation Solutions
PPP	Public-Private Partnerships
PRC	Private for-profit (excluding education) institution
PRC	Private firms
PUB	Public body (excluding research and education)
RDI	Research, development and innovation
REC	Public-sector research institutes
RI	Research Infrastructures
RIA	Research and Innovation Actions
S2E	Stairway to Excellence
SC1	Societal Challenge 1: Health, demographic change and wellbeing
SC2	Societal Challenge 2: Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy
SC3	Societal Challenge 3: Secure, clean and efficient energy
SC4	Societal Challenge 4: Smart, green and integrated transport
SC5	Societal Challenge 5: Climate action, environment, resource efficiency and raw materials

SC6	Societal Challenge 6: Europe in a changing world – inclusive, innovative and reflective societies
SC7	Societal Challenge 7: Secure societies protecting freedom and security of Europe and its citizens
SEWP	Spreading Excellence and Widening Participation
SME	Small or Medium-Sized Enterprise
STRING	STRING as an organisation is a political crossborder partnership between Hamburg and Schleswig-Holstein in Germany, the Capital Region of Denmark, the Region Zealand and the City of Copenhagen in Denmark, and the Region Skåne in Sweden.
SWAFS	Science with and for Society
TRL	Technology Readiness Levels are indicators of the maturity level of particular technologies. This measurement system provides a common understanding of technology status and addresses the entire innovation chain: TRL 1 – basic principles observed; TRL 2 – technology concept formulate; TRL 3 – experimental proof of concept; TRL 4 – technology validated in lab; TRL 5 – technology validated in relevant environment; TRL 6 – technology demonstrated in relevant environment; TRL 7 – system prototype demonstration in operational environment; TRL 8 – system complete and qualified; TRL 9 – actual system proven in operational environment
UNI	Universities
UNIMED	Mediterranean Universities Union
VASAB	Vision and Strategies Around Baltic Sea. VASAB is intergovernmental multilateral co-operation of 11 countries of the BSR in spatial planning and development.
WP	Work Package