



Constraints and possibilities

A comparative study of public support to industry-oriented research and development

Michael Spjelkavik Mark, Espen Solberg, Bo Sarpebakken and Christian Hambro (Gram, Hambro & Garman)

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Preface

The Research Council of Norway has several funding schemes for public funding of industry-oriented research and development (R&D). The aim of this study is to investigate funding schemes in five other European countries, both in term of funding mix and patterns, what are the most important schemes in other countries and finally to which degree EU State Aid rules affects design and magnitude of support.

The study is commissioned by The Research Council of Norway.

We would like to thank all informants in Sweden, Finland, The Netherlands, United Kingdom and France for their contribution. The information provided is a cornerstone in the study.

The report is written by Espen Solberg (NIFU) in particular Chapter 1 and 2, Christian Hambro (Gram, Hambro & Garman) with a particular focus on Chapter 4, State Aid rules and parts of Chapter 3. Bo Sarpebakken assisted with figures in chapter 2 and project manager Michael Spjelkavik Mark have written Chapter 3, parts of Chapter 1, 2 and 4 and had the overall responsibility. The authors thanks Markus M. Bugge and Olav R. Spilling for contribution during the making of the report.

Oslo, June 2017

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Sammenfatning

Mange land har klare ambisjoner om styrke forskning og utvikling (FoU) i næringslivet. Det er bred faglig og politisk enighet om at staten må bidra på ulike måter. Derfor finnes det også en rekke offentlige støtteordninger og mekanismer som skal utløse mer FoU i næringslivet.

Hensikten med denne studien er å finne ut hvordan statlige midler til næringsrettet FoU kanaliseres til bedrifter, forskningsinstitutter og universiteter i seks ulike land. Et hovedformål er å gi et bedre grunnlag for å kunne forbedre og justere de norske finansieringsmidlene for næringsrettet FoU. En sentral del av oppdraget har vært å undersøke om EUs statsstøtteregulering påvirker innretningen og omfanget av offentlig finansiering av næringsrettet FoU i ulike land.

En hovedkonklusjon i rapporten er at statsstøttereguleringen i liten grad påvirker hvor mye myndighetene er villig til å støtte næringslivets forskning. Reguleringen virker å være såpass romslig at det sjelden er behov for å gå over de tersklene som er satt. Samtidig kan det være krevende å forholde seg til alle sider ved reguleringen, og dermed kan mange aktører falle ned på trygge, velprøvede løsninger framfor å utfordre mulighetsrommet.

Kort om studien

Oppdraget omfatter for det første en sammenstilling av tilgjengelige data om offentlig finansiering av næringslivets FoU i de seks landene Norge, Sverige, Finland, Nederland, Storbritannia og Frankrike. Videre har vi gjort desk-studier samt intervjuer og oppfølgende dialog med nasjonale eksperter i de seks landene som analysen omfatter. I kort trekk har vi analysert:

- Struktur og omfang av offentlig støtte til næringsrettet FoU, herunder hvilke aktører som deltar, hva slags roller de har og hvordan de samspiller mellom seg. Dessuten gir FoU-statistikken mulighet for å se på fordeling og omfang av støtten.
- Innretning av nasjonale systemer for offentlig støtte til næringsrettet FoU. Herunder hvilke ordninger som anvendes og hvordan disse ordninger er designet.
- Hvilke konsekvenser statsstøttereguleringen har for organisering av offentlig støtte til næringsrettet FoU? Hvordan håndteres forskjell mellom økonomisk og ikke-økonomisk aktivitet? I hvilken grad skiller det mellom «effective collaboration» (effektivt samarbeid) og «contract research» (oppdragsforskning) og hvordan håndteres deling av resultater og rettigheter?

Struktur og omfang av offentlig støtte til næringsrettet FoU

Studien avdekker til dels store forskjeller mellom de seks landene når det gjelder omfang av offentlig støtte til næringsrettet FoU. For eksempel anvender Frankrike 0,39 % av BNP og Finland bare 0,07 % av BNP til dette formålet. Blant de seks landene vi har studert, ser vi at land med lav og synkende

offentlig støtte også opplever stagnasjon eller nedgang i næringslivets samlede FoU. Det kan indikere at offentlig støtte har en vesentlig betydning, uten at vi dermed kan påvise en kausal sammenheng.

Vi ser også store forskjeller mellom de seks landene når det gjelder balansen mellom direkte og indirekte støtte til næringsrettet FoU. Mens Frankrike og Nederland gir mye av støtten i form av skattelette til FoU, har Sverige og Finland nesten utelukkende direkte støtte. Norge og Storbritannia har på sin side større grad av balanse mellom skattelette og direkte finansiering.

Innretning av nasjonale finansieringskilder

Samtidig er det forskjell på hvordan de viktigste direkte virkemidlene er innrettet. I Norge er de viktigste virkemidlene innrettet som enten enkeltprosjekter eller rundt en senterstruktur. Slik er det også i Storbritannia. Frankrike og Finland opererer kun med enkeltstående prosjekter i deres viktigste virkemidler, mens Sverige og Nederland i tillegg til enkeltprosjekter også gir støtte til større konsortier. En viktig forskjell er hvem som er formell kontraktspartner når tildelingen går til flere partnere: I Norge, Sverige, Finland og Nederland inngås kontrakten med prosjektleder, mens det i Storbritannia og Frankrike inngås egne kontrakter med hver partner.

Generelt er det åpen konkurranse om midlene, med stor frihet til å innrette prosjektene. Men en del ordninger har også restriksjoner som knytter seg til hvilke temaer man kan søke om og hvilke institusjoner som kan stå som leder av prosjektene. Eksempelvis har Norge en rekke tematiske programmer med klare føringer på hvilke temaer man kan søke midler til. I ulike senterordninger er det ofte kun forskningsinstitusjoner som kan fronte søknaden og innta vertsrollen for senteret. Det samme gjelder for støtte til konsortier, som er mer utbredt i Sverige og Nederland.

Suksesskriteriene i Norge knytter seg hovedsakelig til vitenskapelig kvalitet, innovasjonspotensial, gjennomførbarhet samt prosjektteamets kompetanse. De samme kriteriene er i stor grad sentrale også i de øvrige landene. Finland skiller seg noe ut ved å legge større vekt på søknadens troverdighet og prosjektets gjennomførbarhet. Derfor har myndighetene i Finland ofte en tettere dialog med søkere. Frankrike skiller seg enda mer ut ved å legge mye større vekt på forretningsplaner, cashflow-analyser og vurderinger av kommersialiseringspotensial.

Statsstøtteregelverket og offentlig støtte til næringsrettet FoU

Generelt viser NIFUs intervjuer og analyser at landene forholder seg til statsstøtteregelverket. I de fleste tilfeller blir nye ordninger meldt inn under det såkalte gruppeunntaket, dvs. at de oppfyller faste krav til rammer for statsstøtte. I Sverige og Finland finnes det også generelle nasjonale retningslinjer som er tilpasset statsstøtteregelverket. Det er likevel ingen av landene som gir uttrykk for at statsstøtteregelverket har hatt noen stor betydning for innretningen av den offentlige støtten til næringsrettet FoU. Dette fordi programmene i utgangspunktet er designet godt innenfor de gjeldende reglene for statsstøtte.

I de enkelte landene er det en viss oppmerksomhet om distinksjonen mellom kontraktsforskning og det som kalles «effektivt samarbeid». Forskjellen mellom de to er enkelt sagt at den første handler om at kjøp av en tjeneste skal skje etter markedspris og markedsprinsipper, mens den andre (effektivt samarbeid) handler om et gjensidig samarbeid hvor partene har et mer likeverdig forhold når det gjelder mål, gjennomføring og resultater av samarbeidet.

Alle landene vi har sett på, opererer med forskjellige former for effektivt samarbeid, men ikke ut fra et ønske om å maksimere rammen for å gi offentlig støtte. Her er, som nevnt, rammene for statsstøtte ikke den største begrensningen. Når mer av støtten rettes mot «effektivt samarbeid» er det først og fremst begrunnet med at slikt samarbeid i større grad bidrar til at kunnskapen spres til og brukes av flere aktører og dermed skaper flere såkalte eksternaliteter. En dansk studie gjennomført i 2011 påviste betydelige økonomisk effekt for virksomheter som inngikk i et forskningssamarbeid med forskningsinstitusjoner, mens virksomheter som inngikk i kontraktbasert forskningssamarbeid ikke hadde like høy økonomisk effekt av samarbeidet, (Mark, Alslev Christensen, & Frosch, 2011).

Skillet mellom økonomisk og ikke-økonomisk aktivitet

Forskningsinstitusjoner som driver med økonomisk aktivitet, så som kontraktsforskning og utleie av forskningsutstyr, risikerer å bryte med reglene i statsstøttereguleringen. Det kan for eksempel skje dersom offentlig finansiert forskningsutstyr, bygg og laboratorier gjøres tilgjengelig for næringslivet, gratis eller til en pris der ikke avspeiler markedsverdien. Det er derfor et krav at det gjøres et tydelig skille mellom økonomisk aktivitet og ikke-økonomisk aktivitet. For Norge gjelder det at forskningsinstitutter som mottar statlig støtte, er forpliktet til å føre separate regnskaper for økonomisk versus ikke-økonomisk aktivitet. Det samme gjelder for forskningsinstitutter i de øvrige landene. Unntaket er instituttene underlagt den franske paraplyorganisasjonen CNRS i Frankrike, som ikke driver med økonomisk aktivitet. Den generelle vurdering fra informantene er at skillet mellom økonomisk og ikke-økonomisk aktivitet er kulant, men at det ofte kan være vanskelig å tallfeste verdien av de tjenester som tilbys til næringslivet.

Økonomisk aktivitet i forskningsinstituttene kan ofte være i form av inntekter fra oppdragsforskning for næringslivet. I Norge er inntekter til institutt sektoren fra næringslivet på 55% av samlet inntekt. I Sverige er det tilsvarende tallet 53% og i Finland har VTT 30% av deres inntekter fra næringslivet. I Nederlandene er inntekter fra næringslivet til TNO 34%, mens CNRS ikke har slike inntekter. Vi mangler informasjon fra Storbritannia på denne dimensjonen.

Eierskap og deling av immaterielle rettigheter (IPR)

Når forskningsinstitusjoner og næringsliv inngår samarbeid, er målet å utvikle ny kunnskap, ny teknologi eller nye løsninger. Ifølge statsstøttereguleringen kan ikke næringslivet uten videre få tilgang på forskningsresultater fra samarbeid med institusjoner som har fått offentlig støtte. Tilgangen til forskningsresultater må motsvare næringslivets egen økonomiske og resursmessige bidrag til forsknings samarbeidet. I tillegg må næringslivet betale for å få tilgang til rettigheter til forskningsresultatene. Denne verdsettelsen skal, i prinsippet, skje utfra en markedspris.

Deling av forskningsresultater og -rettigheter er vanskelig. Det påpekes både av informantene i Norge og andre land. De fleste land peker på at bedrifter har mulighet til å be om en utsettelse av at forskningsresultater offentliggjøres og publiseres. Utsettelsen er som oftest under et halvt år.

Vanskeligere er det med prissetting av rettigheter til forskning. Våre intervjuer viser at forskningsinstitusjonene ofte forhandler direkte med næringspartnerne om hva som er markedsprisen. Intervjuene peker også på at det er en tendens til at prisfastsettelsen ender på en verdi som er lavere enn den «reelle» verdi. Det kan skyldes at forskningsinstitusjonene gjerne mangler profesjonalitet og innsikt i markeder, kombinert med at bedriftene naturlig presser på for å få en så lav pris som mulig.

Tilgang til forskningsinfrastruktur

Oppbygning og drift av forskningsinfrastruktur er oftest finansiert via offentlige midler. Hvis private foretak får tilgang på slik infrastruktur, for eksempel avanserte test- og laboratoriefasiliteter, uten å betale, kan det være i strid med statsstøttereglene. Det gjelder også hvis prisen er satt lavere enn markedspris. I Norge er næringslivet ofte med på å finansiere driften av forskningsinfrastruktur igjennom kjøp av ulike tjenester. Fra intervjuene ser vi at dette også er tilfellet i andre land. Sverige følger gruppeunntaket artikkel 26 i forhold til prissetting. Det samme gjør seg gjeldene i de øvrige land, der prissetting skjer etter enten til markedspris eller som et estimat på omkostninger.

I tilfeller hvor bruken av forskningsinfrastruktur inngår som en ikke-økonomisk aktivitet, gjelder de samme prinsipper som ved effektivt samarbeid. Og det samme er tilfellet for deling av forskningsresultater og rettigheter til forskningsresultatene. Dette gir selvsagt samme utfordring som beskrevet ovenfor med prissetting av markedspris for forskning.

1 Introduction

The main subject of this study is to find out how government funds for industry oriented R&D are channelled to businesses, research institutes and universities, directly or indirectly. The objective is to gather information, experience, ideas and opinions from other comparable states as a background for assessing the possibility of improving the Norwegian way of funding industry oriented R&D. Attention has been given to ascertaining whether the EU State Aid rules for R&D induce countries to organise the funding differently to how they would have done without the State Aid rules, and whether the funding would have been more generous without the State Aid rules. (OECD, Main Science and Technology Indicators, 2013, 2014)

To analyse the above-mentioned issues, we deploy different approaches and use different sources of data and information. This includes investigating the R&D systems of the six countries, i.e. Norway, Sweden, Finland, the Netherlands, the UK and France. The purpose of studying and comparing the R&D systems is to identify common features and differences, as well as to identify which actors are involved and what part they play in supporting and conducting industry-oriented R&D and how are they interrelated. Further we focus on the funders and beneficiaries of industry-oriented R&D and the level of funding. This is relevant to see how otherwise comparable countries have organised their funding and the funding mix and how the funding is channelled to various actors. Differences in the system, how funding is organised, the funding mix and the level of funding reveal potential alternative ways of organising funding of industry oriented R&D.

Investigating the R&D system does not provide a full picture of how funding for industry oriented R&D is channelled. Thus, we take a deeper look at the most important programs applied. Central questions asked here are:

- What type policy instruments are relevant for funding industry-oriented R&D, e.g. direct or indirect funding, grants, loans or repayable advances.
- How are projects in each program organised?
- Who is eligible for applying and funding?
- What is the total budget for the program?
- If there are several partners in a project is the contractual agreement with a project manager or with all participating partners?
- What kind of demands are there related to collaboration between businesses and institutions and what kind of financial requirements are there in a collaborative situation?

- Who assess the application and what are the main criteria for a successful application?

These questions add information to how government funds for industry-oriented R&D is channelled. And they also give information, inspiration and ideas as to how industry-oriented R&D could be funded in a Norwegian context.

Finally, another key subject is how EU State Aid rules induce countries to organise in a certain way. This, of course, will reveal a national interpretation of EU State Aid rules and how they align their funding mechanism and programs to comply with the rules. Questions of interest here will be how and to what extent the funding agencies and research institutes comply with EU State Aid rules, whether the rules are viewed as troublesome and constraining, or if the rules are seen as meaningful and not too big a hassle. This includes studying if there is a focus on the interpretation of effective collaboration and contract research, how economic and non-economic activities and the right to research results are handled and finally questions related to utilising research infrastructure. These are all important distinctions in understanding the implications of EU State Aid rules and will potentially affect how countries are designing and organising their funding.

1.1 The political backdrop

Increasing the R&D activity in industry is a highly prioritised area, both in Norway and many other countries (OECD 2014). In Norway, the relatively low level of R&D investment in the industry sector has long been a worry and a major rationale for public support to business R&D. Although Norwegian companies have shown a significant growth in R&D investments over the last few years, the recent drop in oil prices has heightened the urgency of developing new and more knowledge based industries.

In the so-called Sundvolden-declaration (2013), the current government stated a clear ambition to intensify measures oriented towards increasing private R&D by strengthening measures with “proven positive effects”. Increasing business R&D and enhancing competitiveness is also one of the three major priorities in the government’s Long term plan for research and higher education 2015-2024 (Langtidsplan for forskning og høyere utdanning 2015–2024, Meld. st. 7 (2014-2015), 2014). According to NIFU’s annual analyses of R&D in the state budget, there is reason to say that this ambition has been followed up with concrete action in subsequent budgets, although less so in the most recent budget for 2017 ((Kallerud, 2017)).

1.1.1 Relevant evaluations

Furthermore, there are several completed or ongoing evaluations of industry oriented public schemes. Worth mentioning here are:

- The recent evaluation of R&D- and innovation-supporting policies by Statistics Norway (SSB), published in 2016 (Fjærli, Rybalka, & Cappelen, 2016)
- SSB’s annual evaluations of the effects of Innovation Norway’s support schemes
- Møreforskning’s regular evaluations of user-driven R&D support through The Research Council of Norway (RCN)
- The ongoing evaluation of the national R&D tax deduction scheme SkatteFUNN
- The ongoing evaluation of RCN’s support scheme for User-driven Research based Innovation (BIA)

These recently accomplished and ongoing evaluations demonstrate a strong need for policy makers and funding agencies to understand the whole mix of policy instruments. This includes the accuracy,

effects, impacts and resource efficiency of both individual measures and the whole mix of policy instruments. We see this particular project as an important contribution in this respect. The comparative aspect of this project provides an element which is absent in the evaluations mentioned above. The focus on State Aid regulations is also scarcely covered in national evaluations.

1.1.2 Major rationales for public support to business R&D

There is a rich scholarly literature on the rationales for providing public support to business R&D. Such studies and theories have also been frequently referred to in policy documents and strategies:

- Market failure referring to the situation where markets left on their own are unlikely to invest in R&D at an optimum level from a societal perspective. Market actors do not take into account the potential positive externalities related to R&D investments. Further, market failures refer to insufficient access to finance (partly due to asymmetric information) and coordination problems between firms. In summary, market failures are argued to lead to underinvestment in R&D. These theories go a long way back, to (Nelson, 1959) and (Arrow, 1962) and are still, with some additional development, highly influential in current studies and policies.
- System failure expands and challenges the market failure rationale by justifying public intervention with insufficient functioning of the whole innovation system. This perspective includes aspects other than R&D and refuses the notion of an optimal equilibrium. Instead, system failure focuses on problems related to broader aspects of the innovation system. In this perspective, government intervention should address improvements in terms of network, infrastructure, learning processes etc.
- A more recent rationale of an active entrepreneurial state has been launched by the SPRU-economist (Mazzucato, 2013) who in a way challenges the whole notion of public intervention and underlines instead that the state is an important actor and change agent in the economy. In this perspective, rationales for interventions become more irrelevant as public sector actors are already considered central agents in the economy.
- A fourth alternative approach has recently been referred to as third generation innovation policy (Shot and Steinmuller 2016). An important message here is the focus on rationales and objectives other than economic growth. The importance of direction in public measures is also central here. Although the policy implications of this framing are still underdeveloped, it is natural to assume that the design of policy measures in this framing will have to pay more attention to the social and environmental consequences of the research and activity performed by companies who receive public support.

1.2 Definitions and delimitations

Although straightforward at the outset, public funding of industry-oriented R&D may be understood, defined and measured in different ways. In this context, there are at least four distinctions which are important to bear in mind:

1.2.1 What is industry oriented R&D support?

Governments and public authorities may stimulate business R&D in several ways, both through financial and non-financial means. Even within the group of financial support mechanisms, there are significant differences, ranging from direct and narrow types of support to broader and more indirect support mechanisms:

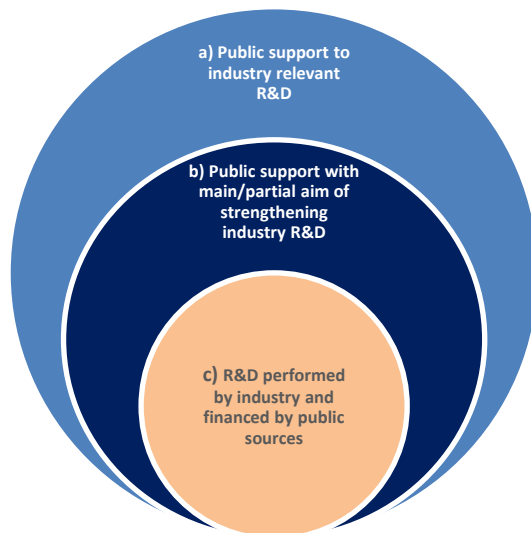
- a) **Support to R&D relevant for industry:** A broad understanding may include all types of public support to R&D activities which are considered *relevant* for R&D in the business enterprise sector, regardless of where the R&D is performed. For instance, many companies and stakeholders would consider funding of basic research in Key enabling technologies (KET) as industry relevant, even though the R&D is often entirely performed in academic institutions and with a scientific

purpose. This may also be the case for large investments in scientific equipment, public laboratories and other types of scientific infrastructure in areas where companies need technology development and research based knowledge. Companies may benefit from such installations directly, e.g. through access to research labs, or indirectly through collaboration with researchers and research institutions with such access. One concrete example in the Norwegian case is the annual contribution to participation in the EU framework programmes. Paying the “entrance ticket” to these programmes constitutes a major public R&D investment (around 7% of total public R&D funding in 2016), which also allows Norwegian companies to participate and compete for EU-funding.

- b) **Business-oriented public R&D funding:** This category narrows the form of support to measures and mechanisms which have a declared *intention* of supporting business R&D. Such support is however not restricted to R&D which is actually *performed* by companies. Furthermore, this category may include measures which are both primarily and partly oriented towards increasing industry R&D. For instance, support through environment technology schemes may have a clear intention of developing greener industries while parts of the financed R&D may be performed in research institutes or higher education institutions.
- c) **Industry performed R&D financed by public sources:** This is a distinct aspect in official R&D-statistics, which only describes the share of companies’ R&D activities which they report to be financed by government. In theory, this category is a subset of b), but in practice the R&D reported by companies in R&D surveys may deviate from R&D funding data provided by funding agencies and analyses of R&D budget allocations (GBARD). This is further explained below.

Figure 1 below illustrates the difference between these three definitions and indicates that the amount of support will differ substantially depending on which definition is used.

Figure 1: Broad and narrow understanding of public support to industry R&D



Source: NIFU, based on Solberg et al 2014

The following recent RCN-data may serve as an example to demonstrate the discrepancies referred to above:

1. In 2014¹, RCN reported a total of 4,003 mln NOK for allocations to *industry relevant R&D*. This amount corresponds to category a) referred to above. R&D support which is deemed *relevant* for

¹ In the year 2015 the figure rose to 4,300 mln NOK.

industry may involve non-industry partners and even be conducted without direct involvement from companies.

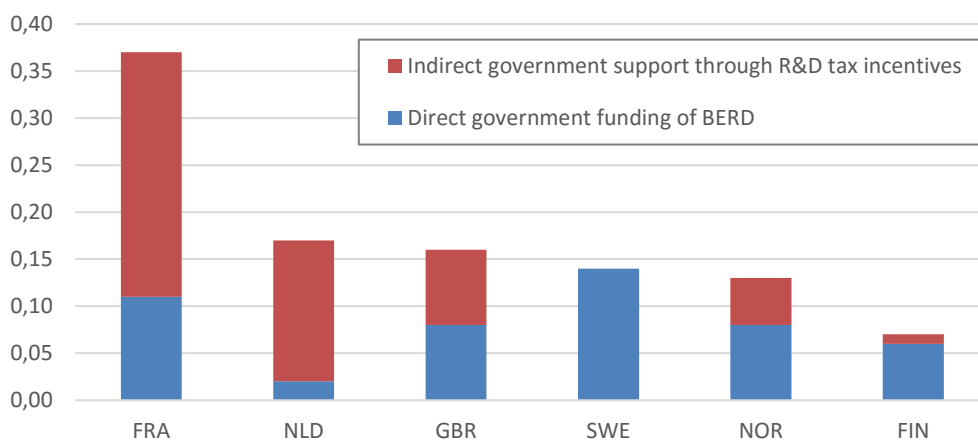
2. The same year, RCN registered actual allocations to industry project partners for a total of 1238 mill. NOK. This amount may correspond to category b) referred to above, in the sense that the allocations are mainly *intended* to support industry R&D, while at the same time the projects in question may involve partners from research institutes and higher education institutions.
3. The same year, Norwegian companies reported having received R&D funding from RCN for a total of 517 mill. NOK. This category corresponds to the narrower category c) in the figure above. The discrepancy between 2 and 3 is due to two factors: Firstly, RCN's allocation data (2) is linked to a single main project partner, while in reality a substantial share of project funding is split between several partners, including non-industry partners. Secondly, it is likely to assume that many companies have difficulties in distinguishing between their own funds and the funds of partners when reporting data in the annual R&D surveys.

For the interpretation of data in subsequent chapters it is important to bear in mind that most available comparable data on public support to industry R&D is based on the narrow definition c) described above.

1.2.2 Support and funding

A second distinction is connected to the terms *support* and *funding*. Strictly speaking, the term R&D *funding*, used in the call, does not include public support through tax incentives. Nevertheless, we consider the role of R&D tax incentives as so important in the funding mix that we include this aspect in our analyses for this report. In a number of countries, there is a clear trade-off between public support through indirect tax measures and direct support through various funding mechanisms. Hence, in some countries, a low degree of direct public funding to business R&D may be compensated by indirect support through tax incentives. As shown by Figure 2 below this balance is also strikingly different in the five countries that Norway will be compared with in this project. Whereas indirect government funding through R&D tax incentives amount to 0,25% of GDP in France and 0,15% of GDP in the Netherlands, there are no R&D tax incentives in Sweden and an insignificant amount in Finland. The amount of indirect government funding in Norway through R&D tax incentives is 0,05% of GDP.

Figure 2: Direct and indirect funding of business R&D in selected countries in 2013, as percentage of GDP



Source: OECD

When measured as a share of GDP, the total level of public support to business R&D is highest in France and lowest in Finland among the six countries in question. France is also among the top OECD-countries in this respect. As the figure shows, this is mainly due to their relatively generous R&D tax incentive scheme. When this form of support is excluded, the level of support as a share of GDP is higher in Sweden. The data for direct government funding in this comparison is based on public funding *reported by companies*, which corresponds to the “narrow” understanding c) in our distinction in Figure 1.

This figure also demonstrates that France and the Netherlands rely heavily on indirect support, while the funding mixes in Sweden and Finland consist almost exclusively of direct support. Norway and the UK appear to have a more balanced mix. The six countries in question therefore represent a variety of balance between direct and indirect support to industry R&D.

1.2.3 Support to R&D vs. innovation and business development

A third distinction concerns the often-neglected difference between support to R&D and to other innovation activities. Drawing this distinction has become particularly important in recent years, as the notion and official definition of innovation has been expanded to include a broader range of innovation activities than those related to R&D and technology (OECD, 2005). Since we in this report focus on R&D, it is important to maintain a clear distinction between *R&D-based* and *non-R&D based* innovation activities. This is particularly important since policies in this area increasingly speak of R&D and Innovation (RDI) as one area of policy. This is often also the case on the more operational level, where both agencies and schemes combine support to R&D and non-R&D based innovation activities. For instance, VINNOVA in Sweden and TEKES in Finland have a combined R&D and innovation support portfolio, while this distinction is more clear-cut in the Norwegian system, where practically all RCN instruments have a significant R&D component, with most instruments under Innovation Norway supporting entrepreneurship and business development in general.

The distinction between support to R&D and other support to business development is also important in terms of State Aid rules, as public support to R&D is generally deemed more in compliance with market failure rationales than other forms of support.

1.2.4 Defining public sector and public support

A key issue in this project is the relation and distinction between the public and private sphere. This distinction is important for both the design of instruments and policies and for their compliance with State Aid rules. At the outset, the distinction is clear, since we deal with public support to R&D performed by private entities. But the distinction between public and private is in fact blurred and varies according to the purpose and context of the delimitation. This will be discussed in the chapters where the distinction is relevant. Two examples can be addressed at the outset:

- a) On the *funding level*, public funding is fairly clear-cut. But public R&D funding may be allocated to private and semi-public organisations which in turn share or allocate parts of this funding to other private partners. In those cases, we will discuss and clarify whether this is in accordance with State Aid rules
- b) On the *performing level*, official R&D statistics distinguish between R&D in four sectors:
 - 1) Higher Education (HEI)
 - 2) Government sector (GOV)
 - 3) Business Enterprise sector (BE/BERD)
 - 4) Private Non-profit sector (PNP).

In this picture, the first two categories belong to the public sphere, while the latter two belong to the private sphere. But in reality, a number of institutions and actors appear as “borderline cases”, whose classification may vary between countries, depending on pragmatic choices made by statistical offices. For instance, the research institute TNO in the Netherlands is classified as GOV, while the Norwegian SINTEF is a BERD organisation, even though the two actors operate with similar roles in their national systems and compete/collaborate closely on the international market. How these classification issues affect the design of measures and their compliance with State Aid rules will be discussed in each case in the subsequent chapters. Undertakings are, to put it simply, organisations that sell goods or services in the market place. These organisations will usually be business enterprises.

1.3 Uniform framework conditions based on the EU State Aid rules

Under the EEA agreement, State Aid to undertakings is forbidden unless the aid in question is covered by the agreement itself, or permitted according to a decision by ESA (the EU Commission) or by secondary legislation, such as the EU regulation 651/2014 (the Block Exception Regulation)

The State Aid prohibition only applies for aid given to “undertakings”. Public administration is not regarded as an undertaking. Universities, and to a large degree, research institutions, offer public services outside the market, and are therefore not regarded as undertakings, and thus can be supported freely by the government. However, such public institutions may not pass on government funds, in cash or in kind, to undertakings, unless they are permitted to do so according to State Aid rules.

An element in the State Aid definitions is that the support in question may distort competition. Government support that is offered to all undertakings, disregarding which business they are in, is not regarded as State Aid. Thus tax incentives for business research and development will usually, depending on how the scheme is set up, not be regarded as State Aid.

Sometimes universities and research institutions offer public services and conduct businesses, such as contract research. When this is the case, one must distinguish between the two parts of the organisation and its activities. The public service part can be given government support freely without regard of the EU State Aid rules. The business activity is regarded as “other undertakings” with regards to State Aid rules. If an institution wishes to operate under a dual regime, it must have accounts that clearly demonstrate that no cross subsidising takes place, that government funds do not seep into the businesses part of the institution.

Although the principles related to State Aid for business research and development are clear enough in theory, other countries might practice them in a different way to Norway, or may have found better ways in which to align their practices with State Aid legislation. Further, as is pointed out by the TAFTIE organisation, there are areas of ambiguity in the EU State Aid rules, leaving room for differences in interpretation². This potentially leads to differences in the organisation of funding and thus might reveal information and experiences that can serve as inspiration to improve the Norwegian way of funding industry oriented R&D

² See TAFTIE Task Force on State Aid Rules for R&D&I (2013)

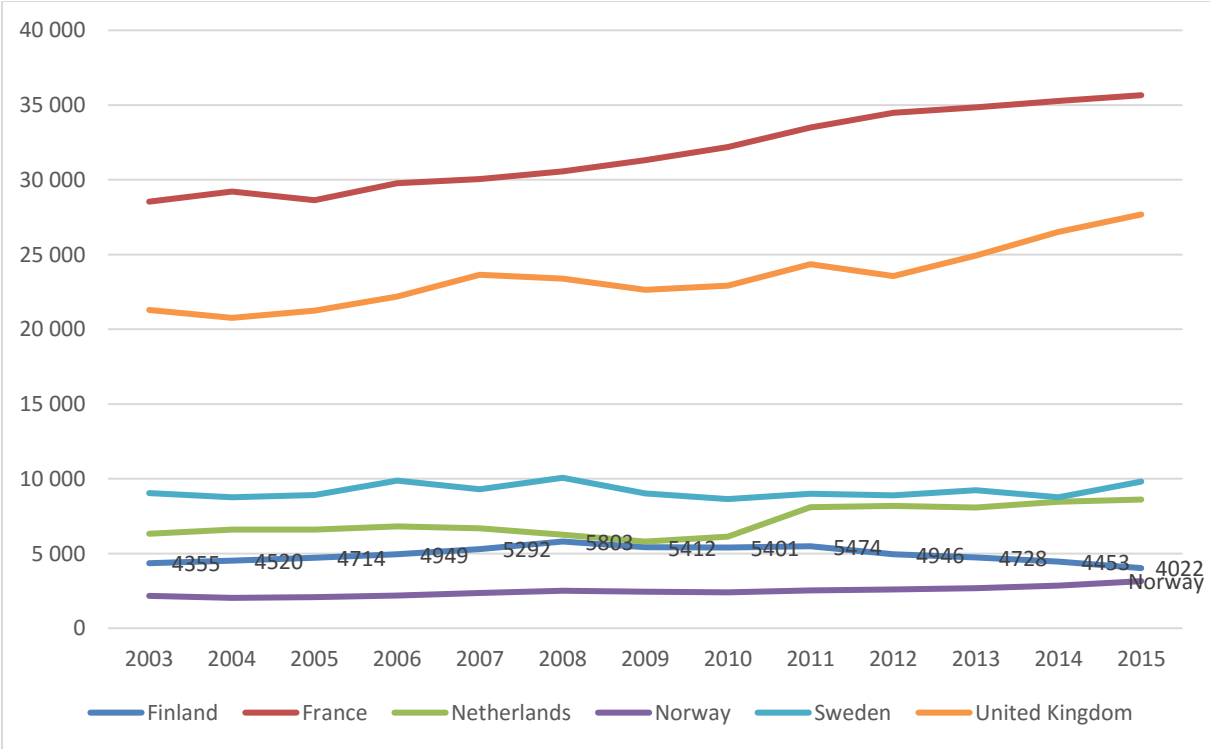
2 Funding mix and funding patterns

As a starting point and general backdrop for this project we provide an overview of public support to business R&D in the six countries in question, according to official R&D statistics. This is also important for establishing a contextual framework for the more detailed comparison of policy instruments, which will follow in Chapter 3.

2.1 Public support to business R&D – the business perspective

A first key indicator is the volume and development over time in the R&D expenditures of the business enterprise sector. The figure below displays both the volume and real growth during the past fifteen years in R&D performed by the business enterprise sector of the six countries in question.

Figure 3: Business Enterprise Expenditure on R&D (BERD). Constant prices in PPP 2003-2015

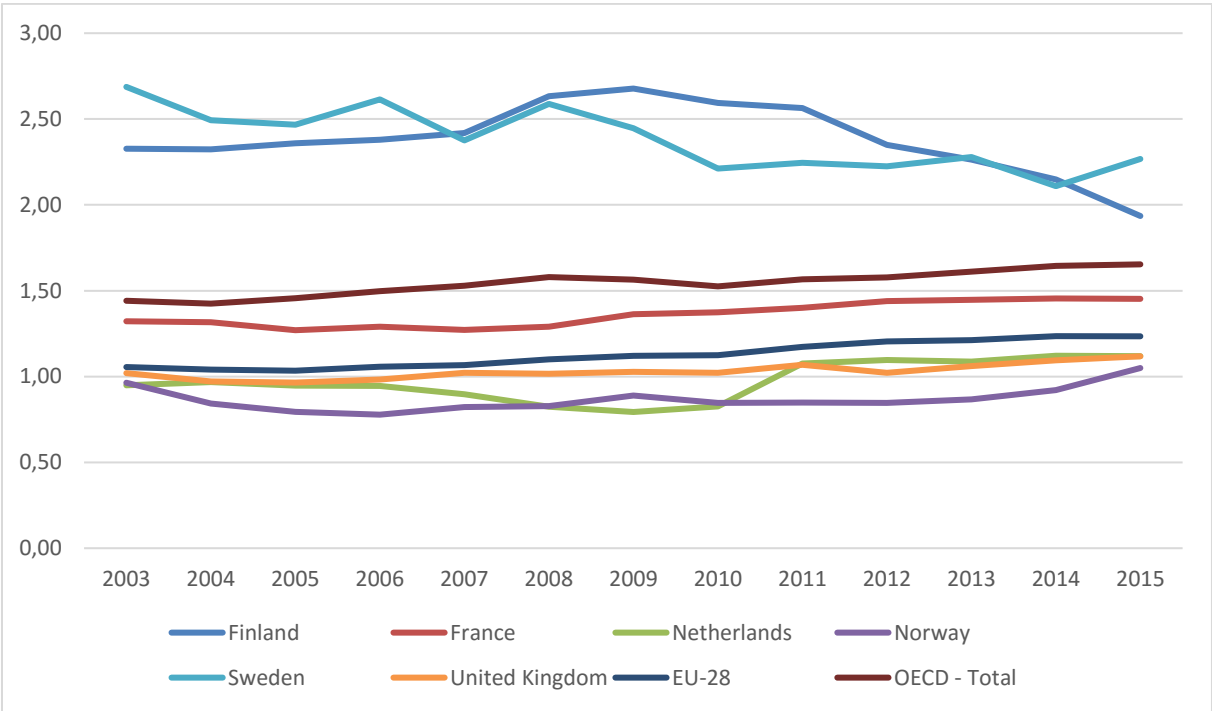


Source: OECD MSTI-2016-2

As the figure shows, France, the UK, the Netherlands and Norway have had a steady increase in business R&D expenditure, while Sweden seems to stagnate and Finland experiences a real decline, especially since 2008. A main explanation behind the latter is the declining R&D activity of Nokia, followed by Microsoft's take-over of the company's mobile phone production.

Since investments in R&D are generally pro-cyclical and sensitive to the general economic development in each country, it is relevant to also look at the development of BERD as a percentage of GDP in each of the six countries in question.

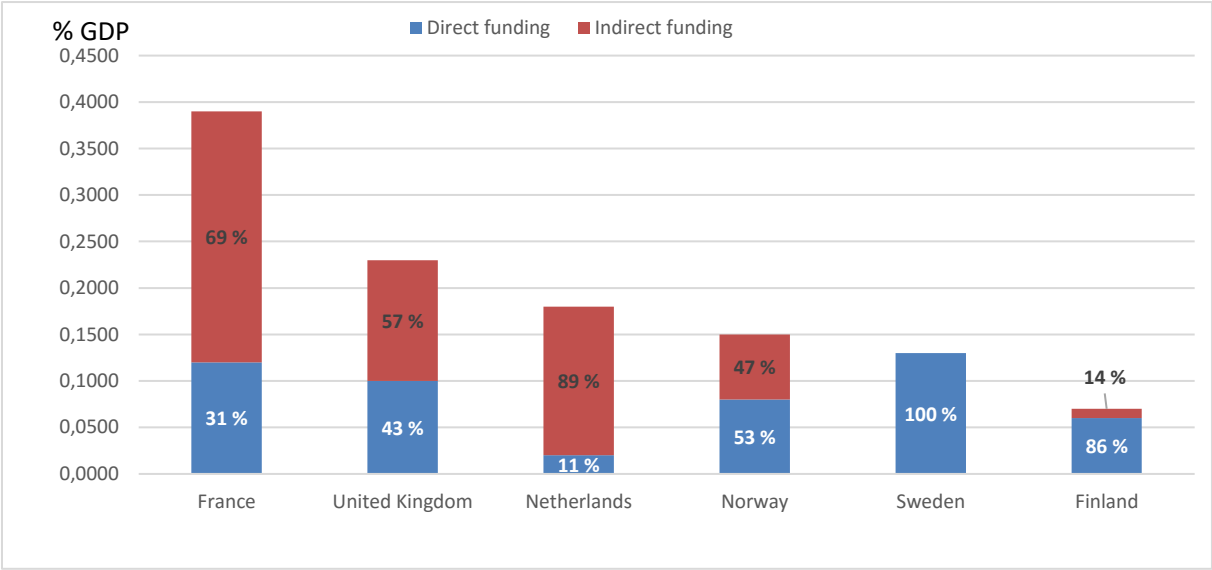
Figure 4: Business Enterprise Expenditure on R&D (BERD) as a share of GDP. Selected countries 2003-2015



Source: OECD MSTI-2016-2

It is striking to observe that the two countries with the highest R&D intensity (Sweden and Finland), are also those which experience a decline in business R&D as a share of GDP. In the other countries, total business investments in R&D increases more than national GDP, with a particularly strong increase in the Netherlands. A crucial question is whether public policies and support play a role in the development of BERD for the countries in question. The figure below shows the total public support to business R&D in the six countries as a share of GDP (y-axis), distinguishing between direct and indirect support in the form of tax incentives. For each country, the balance between direct and indirect support is indicated with percentages on the bars.

Figure 5: Direct and indirect public support to BERD. As a percentage of GDP (y-axis) and as a share of BERD (values on bars). Selected countries, 2013



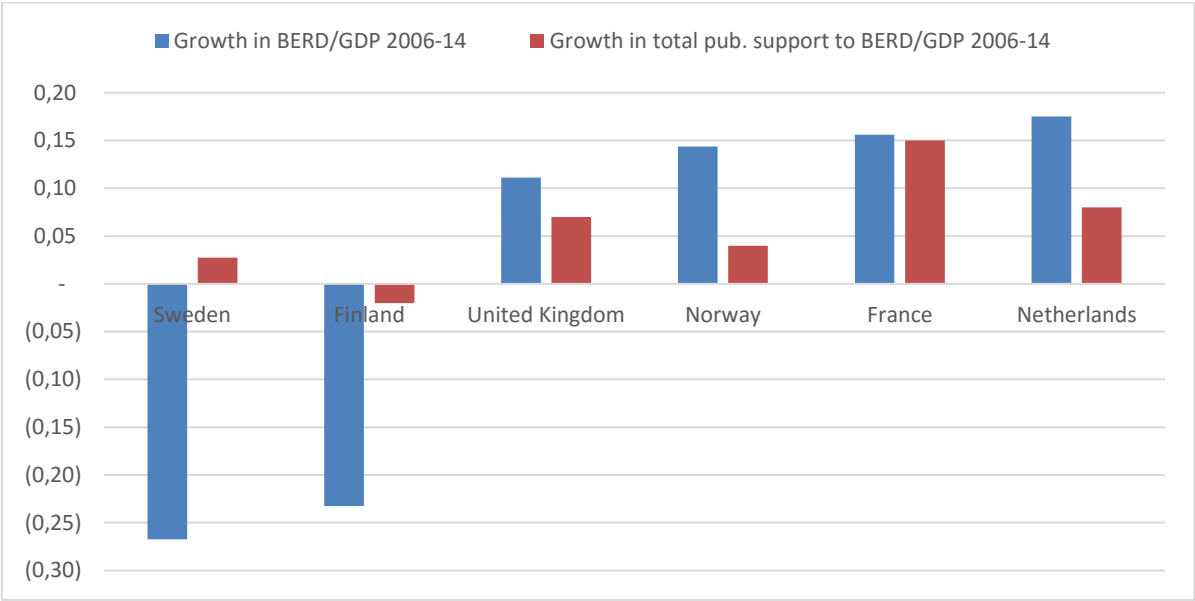
Source: OECD/MSTI-2016-2 and OECD/NEST data on R&D Tax incentives, 2017

It is interesting to note that the intensity of public support is not completely balanced even though the value of tax incentives is included. For the Netherlands, the relatively low level of direct public funding of BERD seems to be compensated for by a relatively generous tax incentive scheme. However, France, Norway and the UK have significant amounts of support through tax incentives *in addition* to a relatively high share of direct public funding of BERD. Sweden has a relatively high level of direct public support but no tax incentives, while Finland stands out with low shares of direct public funding of BERD and at the same time an almost negligible support through tax incentives. Although this aggregate data does not allow conclusions to be drawn regarding causality, it is worth noticing that the two countries which appear to have the lowest level of total support to BERD also show stagnation and decline in BERD.

The figures for direct support (lower bars) should, however, be read with caution. As mentioned above, the definition of BERD varies a great deal across these countries. For instance, the publicly funded BERD in Norway also includes funding to technical industrial research institutes, as most of them are categorised as *business enterprise* in official statistics. On the other hand, similar institutes in the Netherlands as well as in Finland are categorised as government sector and hence not included in the amounts for public funding of BERD.

The figures above on public support to BERD seem to indicate a pattern whereby countries with low levels of total support have experienced a decline in business R&D. To explore this further, the figure below combines the *increase* in total (direct and indirect) public R&D funding to industry with the *increase* in BERD over a certain period of time. Since increasing/maintaining the level of BERD is the ultimate goal of public support to BERD, it is relevant to see whether the increase in total public support is reflected in a subsequent increase in BERD. For the sake of comparisons between countries of different size the values are expressed as a share of GDP.

Figure 6: Total public support to BERD and BERD 2006-2014 in pct of GDP.



Source: OECD/NESTI-R&D Tax Incentive Indicators, and MSTI 2016-2

Although this does not allow for conclusions to be drawn regarding the causal relationship between public support and BERD, it is worth observing that the decrease in BERD as a percentage of GDP in both Finland and Sweden coincides with a decrease/stagnation in public funding to BERD during the same period (2006-2014). On the other hand, the countries with a growth in BERD relative to GDP also show an increase in public support to business R&D. For France and the Netherlands, the growth in public support is entirely due to tax incentives. In Norway and the UK there is a certain growth in direct support, but also for these countries where tax incentives stand for the lion’s share of growth in public support. A general impression is therefore that the observed increase in BERD for the countries in question seems to be related to increased use and/or more generous indirect public support to business R&D.

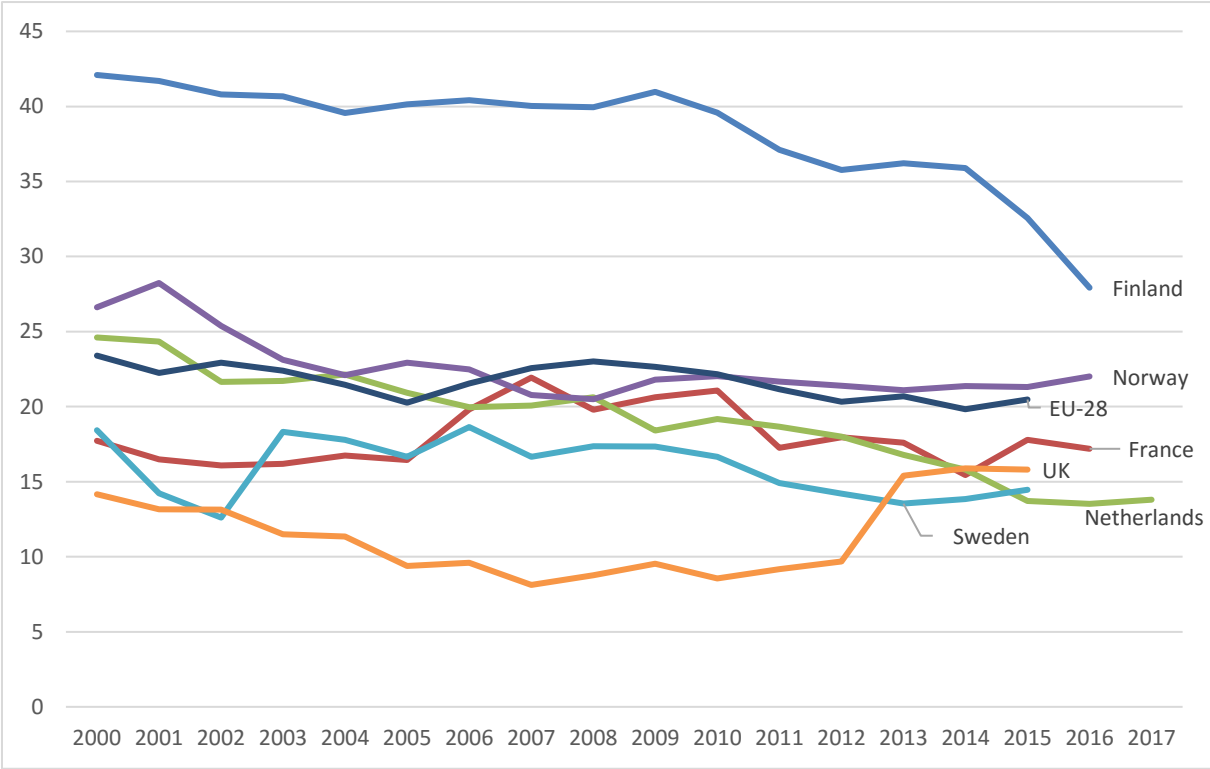
2.2 Public support to business R&D – the public perspective

While the section above dealt with public support to business R&D from a business enterprise perspective, we now consider this type of support from a government perspective. This means that the support directed towards this purpose is seen from an *intentional* point of view (see also chapter 1.2.1 above).

The most commonly used indicator in this context is the so-called GBARD/NABS-indicator³, which classifies public R&D budgetary allocations (GBARD) according to a set of 14 standardised socio-economic objectives (NABS). Among these, five objectives are considered more directly relevant for R&D in the business enterprise sector and therefore clustered under the common headline “Economic development”. This category includes public support directed towards *Agriculture, Transport, Telecommunication/other infrastructures, Energy and Industrial Production/technology*. The figure below shows the public R&D funding devoted to these objectives as a share of total civil R&D funding in the six countries in question as well as for the OECD and EU 28 average.

³ GBARD (Government Budget Allocations for R&D); NABS (Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets)

Figure 7: Public R&D allocations to Economic Development programmes as a percentage of Civil GBARD. 2000-2016.



Source: OECD/Eurostat. Joint OECD-Eurostat international data collection on resources devoted to R&D

The development since 2000 to a large degree confirms the general picture derived from the indicators above. Public R&D-funding in Finland and Sweden seems to give lower priority to business oriented programmes and purposes which, as illustrated in Figures 13 and 14, coincides with a decrease and stagnation in BERD. For Finland, there seems to be a significant shift in the profile of R&D funding, from a strong business oriented profile at the start of the 2000s towards more general non-industry oriented purposes in recent years. One possible explanation is that in times of fiscal constraints, which has been the situation in Finland since the financial crisis, industry oriented support schemes are more vulnerable to budget cuts than, for instance, public allocations to universities and public research organisations.

The share of public R&D funding to business oriented R&D is also declining in France and the Netherlands, but for these two countries it is important to bear in mind that the GBARD data does not include support through tax incentives. It therefore seems that the decreasing emphasis on public allocations to business R&D in France and the Netherlands is compensated for by the parallel expansion of support through tax incentives. In Norway, the share of public funding directed towards industry relevant topics seems quite stable throughout the period. Hence, for Norway, the introduction and subsequent expansion of the tax deduction scheme seems to constitute a supplement more than a replacement of traditional mechanisms for public support.

2.3 Overview of public support to industry oriented R&D

The indicators presented above reflect different aspects of public support to business R&D in the six countries in question. Although international comparisons in this area include a number of methodological caveats, some general patterns appear when all dimensions are seen together.

The figure below summarises the amount of public support to business R&D measured with different denominators.

Figure 8: Total public support to business R&D as a share of GDP, BERD, government financed R&D and GERD. Direct and indirect support. 2013/2014



Note: Due to varying data availability, the figures combine data for both 2013 and 2014

Source: OECD/NESTI-R&D Tax Incentive Indicators, and MSTI 2016-2

Across all four comparisons, France stands out with the most generous level of public funding to business R&D, followed by the UK. Both these countries have a mix of direct support and tax incentives. The same balanced mix is also apparent in Norway, but with a lower level especially when compared to Norway’s high GDP. The two countries where tax incentives have little or no importance (Finland and Sweden), have low levels of total support in all comparisons.

One should bear in mind that the level of public support to business R&D in Figure 8 above follows the narrow definition of direct public support (public financing reported by companies). If public support is instead defined as government budget allocations with the *purpose* of stimulating economic development, a different picture appears, as is shown in Figure 7 above. This data is however less reliable and may include large shares of public support which are indirectly relevant to industry but not directly aimed at R&D performed in private undertakings.

2.4 Funding instruments in the six countries

In general, funding instruments are divided into either direct funding or indirect funding. Direct funding is further divided by several subgroups including competitive grants, debt financing, repayable advances, technology consulting, innovation vouchers, equity financing and public procurement. Indirect funding covers various tax incentive schemes. This is a division that the OECD operates with and we will operate with the same distinction of funding mix.

In the offset a somewhat homogenous or equal funding mix across the six countries could be expected. They are all governed by the EU state aid rules. They are countries that rank high or relatively high on the Union Innovation Scoreboard and are among the richest countries in the world. They all have policies for stimulating industry oriented R&D and R&D systems with strong government support to industry oriented R&D channelled through agencies.

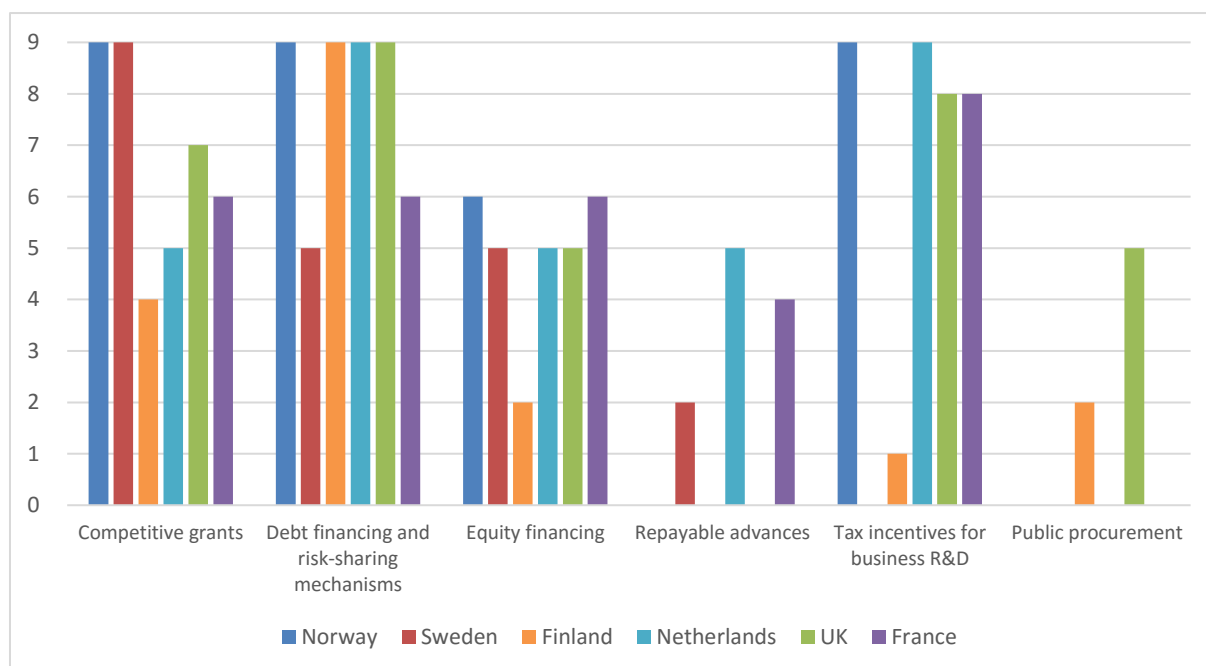
Yet we see that there are significant differences between the countries as seen in Chapter 2. If looking at how importantly various funding mixes are rated across the six countries in question we find interesting variation. Responses are provided by country delegates to the OECD Committee for Scientific and Technological Policy to the following question: Which of the following public instruments of business R&D and innovation are in use in your country? Which are the principal instruments of public funding of business innovation in your country? How has the relative balance between these instruments changed recently, if at all? Please rate the relative relevance of the following financial instruments in your country's policy mix (high- medium- low - not used) and indicate whether their share in the total has increased/decreased or has remained unchanged.

As we see, grants are of high importance and increasing relevance in Norway and Sweden. Grants are also of increasing relevance to France, yet the current importance is assessed to be at medium level. In Finland and the UK grants are assessed to be of decreasing relevance. Debt financing and risk-sharing mechanisms are rated as increasingly relevant in all countries but Sweden. In addition, debt financing and risk-sharing mechanisms are seen as highly relevant to Norway, Finland, the Netherlands and the UK. Equity financing is of medium relevance to all countries but Finland.

Worth mentioning also are the indirect funding instruments through tax incentives. Here we find a striking difference across the six countries. To Norway and the Netherlands tax incentives are rated high in relevance and with an increasing relevance. To France and The UK tax incentives are also rated high in relevance and but with a stable relevance. On the other end, we see that tax incentives in Sweden are insignificant and in Finland are of both low and decreasing relevance. Finally, it is interesting to point out that public procurement as an instrument is not widespread in the six countries. We see a stable relevance at low level in Finland and stable at medium level in the UK.

It is important to notice that the assessment of different funding instruments does not reflect the funding level.

Figure 9: OECD assessment of the importance of different funding instruments ranked from 0 to 9



Source: OECD MSTI-2016-2

Note: 0= not used; 1= low and decreasing relevance; 2= low and stable relevance; 3=low and increasing relevance; 4= medium and decreasing relevance; 5= medium and stable relevance; 6= medium and increasing relevance; 7= high and decreasing relevance; 8= high and stable relevance; 9= high and increasing relevance.

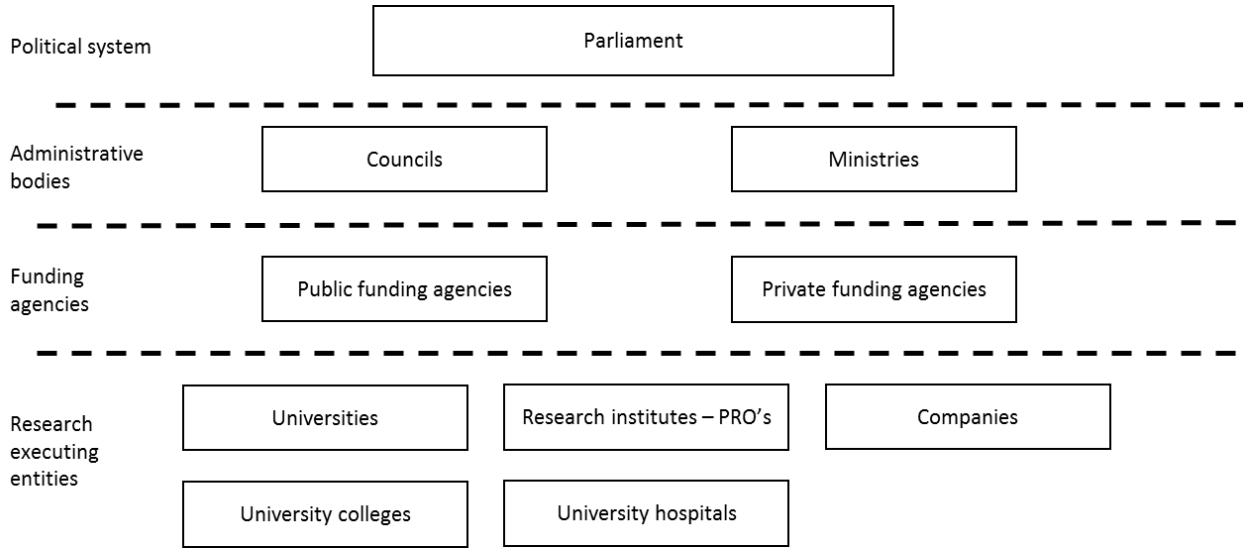
2.5 The main actors and their role in the national R&D system

Across the six countries in question uniformity can be found when looking at the vertical integration of the R&D system. At the vertical level the system consists of four levels: Figure 10 presents a general overview of the national systems. A more detailed description of the national R&D system country by country can be found in Appendix A.

At the top, there are cabinets with ministers and parliament. They set out the overall economic conditions. Then at the second level there are ministries with special responsibility for developing the R&D policy. In addition to developing policies they are also the main public funders.

The third level consists of the agencies, those responsible for implementing policies. Furthermore, they are the administrators of funding projects and, in addition, are often those handling applications for competitive grants. Finally, we have the R&D performers – the executing entities. This is also the level that receives the funding and thus become the beneficiaries of public funded R&D.

Figure 10: National R&D system



Source: NIFU

When looking at the horizontal integration there are some differences across the six countries. The structure of four levels remains the same, yet how each of the levels is organised and integrated differs to some extent. It is in particular at the level of agencies and the institute sector that these differences can be found. The UK has a strict division of responsibility at implementation level divided into a section for higher education institutions, research councils and Innovation UK with the responsibility of managing most instruments related to business R&D. This differs a bit in the Netherlands where the task force for applied research works alongside research councils, the Royal Academy, the Technical Foundation and a business agency (RvO).

As for Norway, the setup at implementation or agency level differs a bit from the other countries. This is in terms of the distinction between the RCN and Innovation Norway. In other countries, we see that innovation agencies BpiFrance, InnovateUK, TEKES, VINNOVA and RvO also finance R&D programs. This is different in Norway where the RCN finances only innovation programs with clear R&D elements and Innovation Norway hardly finances R&D programs.

Further we see that the level consisting of formal counselling and evaluating bodies differs across the countries. In France and the Netherlands there are formal bodies at many levels in the R&D system that council, monitor and evaluate. Thus, they formally affect the development of policy. Other countries also focus on evaluations and using external expertise in developing policy, yet it seems to be on a less formal basis.

Finally, though there are some differences when looking at the beneficiaries across the six countries, the role and organisation around universities and businesses are alike. The difference lies within the public research organisations and the institute sector. Differences include the magnitude, measured by share of public funding, etc. In Sweden, public research institutes received 12% of public funding for research measured as a balance share of both higher education (HERD) and government (GOVERD) R&D expenditure. For Norway, the figure is 32% and in France the figure is 39%.

The national R&D systems point to the most important actors. This is important information to consider during the next steps of our study, since it identifies the organisations that are relevant to contact in order to get more in-depth information on the main public funding schemes for industry oriented R&D as well as information on how they apply to the EU State Aid rules.

Table 1: The most important funding actors

Country	Organisation	Short description
Norway	The Research Council of Norway (RCN)	The Research Council of Norway serves as the chief advisory body for the government authorities on research policy issues, and distributes roughly NOK nine billion to research and innovation activities each year. The Research Council works to promote international cooperation and increase participation in the EU framework programme on research and innovation. The total funding budget for RCN was €912m in 2015.
Sweden	VINNOVA	Vinnova is Sweden's innovation agency. Their mission is to promote sustainable growth by improving the conditions for innovation and funding needs-driven research. Vinnova promotes collaborations between companies, universities, research institutes and the public sector. Vinnova does this by stimulating a greater use of research, by making long-term investments in strong research and innovation milieus and by developing catalytic meeting places. The funding budget for Vinnova was €281m in 2015.
Finland	TEKES	The main contributor in Finland is TEKES. Tekes works with the top innovative companies and research units in Finland. Every year, Tekes finances some 1,500-business research and development projects, and almost 600 public research projects at universities, research institutes and universities of applied sciences. Tekes funded €369m to companies in 2016.
The Netherlands	RvO.nl	Netherlands Enterprise Agency is part of the Ministry of Economic Affairs and works at the instigation of ministries and the European Union. It helps with grants, finding business partners, know-how and compliance with laws and regulations. RvO employed 510 FTEs in 2015 and had a budget of €4,000m in 2013.
United Kingdom	Innovate UK	Innovate UK is a business-focused organisation dedicated to promoting technology-enabled innovation across the UK. Its role is to promote and support research into and the development and exploitation of science, technology and new ideas for the benefit of business, in order to increase sustainable economic growth and improve the quality of life. The number of employees is 140 and the budget was approximately €1,300m over the past 3 years.
United Kingdom	Business, entrepreneur, innovation and skills department	The department brings together responsibilities for business, industrial strategy, science, innovation, energy,

		and climate change. Among others they are responsible for ensuring the UK remains at the leading edge of science, research and innovation.
France	Bpi France	<i>Bpifrance</i> provides assistance and financial support to small and medium-sized enterprises, facilitating access to banks and equity capital investors, especially during the high-risk phases: Start-up, Innovation, Development, International, Buy out. <i>Bpifrance</i> is running several innovation support programmes, either for individual companies or for collaborative research and innovation projects. On average, 2500 companies are supported annually. The current number of employees is 2,000.

Source: NIFU 2017 based on annual reports and the organisations own presentation on their web pages.

Additionally, the national R&D systems highlight the most important research institutes. Either large individual institutes such as TNO in the Netherlands and VTT in Finland or amalgamations of research institutions such as RISE in Sweden and CNRS in France.

Table 2: Important research institutes

Country	Organisation	Short description
Sweden	RISE	RISE is an umbrella organisation of The Swedish Research Institutes. The aim is to ensure the competitiveness of the Swedish business community on an international level and contribute to a sustainable society. RISE have 2,200 employees support and promote all manner of innovative processes, and roughly 100 testbeds and demonstration facilities are instrumental in developing the future-proofing of products, technologies, and services. The turnover at the RISE Group in 2015 was €325mIn.
Finland	VTT	VTT Technical Research Centre of Finland is the leading research and technology company in the Nordic countries. VTT has a national mandate in Finland. They produce technology for business and use research and knowledge to provide expert services for their domestic and international customers and partners. VTT develops new smart technologies, profitable solutions and innovation services. VTT employed 2,192 people in 2015 and had a net turnover of €158mIn.
The Netherlands	TNO	TNO is an independent research organisation. TNO connects people and knowledge to create innovations that boost the competitive strength of industry and the well-being of society in a sustainable way. There are over 2,900 employees at TNO Who work on issues in five fields of significance to society: Industry, Healthy Living, Defence, Safety & Security, Urbanisation and Energy. The turnover

		for 2016 was €416mIn incl. government funding.
France	CNRS	The French National Centre for Scientific Research (<u>French</u> : Centre national de la recherche scientifique, CNRS) is the largest governmental research organisation in France and the largest fundamental science agency in Europe. It employs 32,000 permanent employees (researchers, engineers, and administrative staff) and 6,000 temporary workers. The turnover in 2015 was €3,309mIn.

Source: NIFU 2017 based on annual reports and the organisations own presentation on their web pages.

2.6 Structural differences across beneficiaries

There is diversity among those receiving funding across the six countries. This is the case for the institute sector and the business sector and can thus be a sound reason for differences in the funding and policy mix for each country. Figure 12 presents a picture of the structural differences across the six countries according to differences among potential beneficiaries, here defined as companies performing R&D.

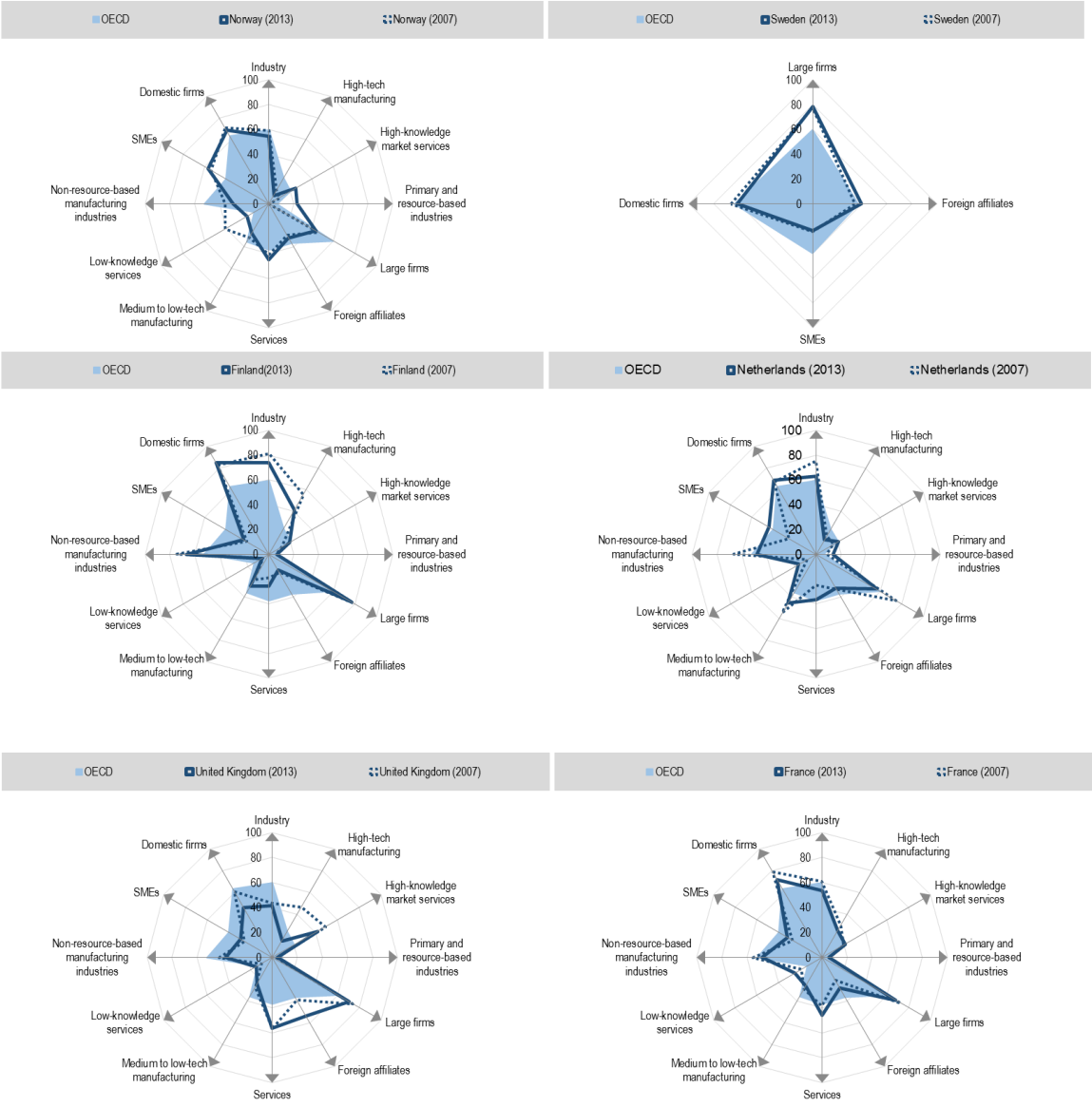
The composition of businesses performing R&D does show some differences, both in terms of size and sectorial composition, as seen in Figure 11. For Norway, it is evident that SMEs, the High-level market service as well as primary and resource based industry are over-represented as compared to the OECD average. On the contrary non-resource based industries as well as larger companies are under-represented. In Sweden, large companies are over-represented, whereas in Finland high tech manufacturing and domestic companies especially are over-represented. In the United Kingdom foreign companies as well as companies within service and high knowledge market service sectors are over-represented. One the other hand we see that domestic companies as well as SMEs are under-represented. In the Netherlands, foreign companies, SMEs and companies within the service sector are under-represented. Whereas France and the Netherlands are, to a large extend, in line with the OECD-average⁴.

The country differences could be a leading explanation as to why there are differences in the funding and policy mix. There are no uniform target groups across the countries, thus policy development and aims are most likely to differ. Whereas Sweden works actively to loosen their dependency on large multinationals, Norway push for having large companies in order to invest more in R&D and to develop national R&D lighthouses.

In general, though, there seems to be a consensus when it comes to the challenges of R&D across the six countries. There is a need to continuously stimulate industry oriented R&D investments and derive innovation from the investments. And there is a need for closer and more comprehensive collaboration between academia, i.e. universities and research institutions, and businesses. The latter is seen as a central aspect in transforming basic and applied research towards innovation and value creation.

⁴ It is possible to elaborate further on the structural differences across the countries. Among other factors, the level of R&D investments, level of innovation, public-private R&D collaboration, share of PhDs and level of exports divided by sector and company size could have added information as to the structural differences. Yet this would be quite comprehensive and is not the main focus of the study. Thus, we will not go any further in this discussion other than to conclude that structural differences are indeed present and are likely to affect funding mix of the six countries in question.

Figure 11: Structural differences among R&D performing companies



Source: OECD MSTI-2016-2

3 Most important schemes for supporting industry oriented R&D

The focus in this chapter is the structure of public funding to industry-oriented R&D. In the chapter, we find that the funding mix differs across the six countries in question. It is evident that competitive grants are the main source in the three Nordic Countries, with Norway also utilising tax incentives and Finland utilising soft loans. In the Netherlands, the United Kingdom and France the funding mix is divided by a broad spectrum of instruments including grants, loan, reimbursement and, in United Kingdom, public procurement as well.

Grants are subject to open competition but restrictions differ from program to program. Some programs are targeting a particular area of research, others require a research institute to be leading the project, others require public-private collaboration or even a consortium structure and finally projects which are targeting SMEs. Soft loans and tax incentives are open to all.

In the case of many several partners in a grant in Sweden and France, the funding authority writes a contract with each partner. Whereas the funding authority writes a contract with the project or consortium leader in Norway, Finland and the Netherlands.

Where there are requirements for businesses to collaborate with research institutions to receive funding also differs from program to program. There are programs where businesses are required to collaborate with research institutions and programs where a collaboration is viewed positively, but is not a requirement. In the case of collaborating, research institutions are not required to contribute with internal funding in the projects.

3.1 Most important funding instruments

The importance of funding instruments measured as the yearly budget allocation differs across the countries in question. From the comprehensive report completed by Bird & Bird Brussels (2017)⁵ on support schemes for research, development and innovation, they find significant differences in the distribution of national budgets for public funded private R&D and innovation.

Table 3 shows some clear differences in both prioritisation and total magnitude of public support. Notably there seems to be an overall consistency with Figure 9 in the sense that the funding instruments with the highest allocation of funding are also ranked as the most important (a score

⁵ See Bird and Bird Brussels, ENIRI (2017): *State aid support schemes for RDI in the EU's international competitors in the fields of Science, Research and Innovation*, Directorate-General for Research and Innovation Impact of State Aid on RDI Investments, EUR 2017.2457 EN

between 7 and 9 in Figure 9). For example, grants are clearly the most important funding instrument to Sweden, both when being assessed by delegates to the OECD Committee for Scientific and Technological Policy and when we look at the funding allocation in Table 2. On the other hand, tax incentives are clearly of importance to the Netherlands, the United Kingdom and France, and the funding allocation in Table 3 confirms this.

It is important to stress that there are inconsistencies and discrepancies between the figures from Bird and Bird Brussels⁶ and the Main Science and Technology Indicators by OECD. Furthermore, Norway is not part of the Bird and Bird Brussels report, leading to potential and likely differences in what is included as budget posts for public support for private R&D and innovation. One clear difference is that the Bird and Bird Brussels report includes funding for Non-profit organisations and public entities. For example, in Finland non-profit organisations and public entities make up 70% of the national budget, in Sweden the corresponding figure is 83%. Despite the discrepancy the figures are of relevance since they indicate the magnitude of public financing to business R&D and innovation and thus an indication of national prioritising of funding mixes.

Table 3: National budgets public support schemes for supporting private R&D and innovation

	Norway	Sweden	Finland	Netherlands	United Kingdom	France
Direct public funding¹⁾	539	1.443.9	2021.4	2302.6	6977.8	12839.7
Debt financing, loan and risk sharing²⁾	58*	52.7	324.8	3078.8	4011.8	8543.3
Tax reduction³⁾	319	125.3	66	5589.9	7719.4	26619
Other⁴⁾	0	94.3	768.9	2.3	210.6	9.3
Total	913	1716.2	3181.1	10973.6	18919.6	48011.3

Source: NIFU 2017, based on Bird and Bird Brussels (2017), ENIRI (2017): *State Aid support schemes for RDI in the EU's international competitors in the fields of Science, Research and Innovation*, page 918. Information from RCN based on "prosjektbanken", a database of all funded projects at RCN and the annual report of the tax deduction program called SkatteFUNN and information on Innovation Norway programs for R&D and innovation from Espen Solberg; RIO Country Report 2015: Norway; EUR 27858 EN.

Note *: RCN does not offer loans, thus the €58mln is related to loans granted by Innovation Norway aimed at innovation.

1): Direct funding to the beneficiaries such as grants, subsidies, scholarships, innovation prizes, premium voucher based grants.

2): Low-interest loans (including for highly qualified human capital), Subsidised loans, Reimbursable loans. Venture capital; Support to risk capital and seed funding for the establishment of new companies.

3): Including tax deferrals, tax credit, and taxes allowances.

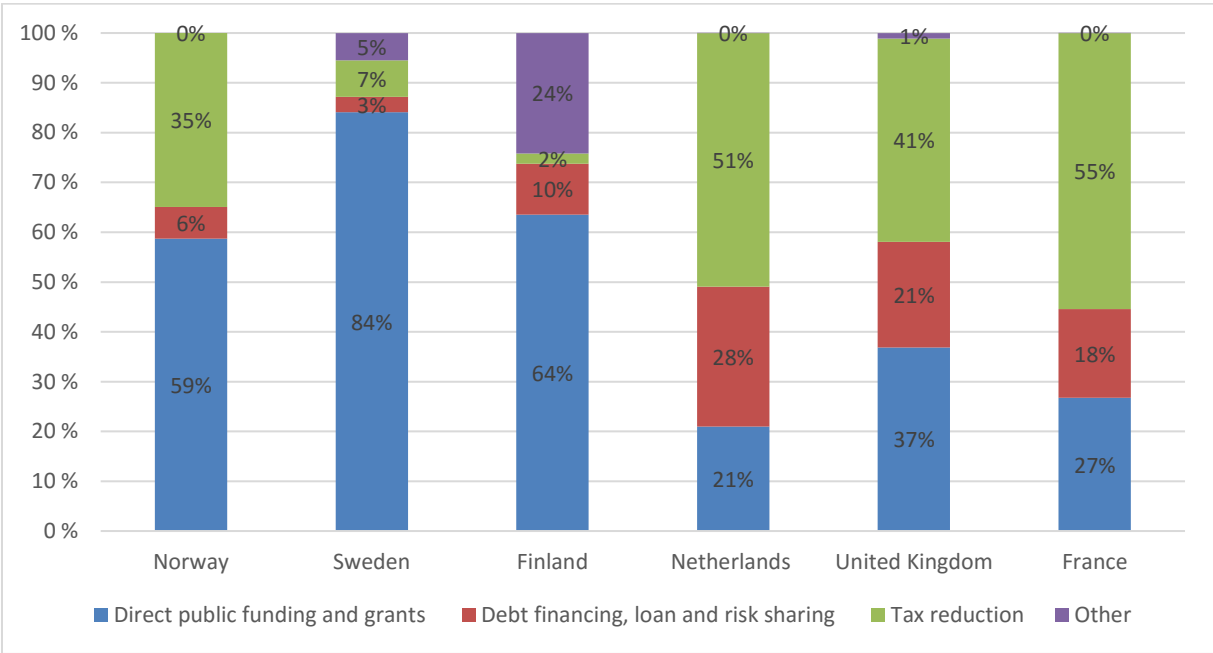
4): Covers instruments aiming to increase beneficiary's expenditure for RDI including facilitations of the collaboration of business companies with State-owned institutions, research mobility between private and public sectors, use of public RTD infrastructures by the business companies. To the best of our knowledge Finland supports networking activities and venues for seminars, meetings and conferences as part of their R&D support activities.

To compare the relative share of budget allocation, Figure 12 shows the relative distribution of the budgets as presented by Bird and Bird Brussels. In Norway, the distribution of public support for business R&D and innovation is nearly 60% for grants, 35% for tax incentives and 6% for debt financing and loans. In Sweden grants are clearly the most important funding mechanism with 84% of the total budget. This is in line with the finding of the OECD assessment presented in Figure 9. Further grants are also most important to Finland whereas 10% of their public support is aimed at debt financing and loans. This is also somewhat similar to the findings in Figure 9.

⁶ See on Bird and Bird Brussels, ENIRI (2017): *State aid support schemes for RDI in the EU's international competitors in the fields of Science, Research and Innovation*, page 918

As can be seen, the focus and distribution of funding are more alike in the Netherlands, the United Kingdom and France compared to the Nordic countries. Here tax incentives constitute between 41% and 55% of the budget allocated for funding private R&D. Further debt financing, loans and risk sharing instruments constitute between 18% and 28%. The lower share of grants in these counties is reflected in the OECD assessment of the importance of various funding instruments presented in Figure 9.

Figure 12: National budgets public support schemes for supporting private R&D and innovation



Source: NIFU 2017, based on Bird and Bird Brussels, ENIRI (2017): *State Aid support schemes for RDI in the EU's international competitors in the fields of Science, Research and Innovation*, page 918. Information from RCN based on "prosjektbanken", a database of all funded projects at RCN and the annual report of the tax deduction program called SkatteFUNN and information on Innovation Norway programs for R&D and innovation from Espen Solberg; RIO Country Report 2015: Norway; EUR 27858 EN.

3.2 Most important programs identified by national experts

Here we focus on the most important funding instruments to industry-oriented R&D. The aim is to get a deeper understanding of how the public support is designed. We also want to grasp which specific programs are the most important and what characterises these programs in terms of instrument applied, eligibility, contractual agreements, success criteria, assessment procedure and demands for collaboration between research institutions and business.

We have asked national experts of each of the six countries in question to point out the most important programs for public funding of business R&D. In addition, we have asked them to provide us with detailed information about each of the identified programs. The decisive parameter for selecting the most important programs has been the size of the budget for the individual project.

Table 4 provides an overview of the most important funding programs as identified by national experts. The programs are divided by country and by the categorisation deployed by the OECD for type of funding instrument.

As we see, all six countries have competitive grants among their main funding instruments as identified by our national experts. Our national experts all stress competitive grants when asked to

mention the most important programs and to describe them in detail. Finland and the Netherlands mention soft loans as important. Norway, the Netherlands, the United Kingdom and France also mention tax incentives. France seems to utilise the broadest range of funding channels, using competitive grants, debt financing, repayable advances and equity financing in their direct funding mix and in addition we have seen that they rely heavily on tax incentives.

Table 4: Most important funding instruments by type and country

	Norway	Sweden	Finland	The Netherlands	United Kingdom	France
Direct funding mix						
Competitive grants	X	X	X	X	X	X
Debt financing and loan			X	X		X
Repayable advances						X
Equity financing						X
Public procurement						
Indirect funding						
Tax incentives	X			X	X	X

Source: NIFU 2017, based on information from national experts

In the following section we present the most important instruments as they have been given by national experts. They will be presented schematically in order to allow easier comparisons. To each of the six countries in question we give a general introduction, including figures of the national level of public financed industry-oriented R&D and, in some cases, the direct support to business R&D. The programs will be presented schematically below:

- Who is the funding actor and how are the individual programs organised?
- What kind of instruments are applied?
- How are the projects organised, including if contracts are made with a project manager only or with all participants in a project?
- Is the funding aimed at individual projects or is it more of a centre structure?
- What is the amount of funding for the program?
- Is the funding subject to competition and are there restrictions on who is eligible to apply and obtain support?
- What are the main success criteria for getting funding?
- How are applications assessed and by whom?
- What are possible requirements related to collaboration between industry level and research institutions?
- In terms of collaboration, are partners required to contribute with internal funding and is this funding in kind funding or in terms of financial resources?
- Finally, are the programs comparable to any Norwegian funding instruments?

Table 5 summarises the overall findings from the six countries. The table does not cover all the details of the various programs and instruments, which will be presented in the following.

Table 5: Overall description of the most important direct funding programs and schemes across the six countries

	Norway	Sweden	Finland	The Netherlands	United Kingdom	France
Funding actor	RCN and beneficiaries	Vinnova, Energy agency, Formas and beneficiaries	Tekes and beneficiaries	RvO and beneficiaries	InnovateUK and beneficiaries	Bpifrance and beneficiaries
Funding amount (total by identified programs)	60% of the public funded industry-oriented R&D	25,5% of the public funded industry-oriented R&D	17,2% of the public funded industry-oriented R&D	38,3% of the public funded industry-oriented R&D	17,7% of the public funded industry-oriented R&D	10% of the public funded industry-oriented R&D
Open for competition	Yes, but with some restrictions on applicants	Yes, but with some thematic restrictions on applicants	Yes, but with some thematic restrictions on applicants	Yes, but with some thematic restrictions on applicants	Yes	Yes, but with some restrictions on applicants
Who is eligible for applying	Depends on instrument	Depends on instrument	Depends on instrument	Depends on instrument	Open to all	Open to all
Who is eligible for funding	Both private companies and research institutions	Both private companies and research institutions	Both private companies and research institutions	Both private companies and research institutions	Both private companies and research institutions	Both private companies and research institutions
Organisation of projects	Individual and centre structure	Individual and consortium structure	Individual projects	Individual and consortium structure	Individual and centre structure	Individual projects
Contract agreement	With project manager	With project manager	With project manager	With project manager	With all participants	With all participants
Success criteria	Scientific quality and innovation potential	Potential, feasibility and project team	Potential, trustworthy participants, etc.	Potential, academic, feasibility	Potential, feasibility	Business plan, cash flow, commercialisation
Assessed by	In most cases an panel of internal and external experts	Internal and external experts	Internal and external experts	Internal and external experts	Internal and external experts	Internal at the Bpifrance

Source: NIFU 2017, based on information from national experts

Note: Indirect funding is not included, these include a substantial share of public funded industry-oriented R&D in Norway, The Netherlands, United Kingdom and France.

3.2.1 Norway

Public support of industry-oriented R&D has been a key strategy to the present government. This emphasis is driven by a focus on “life after oil” and the relatively low R&D intensity faced by Norwegian companies. The public measures and instruments for stimulating business R&D consist of a rather broad portfolio of programs. Research based innovation projects in the business sector (IPN) are central, covering, among others, the User-driven Research-based innovation scheme (BIA), a scheme without any specific theme but also industry projects within theme-based programs such as

NANO2021. IPN does not necessarily require collaboration between industry and research institutions. Collaboration with other R&D executing companies is also a possibility, but any collaboration would be based on what the individual company needs. There are other programs with a stricter focus on bringing together industry and research institutions such as Knowledge-Building projects for Industry (KPN), Centres for Research-based innovation (SFI) and Environmentally-friendly Energy Research (FME). In addition, a larger number of large thematically oriented programs target industry-oriented R&D, e.g. BIOTEK2021, NANO2021, PETROMAKS2 and IKTPLUSS. These thematically oriented programs can be financed by IPN.

Additionally, in Norway indirect funding through tax incentives plays an increasing part of public support to industry-oriented R&D. Based on the latest figures from the official R&D statistics it seems that indirect tax incentive funding through SkatteFUNN has surpassed other public funding instruments in stimulating private R&D. Whereas the total funding of business R&D from other public funding instruments in 2013 €102mIn grew⁷ by 25% to €128.5mIn in year 2015. At the same period of time the SkatteFUNN funding rose by a little more than 100% from €71.3mIn in year 2013 to €144.1mIn in year 2015. These figures do not correspond with the figures from RCN or the Ministry of Finance, yet they show that to companies reported R&D activities in Norway SkatteFUNN is considered as a more important stimuli than the collective other public instruments.

According to MSTI 2016-2 and the OECD-R&D Tax Incentive Indicators, Norway spends 0,131% of GDP on public funded industry-oriented R&D both in direct and indirect funding. This adds up to a little more than €360mIn. Of this the RCN administrate a funding budget which amounts to €275mIn a year, corresponding to a little more than 76%. Worth mentioning here are the OFU/IFU - Public and Industrial research and development contracts administrated by Innovation Norway. The program has an annual budget of €59mIn, funding both public sector institutions and businesses.

The following presents the main instrument of funding as identified by the RCN.

Innovation projects in the business sector (IPN)

The objective is to stimulate R&D activity in trade and industry, particularly activities that promote innovation and sustainable value creation. The funding actor is the RCN with up to 50% of the project costs. IPN is a funding instrument for thematic programs as well as projects without any thematic association. The funding instrument applied is competitive grants.

The projects can be organised in various ways. There is no specific requirement for collaboration with universities or research institutes. Contracts are signed by the project manager even if there are several participants. The funding aims at individual projects.

The total funding for IPN is more than €141mIn, according to RCN, corresponding to 39.3% of the public funded industry-oriented R&D⁸ both in terms of direct and indirect funding. The funding is subject to competition. Eligible receivers of funding must be a Norwegian company/organisation. The project owner may seek funding on behalf of a group of companies.

The main success criteria consist of a strong application and a strong team along with a realistic research project. Furthermore, there is a list of criteria including level of innovation, potential for value creation, additionality, R&D project quality and relevance to the call for proposals. The assessment of application can differ depending on which program the application is addressed to.

⁷ Note this is in running prices and thus not corrected to the general price development. Furthermore, the currency conversion is based on the exchange rate in April 2017. In fact, the Norwegian currency dropped around 15% from 2013 to 2015. The 15% drop would have reduced the growth rates, yet since the point is to show the level of public funding for private R&D rather than a development in exchange rates we use the same exchange rate for all translations.

⁸ As stated by OECD MSTI 2016-2

Knowledge-Building Project for Industry (KPN)

The objective is to contribute to industry-oriented researcher training and long-term competence development in the Norwegian research community within topics that are crucial to the development of business and industry in Norway. The funding actor is the RCN, but participating companies must contribute at least 20% financing in cash. The instrument applied is a competitive grant.

Projects under KPN typically run for three to five years. They are led by a Norwegian research institution but with a requirement for the participation of a private company. Contracts are made with the project manager and the funding is aimed at individual projects.

The granted funding in year 2016 was €65.2mIn according to RCNs project database. KPN funding then accounts for 18.1% of the public funded industry-oriented R&D⁹ both in terms of direct and indirect funding. The funding is subject to competition yet the leading applicant must be a research institution.

The main criteria for funding, aside from requirements of projects lead by research institutions, is company participation. And that the companies finance at least 20% in cash. Furthermore, there is a requirement of relevance; here the relevance concerns future competence demands in businesses and that the particular KPN project will aim at closing this competence gap. The applications are assessed by a panel of experts.

Centres for Environmentally-friendly Energy Research (FME)

The overall objective of the FME scheme is to help solve key challenges in the energy sector, generate solutions for the low-emission society and enhance the innovation capacity of the business sector. The funding actors are the Research Council, the host institution and the partners. The Research Council's allocation to the centre may comprise a maximum of 50% of the centre's overall budget. The contribution of user partners must equal at least 50% of the Research Council's allocation to the centre. The funding instrument applied is competitive grants.

The financed projects are organised around a centre structure. The host institution for a centre can be a university, a university college or a research institute. Contracts are made the host institution. The host institution should have a strong reputation within the disciplines or areas the centre addresses. The partners (enterprises, public organisations and other research institutions) must contribute to the centre in the form of funding, facilities, competence and their own efforts throughout the life cycle of the centre. User partners must point out the commercial potential they envisage resulting from the centre's activities.

The yearly funding is €20.5mIn a year. This corresponds to 5,7% of the public funded industry-oriented R&D¹⁰ both in terms of direct and indirect funding, which is subject to competition. Apart from the host institution, there must be a research institution as part of the project. In addition, other research institutions and companies are eligible to be part of a centre. Though not a requirement proposals for centres that incorporate international companies as partners are viewed in a positive light.

The success criteria for the FME centres are:

- Potential for innovation and value creation
- Scientific merit of the application
- Relevance of the application relative to specific strategic and thematic guidelines set out in the call for proposals.

In the overall assessment and selection process, special emphasis is placed on the relevance criteria. However, to qualify for FME status and funding, the centres must demonstrate an adequately high

⁹ As stated by OECD MSTI 2016-2.

¹⁰ Ibid

level of both scientific merit and potential for innovation and value creation. The Research Council will also take into consideration the profile of the FME portfolio to avoid overlap between activities at the various centres. Importance will be attached to each centre having a distinct profile that distinguishes it from the other FME centres.

The assessment is completed by the Research Board of the Division for Energy, Resources and the Environment, or a committee comprised of members of the research board and other experts. They will submit its recommendation to the Research Council Executive Board, which is responsible for final approval of the award of centre status and allocation of funding.

As FME is a centre structure, collaboration is natural, yet it does not seem that there are strict requirements as to collaboration between companies and research institutions.

Centres for research based innovation scheme (SFI)

The SFI scheme aims at promoting innovation by supporting long-term research through close cooperation between R&D intensive companies and prominent research institutions. The main objective for the SFI is to enhance the business sector's capability to innovate by focusing on long-term research based on forging close alliances between research-intensive enterprises and prominent research groups.

The funding actors are The Research Council (up to 50% of the budget) and the SFI consortium (at least 50% of the budget), whereof participating companies are required to provide at least 25% of the centre's annual budget. The funding instrument is a competitive grant. The funding is aimed at financing a centre structure.

The centres are organised by a host institution; this can be a research institution as well as R&D intensive companies, though there are requirements for the host institution to have high academic standards. In practice this means that only research institutions or very large companies with substantial R&D activities become host institutions. Contract agreements are made with the host institution.

The yearly funding of SFI is €21.65mIn a year. This corresponds to 6,0% of the public funded industry-oriented R&D¹¹ both in terms of direct and indirect funding. The main success criteria for receiving funding are:

- Scientific quality on a high international level
- High potential for innovation and value creation for Norwegian partners and society at large
- A solid application including a sound vision and research plan, good overview of management and organisation, international collaboration and researcher education as well as senior researcher's profile and expertise.

The applications are assessed by a committee consisting of national and international experts. The evaluation process follows these steps:

- Scientific quality is evaluated by three international experts for each application and an international scientific committee
- Potential for innovation and value creation is evaluated by national industrial panels with relevant expertise for a group of applications
- Enhanced Board for Division for Innovation makes complete review of applications
- RCN Executive Board makes the final decision

¹¹ As stated by OECD MSTI 2016-2.

3.2.2 Sweden

Most public funded programs for private R&D in Sweden are collaborative programs containing some involvement from public sector and/or universities, cf. Rio Country Report Sweden (2015) – the former ERAWATCH¹². In that sense the Swedish way of organising their private R&D programs is somewhat alike to Norway's, where the programs KPN, SFI and FME also rely heavily on collaboration and interactions between the public and private sectors. The Swedish knowledge foundation¹³ also has several programs funding collaborative R&D projects between the so-called “new-universities” and businesses. Yet these are relatively small in magnitude, e.g. the “Synergi” program has a yearly budget of €8mln, corresponding to 1,5% of the public funded industry-oriented R&D.

Sweden does not have a specific tax deduction program for indirect R&D funding. Yet in 2014 Sweden introduced a scheme for reduction of social security contributions for commercial R&D activity. Only limited companies in the private sector are eligible. The scheme is limited in scope and should be regarded as a pilot initiative intended to explore what effects this type of fiscal instrument will have on R&D investments in Swedish businesses.

In Sweden Vinnova is the main administrator of industry oriented R&D funding. They finance a broad range of programs amounting to more than €251mln; of these €86mln was funded directly to private businesses in 2015, see VINNOVA's annual report for 2015. The €251mln corresponds to 56% of public funded industry-oriented R&D. According to OECD MSTI 2016-2 Sweden allocates 0,117% of GDP to public funding of industry-oriented R&D, a figure that adds up to €500mln.a year.

The main source of funding for stimulating industry oriented R&D is through competitive grants; as in Norway, which places a mixed focus directly on either businesses or collaborative programs. With assistance from Vinnova the following three programs have been identified as the most important.

Innovation projects in businesses (IPB)

The objective is to stimulate companies to engage in knowledge- and capacity-building in order to develop innovation. This includes investments in R&D. Furthermore, the objective is to provide financing to projects that otherwise suffer from lack of finance, to improve marketing and promotion of innovations and finally the program aims at strengthening the competitiveness of the company. Though several of the objectives target innovation activities, such as improving marketing and promotion of innovations, the overall aim is one of building capacity based on R&D for developing new products and services with substantial commercial potential¹⁴.

The funding actor and administrator is Vinnova. The instrument applied is competitive grants aimed at individual projects. The activities that are eligible for funding are, among others, development of technical prerequisites, developing new knowledge for prototypes, developing new production methods and larger development projects. The individual projects are organised by a single company and thus the contract is agreed with the company.

Applicants can apply for up to €210,000 (SEK2mln) and the total funding budget is €15.7mln a year corresponding to 18,2% of VINNOVA's funding directly to business. The €15.7mln is 3,1% of the allocation to industry-oriented business R&D. The funding is subject to competition and around 15% of the applicants are approved. The applicants must be an SME with less than 249 employees, but with a yearly turnover of more than €52,000 (SEK500,000).

¹² See Merle Jacob, Åsa Lindholm Dahlstrand, Maren Sprutacz; RIO Country Report (2015): Sweden; EUR 27859 EN;

¹³ The Swedish Knowledge Foundation is the KK-stiftelsen The Knowledge Foundation is the research financier for universities with the task of strengthening Sweden's competitiveness and ability to create value.

¹⁴ See Vinnova (2016): «Innovationsprojekt i företag».

The main success criterion for getting funding is the relevance and potential of the suggested project. In addition, high probability of implementation and the competence of the research team are important success criteria.

The applications are assessed by a person from VINNOVA, as well as by three other individuals with insight into the areas raised by the application. Each person assesses the application on an individual basis. After that they meet and discuss application and decide who gets the highest rank. The applicant with the highest score is then invited to an interview before the final assessment is made.

Since the program targets individual SMEs there is no requirement as to collaboration.

The program could have fitted well under the IPN in Norway. In many ways, it has much in common with projects financed under IPN.

Strategic Vehicle Research and Innovation program (Fordonstrategisk Forskning och Innovation (FFI))

The objective is to contribute to the following main goals: reducing the environmental impact of transport, reducing the number killed and injured in traffic and strengthening international competitiveness. FFI is a partnership between the Swedish government and automotive industry for joint funding of research, innovation and development concentrating on Climate & Environment and Safety. The background to the investment is the view that development within road transportation and the Swedish automotive industry has a big impact for growth in the Swedish economy.

The funding agent is Vinnova. They fund up to 50% of the project costs and administrates the program. Contracts are made with each participant. The funding instrument applied is competitive grants. The projects are preferably collaboration projects with the aim of strengthening the Swedish transport sector.

The yearly budget for the program is €44mln, corresponding to 8.8% of the allocation to industry-oriented business R&D and 17,5% of Vinnova's funding budget. The funding is subject to competition and there are no limits as to who can apply, yet it is required that the project must be of advantage to the Swedish transport sector. This implies that universities, research institutes and industry can apply.

The success criteria are somewhat similar to those of the IPB program. Relevance and potential are important as well as high probability of implementation and a strong research team. The applications are assessed by a selected group of at least 5 persons. These are a mix of generalist, sector or technical experts.

Collaboration is not a definite requirement. Yet it is considered a good thing if the project includes collaboration with different partners. The funding requirements follow EU state aid rules which limit large businesses to receiving no more than 50% of their R&D costs in the project. Universities and research institutions can receive 100% of their R&D costs. In total the project cannot receive more than 50% of the total R&D costs and at least 25% of the R&D costs must be financed by business.

There is currently no transport sector program in Norway, yet the FFI program is to some extent similar to large scale programs at the RCN.

Strategic innovation program (SIO)

The aim of the program is to create the basis upon which Sweden's business, academic and public sectors collaborate in order to solve grand challenges in society. In addition, the program must stimulate increased competitiveness for Swedish business. The program consists of two types of efforts. Strategic research and innovation agendas – that aims to stimulate a strategic dialogue between actors to, through joint research and an innovation agenda, highlight areas for improvement and the needs and possibilities available. SIO programs – that aim to support the implementation of the research and innovation agendas, are the most important for Sweden, along with those programs

that have the greatest potential to create conditions for international competitiveness and find sustainable solutions to global challenges faced by society.

The yearly budget for SIO is €68mln. The figure corresponds to 27% of the total funding budget for Vinnova and 13,6% of the allocation to industry-oriented business R&D in Sweden.

The SIO program is a bit complex in its organisation. First it covers two different areas of focus, the SIO agenda and the SIO program. Both areas are organised differently. The SIO agenda stimulates the push of R&D agenda. An agenda should describe the innovation area and set out visions, goals and strategies for the development of this area. It will be jointly developed by the stakeholders and describe the innovation area's challenges, development needs and opportunities. The developed agenda should be used to guide the renewal and development in the identified grand challenges. In comparison, the SIO program consists of 16 different R&D areas.

The programs are mostly competitive grants, but there are also other kinds of funding instruments such as innovation competition, according to Vinnova. The grants are usually open to anyone to search. However, the programs limit the callouts area-wide, for example, metallic materials have announcements in sub-areas of their area, which have been selected in their research and innovation agenda.

There are three main success criteria for funding; first is potential particular in terms of value added. Second is feasibility such as how well planned and balanced in structured work packages, budget and resource allocation. Finally, the team or consortium for the project is important.

Applications are assessed by an external assessment group, i.e. not by the Vinnova, Energy Agency or Formas authorities who jointly is responsible for the program. The assessment group is proposed by the program but is decided by the authorities.

All projects build on collaboration between companies and research institutions, in principle. Companies pay 50% of the project costs whereas the authorities pay the other half. The research institutions do not pay. Intellectual property rights and the rights of academic results are handled individually in each project and is not controlled by the authorities, yet it is required that these matters are handled by formal contracts.

Vinnova, the Energy Agency and Formas have a contract with project managers regarding funding and reporting. Everyone participating writes on "Project party's approval" and by signing, the project partners undertake to carry out their part of the project and that this is done in accordance with VINNOVA's terms and conditions.

Comparing Norway and Sweden

To sum up, the text box below compares the main findings when analysing programs for public funding of industry-oriented R&D in Norway and Sweden.

Sweden uses less of its GDP on industry oriented R&D than Norway does. According to OECD figures, 0,131% of GDP in Norway is allocated to industry oriented R&D whereas the corresponding figure for Sweden is 0,117%. In absolute figures Sweden spends more on funding industry-oriented R&D than Norway. Sweden spends €498mln a year compared to €360mln in Norway.

The most important instrument for funding in Sweden is competitive grants. This is to a larger extent than in Norway where the funding mix also includes the important tax incentives.

In both Sweden and Norway, the matter of who is eligible for funding and who can apply is program specific. There are programs with specific demands as to whether businesses or research institutions can apply and receive funding.

In the case of several project-participants in Sweden, every party involved signs a contract. This is contrary to Norway where contracts are arranged solely with the project manager.

Most programs in Sweden, apart from IPF, are based on consortiums with participation of both research institutions and businesses. Thus in order to receive funding businesses are required to collaborate with research institutions. This is the case in Norway where IPN does not require collaboration but KPN, SFI and FME aim to bring businesses and research institutions closer together.

Collaborating research institutions are not required to contribute with internal funding. They can do so if they want to, but Vinnova covers up to 100% of the costs faced by collaborating research institutions.

Source: NIFU 2017, based on Merle Jacob, Åsa Lindholm Dahlstrand, Maren Sprutacz; RIO Country Report 2015: Sweden; EUR 27859 EN and email correspondence and interviews with Daniel Johansson, Anna Orbak, Carl Nurmberg, Christina Kvarnström, Vilgot Claesson all VINNOVA, Enrioco Deiaco, Tilväxtnalys and Olof Sandberg, RISE

3.2.3 Finland

In Finland, the funding streams which cover the entire R&D process from fundamental research to market innovation are organised as cooperative services of funding organisations and as public-private partnerships. The concepts are based on the understanding that the innovation process is not a linear chain from basic research to commercialisation but instead is an interactive process where activities are concurrent and parallel, cf. Rio Country Report Finland (2015). About half of the cooperation between universities, research institutes and companies in Finland is partially funded by Tekes.

Tekes finances industry oriented R&D in terms of both grants and loans. Soft loans from Tekes add up to 2,3% of the total private R&D expenditure for Finnish companies. This corresponds to €105.8mln. According to Statistics Finland the public funding for business R&D in 2014 was €223mln. Yet there seem to be some inconsistency between figures from Statistics Finland and the OECD, as the OECD claims that 0,073% of Finnish GDP to industry-oriented business R&D, including both direct and indirect funding, is €187mln when converted to absolute figures. The discrepancy might be due to a sharp decline in the Finnish economy from 2014 to 2015.

As stated, Tekes is the main contributor in public support for industry oriented R&D. The Finnish Academy also has a few programs yet after talks with Tekes and a counsellor for Science Affairs from The Ministry of Employment and the Economy, as well as The Research and Innovation Council we agreed to focus on Tekes only. In 2015 Tekes gave a total of €575mln towards funding research projects¹⁵. The funding is divided between:

- R&D grants to companies and public organisations cover €191mln.

¹⁵ Source: Tekes Annual report (Tekes, 2015)

- R&D loans to companies cover €175mln – the discrepancy compared to the €105,8mln might be due to the fact that Tekes also offers loans for innovation and entrepreneurial activity.
- Research funding for universities, research institutes and polytechnics cover €209mln.

Through a dialogue with Tekes we have identified the following programs as the most important.

F€€ling - Intangible value creation and experienced value

The program wants to raise customer experience, emotions and meanings as key business drivers besides technology and expertise. In addition to emotions and customer experience, the program encourages companies to exploit all their intangible assets more effectively, including brands, reputation and knowledge capital.

The funding actor here is partly Tekes, which funds 50% of the program, whereas the other 50% is financed by project partners. Tekes operates from a matching principle, where the percentage of own funding differs. Universities or research institutes contribute 20-40% of the project costs, whereas companies contribute no less than 50%. Funding from the companies is mostly given in cash, but it can also be in-kind financing.

F€€lings program provides various services to participants. These include practical tools and guides to understanding what creates value for customers, and the benchmarking of good business practices. Yet the funding instrument is a competitive grant.

The F€€lings program encourages practical cooperation and networking between private companies and public research organisations. The funding is aimed at individual projects. Contracts are agreed with the project manager.

The amount of funding to single projects is not disclosed. The total budget for F€€lings from 2012-2018 is €50mln. A plain average levels to €8.3 a year corresponding to 4,4% of the allocation to industry-oriented business R&D.

The funding is subject to competition and there are open calls. In principal, the call is open to all, yet you must be registered in Finland in order to participate. The main success criteria are relevance, potential, how high the probability is of implementation and the competence of the research team. Furthermore, there is a strong focus on how trustworthy companies and persons can be proven to be. TEKES runs checks on tax registers and company accounts. It is a very prudent and careful process, assessed by sector experts and Tekes jointly.

Project proposals are evaluated by Tekes experts. Important evaluation criteria are:

- the technology or competence developed in the project is mainly new and challenging
- the project's potential impact on future business opportunities and society
- companies' role in implementing the project and utilising the research results
- project resources, competence, international cooperation

There are no programs in Norway that are similar to F€€lings.

Liideri – Busienss, productivity and enjoyment at work

The objective of the Liideri programme is to renew the business operations of companies through developing management and forms of working and actively utilising the skills and competencies of their personnel. This is how companies can create the prerequisites for a sustainable competitive edge, improve productivity and add enjoyment to work. Key focuses are management 2.0, employee driven innovation and new ways of working.

The funding actor is Tekes with 50%, again with 20-40% funding from universities or research institutes and no less than 50% from companies. The program is organised by Tekes but also

connected to the National Working Life Development Strategy to 2020 and the EUWIN – European Workplace Innovation Network.

The instrument applied is competitive grants. It is not clear how the projects are organised since they cover both projects, research calls, networks, action groups, morning coffee events and discussion, comments and networking possibilities in social media¹⁶. Yet the contractual agreement is made with the project manager.

The amount of Tekes funding for the program is €85mIn over 6 years, around €14mIn per year. This corresponds to 7,5% of the allocation to industry-oriented business R&D. As with F€€lings the funding is subject to competition and the call is open to all companies registered in Finland. The main success criteria and assessment also follows F€€lings.

There are no programs in Norway that are comparable.

Industrial Internet – Business revolution

The program aims to renew the business operations of companies through the Industrial Internet and encourage companies from different fields to engage in new kinds of cooperation. The funding actor is Tekes with 50%, again with 20-40% funding from universities or research institutes and no less than 50% from companies.

The program is organised by Tekes, which also offers funding targeting digitalisation through the programs 5th Gear and Bits of Health. Furthermore, the program provides international opportunities, e.g. through EUREKA cluster program ITEA3.

The funding is aimed at individual projects and contracts are agreed with the project manager. The budget for the program is €100mIn where Tekes funds €50mIn. Over a 5 year period this averages out to €10mIn a year; around 5,3% of the allocation to industry-oriented business R&D. The funding is subject to competition and the call is open to all companies registered in Finland. The main success criteria and assessment are also similar to those presented in the description of F€€lings.

Together, the three programs are representative of the 16 various programs active at TEKES in 2015. Even though the programs presented here might seem marginal they have much in common with the 16 other programs. The 16 programs cover 69,9% of the allocation to industry-oriented business R&D in Finland in 2015.

Comparing Norway and Finland

To sum up, the text box below compares the main findings when analysing programs for public funding of industry-oriented R&D in Norway and Finland.

¹⁶ See <https://www.tekes.fi/en/programmes-and-services/tekes-programmes/liideri/services/>

Finland uses less of its GDP on industry oriented R&D than Norway. According to OECD figures 0,131% of GDP in Norway is allocated to industry oriented R&D whereas the corresponding figure for Finland is 0,073%. In absolute figures Finland also spends less on funding industry-oriented R&D than Norway. Finland spends €223mln a year compared to €360mln in Norway.

Competitive grants are an important funding instrument in Finland. Yet soft loans have also been claimed to be important. On the other hand, Finland does not have tax incentives, while Norway does.

In Finland programs are open to all as long as you are registered as a legal entity in Finland. The process for selecting projects is somewhat different to that in Norway. In Finland, there is a close ongoing dialogue between potential applicant and funding actor. Furthermore, the large beneficiary body TEKES runs a check up on all applicants regarding their tax situation and whether they have unusual liabilities.

In the case of several participants in a project, the contract is agreed upon and signed by the project manager. Thus the general practice is like that in Finland and Norway.

Collaboration between businesses and research institutions is not a requirement in Finland. It will in most cases be a positive but not decisive factor for funding. Research institutions can provide funding in cash, but mostly they provide funding in kind. Funding from public research institutions is not a requirement in projects.

Source: NIFU 2017 based on Kimmo Halme, Veli-Pekka Saarnivaara, Jessica Mitchell; RIO Country Report (2015): Finland; EUR 27861 EN as well as interviews and email correspondence with Erja Heikkinen, The Ministry of Employment and the Economy and Research and Innovation council, Petteri Kauppinen, The Ministry of Education and Culture, Pekka Sivonen, Ari Suomela, Christopher Palmberg and Esa panula-Ontto, all TEKES.

3.2.4 Netherlands

With the introduction of the Enterprise Policy, the government reconsidered the way in which support given to research and innovation helps support economic growth. Instead of directly subsidising R&D, the ministry of EA mainly helps firms to participate in public-private research collaborations or allow them to deduct costs related to engaging in R&D. The main public programs aimed at stimulating R&D are the TKI's for collaborative research, SME support and the WBSO/RDA tax deduction schemes. In general, there is some direct funding through grants. Most is through loans and is connected to collaborative research.

In addition, there is an ambition to create innovation through public procurement. The Dutch government procures around €60,000mln a year, and has a specific target aiming at 2.5% of the procurement volume being in public procurement of innovative solutions.

According to OECD the Netherlands allocates 0.198% of their GDP to industry-oriented business R&D including both direct and indirect funding. This corresponds to €1,307mln.

The following programs have been highlighted as the most important ones:

Top Consortia for Innovation

R&D collaboration programs and projects which enjoy a financial top-up in the form of a public contribution. In TKI many existing research initiatives are being put together. An essential element is that research is conducted through public-private partnerships. Besides supporting regular research projects of the TKIs, the government provides a top-up for research-oriented PPP-initiatives. For each euro an enterprise contributes to a TKI, the government adds another 25 cents. The funding actors are thus the participants of the consortia and the Dutch government.

There is at this moment a lack of information on how individual projects are organised. Contracts are signed by the project manager, which is a public funded research institution.

The funding supports a consortium structure. In 2014 industry invested €359m in research conducted into TKIs and the public funding was €455m. The €455m corresponds to 34,8% of the Dutch allocation to industry-oriented business R&D, including both direct and indirect funding.

At the TKIs it is public funded research institutes that lead the application and projects. Yet all businesses are allowed to participate as long as they are in collaboration with a public funded research institute.

The main success criteria for TKIs are:

- If the focus or coherence of research is relevant
- If the quality of research is assessed to be high
- If the project provides value for the Dutch economy
- If there is additional value compared to existing knowledge stock
- If there is financial or administrative involvement from the applicant (it is either an undertaking or a research institution)
- If there is a high probability of implementation
- If there is an international dimension to the research
- If the research is made available to the public
- If the project is well-organised

These criteria are assessed by an advisory committee.

Private collaboration is a requirement of the leading public funded research institutes and the company must finance participation in cash, yet there is no information on whether in kind financing is also allowed.

To our knowledge there is no similar program in Norway.

MIT: SME innovation stimulation region and top sectors

The aim of the MIT scheme is to stimulate innovation through SMEs across regional boundaries. Furthermore, the program supports participation of SMEs in all the nine top sectors¹⁷. The funding actor of the MIT is both governments and regions. The program is organised through RvO.

There are several types of instruments applied in the MIT. There are consultancy projects, feasibility projects, R&D collaboration, knowledge vouchers and TKI instruments. The funding is aimed at individual projects, and as stated in the Enterprise Policy Monitor 2015, 90% of the MIT budget in 2014 was allocated towards R&D collaboration and feasibility projects.

The funding is aimed at individual projects and contracts are made with the project manager. The funding for MIT is €46m, corresponding to 3,5% of the public funding for industry-oriented R&D both directly and indirectly. There is no restriction to applicants other than that they must be an SME.

Collaboration is not a requirement, yet it is viewed upon as a bonus. Aside from that, information on the main success criteria and how applications are assessed is lacking. There is also a lack of information on what the funding requirements are in terms of R&D collaboration. The MIT with its focus on specific sectors (the top sectors) could be comparable to the large programs or the programs under IPN. Yet the specific outline of MIT is not directly equal to a specific Norwegian program.

Comparing Norway and Netherlands

To sum up, the text box below compares the main findings when analysing programs for public funding of industry-oriented R&D in Norway and Netherlands.

¹⁷ The nine top sectors: <https://www.government.nl/topics/enterprise-and-innovation/contents/encouraging-innovation>

The Netherlands uses a higher share of its GDP on industry oriented R&D than Norway. According to OECD figures 0,131% of GDP in Norway is allocated towards industry oriented R&D whereas the corresponding figure for the Netherlands is 0,198%. In absolute figures the Netherlands also spends more on funding industry-oriented R&D than Norway. The Netherlands spends €1,307mIn a year compared to €360mIn in Norway.

The funding mix of the Netherlands is somewhat different to that in Norway. The most important instruments are tax incentives, soft loans and to some extent direct funding through grants. Several instruments are combined in the Top Consortia focus where a certain area of Dutch expertise is in focus and a variety of instruments are utilised to stimulate public and private R&D and collaboration between research institutions and businesses.

Loans and tax incentives are open to all businesses, yet Top Consortia is limited to research institutions to lead. Businesses can participate but only if they are in collaboration with research institutions. Thus the funding instruments are somewhat different to those in Norway, which to a larger extent utilise competitive grants.

In the case of several participants in a project under Top Consortia, the contract is agreed upon and signed by the project manager. Thus, the general practice is alike in the Netherlands and Norway.

Collaboration between businesses and research institutions is not a requirement. It will in most cases be a positive but not decisive factor for funding. Funding from public research institutions is not a requirement in projects.

Source: Matthijs Janssen, Bram Erven, Pim Den Hertog, Koen Jonkers; RIO Country Report (2015): The Netherlands; EUR 27857 EN. Interviews and email correspondence with Pieter de Bruijn and Cock Schenk Rijksdienst voor Ondernemend RvO Nederland (Business and Enterprise Agency)

3.2.5 United Kingdom

The majority of government support for research funding falls within the broad area of innovation support and include various knowledge transfer support mechanisms and tax credits for R&D. In the UK the direct and indirect public funding for industry-oriented R&D sum up to 0,163% of GDP. This corresponds to €3,646mIn.

A large number of schemes are aimed at linking the public and private sectors (which may therefore be categorised as 'research networks'), thereby promoting the flow of new research ideas into new technologies and commercialised products, processes and services: examples include several of Innovate UK's schemes such as Knowledge Transfer Networks, Collaborative R&D and Knowledge Transfer Partnerships. These instruments involve elements of co-funding from industry and are not always eligible for the definition of "direct funding".

As stated previously, the UK has significant tax deduction schemes. The tax relief from the fiscal year 2011/2012 is estimated to be around €1,500mIn. That is more than 40% of the public funding for industry-oriented R&D both directly and indirectly. The R&D tax deduction schemes provide tax relief for more than 12,000 companies.

In addition to indirect and direct R&D funding the UK also has programs for public procurement. In 2013/14, the UK public sector spent a total of £242 billion (€319b) on procurement of goods and services. The government has set a target of procuring 25% of goods and services by value from small and medium-sized enterprises (SMEs) by 2015, which it met in 2014 when it spent 26% with SMEs.

The main programs have been selected in limited dialogue with Innovate UK and the business, entrepreneurship, innovation and skills department at governmental level.

Catapults UK

The Catapult centres are a network of world-leading centres designed to transform the UK's capability for innovation in specific areas and help drive future economic growth. They are a series of physical centres where the very best of the UK's businesses, scientists and engineers work side by side on late-stage research and development – transforming high potential ideas into new products and services to generate economic growth. The funding is expected to vary through the life of a centre, but the basic offset is a 1/3 times 3 model divided by:

- business-funded R&D contracts, won competitively
- collaborative applied R&D projects, funded jointly by the public and private sectors, also won competitively
- core public funding for long-term investment in infrastructure, expertise and skills development

Each Catapult centre will be established as a company ltd by guarantee (CLG), a separate legal entity from Innovate UK.

The instrument applied here is a mix of competitive grants and direct private and public funding. Catapults are not-for-profit, independent physical centres which connect businesses with the UK's research and academic communities to work on late stage R&D projects. Each Catapult centre specialises in a different area of technology, but all offer a space with the facilities and expertise to enable businesses and researchers to solve key problems collaboratively and develop new products and services on a commercial scale. There is at this moment lack of information on the contractual agreements.

The funding supports a centre structure and the yearly amount of funding is €300mln. This amount corresponds to 8,2% of the public funding for industry-oriented R&D both directly and indirectly. The funding and participation in a centre is in principle open to all businesses that find the specialisation of the centre relevant. The centres are explicit in stating that both large and small companies are welcome to join. There is at this moment a lack of information on the main criteria for funding, how the applications are assessed and by whom, what the requirements for collaboration between industry and research institutions are, as well as a lack of information regarding requirements of internal funding.

Catapults are to some extent comparable to the Norwegian Centres for research based innovation. Yet the larger difference here is that the Catapults are open to taking on new projects with new collaboration partners when considered feasible.

Collaborative R&D projects

The aim of collaborative R&D projects is to support collaborative research and development (R&D) projects and feasibility studies involving companies and research organisations in the UK. There is at this moment a lack of information on who is funding actor(s), how the program is organised and what kind of instruments are applied. Furthermore, there is a lack of information regarding contractual agreements and how individual projects are organised.

The funding aims at individual projects with a two-to-three-year duration, and requiring an Innovate UK investment of around £500,000 to £2 million. The total amount of funding is €184mln over two years, cf. Cio country report UK 2015. This corresponds to 2.5% of the public funding for industry-oriented R&D both directly and indirectly in the UK. Funding is available to UK businesses to help drive innovation.

There is at this moment a lack of information on the main criteria for funding, how the applications are assessed and by whom, what the requirements for collaboration between industry and research institutions are, as well as a lack of information regarding requirements of internal funding.

There are a number of public R&D support schemes in Norway that allow for, encourage and even require collaboration between industry and various research institutions. This includes SkatteFUNN,

where figures from 2014 state that 28% of all SkatteFUNN-projects included cooperation in terms of purchase of external R&D. But there are also programs like the so-called User-driven Research-based Innovation programme (BIA), and Centres for Research-based Innovation (SFI) scheme, which aims to enhance the capability of the business sector to innovate by forging alliances between research-intensive enterprises and prominent research groups, which are important for stimulating business R&D through R&D collaboration.

Knowledge Transfer Partnership

A longstanding program active since 1975, the Knowledge Transfer Partnership (KTP) scheme helps businesses to innovate and grow. It does this by linking them with a university and a graduate to work on a specific project. Each KTP is a three-way partnership between a business, an academic institution and a graduate. The academic institution employs the recently-qualified graduate who works at the company. The graduate, known as the 'associate', brings new skills and knowledge to the business.

KTP is funded by Innovate UK along with 12 other funding organisations. These funding organisations include Research Councils, the devolved administrations and a number of other government departments recognising the importance of knowledge transfer to economic development and wealth creation. It is part-funded by a grant. The amount businesses need to contribute is different for SMEs and larger companies. If you are a small to medium-sized business, you will need to contribute a third of the costs, whereas large companies may need to contribute half the costs. According to the InnovateUK homepage the average annual contribution to a project for an SME is around £23,000 and £ 30,000 for large companies.

The number of funding organisations changes from call to call. In June 2015 there were 7 funding organisations, each of whom had their own priorities and criteria of who and what to fund. There is at this moment a lack of information about the contractual agreements.

The funding aims at individual projects. The amount of public funding in the years 2014-2015 was €45mIn or €22,5mIn a year. This corresponds to 0,6% of the public funding for industry-oriented R&D both directly and indirectly.

The funding is subject to competition and everyone is in principle eligible to apply for funding. Yet some of the funding organisations may have specific requirements. E.g. in June 2015 Scottish Funding Council prioritised SMEs and projects with "supply chain involvement", cf. KTP Sponsor Funding Criteria June 2015.

The main success criteria for getting funding are: a clear additionality, and important to improve the UK knowledge base. The project must not be a solution that is "off the shelf", it must be "stimulating and challenging for all three partners" and the stated "potential benefits for all three partners [must] be likely to accrue".

Each KTP application is assessed against a list of Funding Organisation Criteria and the Overarching Criteria which, in general, ensure that the proposal fits within the agreed mission and objectives of the program. In some cases support from more than one funding organisation may be required in order for the proposal to be supported.

Though it is indirectly indicated we lack more specific information on the requirements concerning collaboration and funding requirements.

Norway has no such program linking businesses, academia and.

SBRI – including a pre-commercial procurement program

The Small Business Research Initiative is the main support scheme that focuses on demand-side issues. Operating under the auspices of Innovate UK; it involves several government departments in

supporting procurement of innovative solutions from SMEs. The public sector acts as the lead customer.

The funding instrument is not a grant; rather, the instrument is through the procurement. The individual project follows a three-step model:

1. InnovateUK and governmental departments create a competitive call for desired solutions to identified needs in the public sector.
2. Phase 1 –where scientific, commercial and technical feasibility is determined. Here various test projects receive funding between £20,000 and £100,000, within a time frame of 2 to 9 months. The results here will largely determine any entrance to phase 2.
3. Phase 2 – prototyping developing product or service to the point of commercialisation. May be up to two years and have a project funding of £1,000,000.

There is at this moment a lack of information on the contractual agreements and how each individual project is organised. The level of funding is 100% of the private R&D costs in the projects. Furthermore, the business can claim R&D tax credits for their investments. Six of the larger UK government departments targeted £200mIn (€234mIn) in fiscal year 2014/15 in SBRI initiatives; this corresponds to 6,4% of the public funding for industry-oriented R&D both directly and indirectly.

All businesses are eligible to apply, and there are no requirements as to collaboration with academia. There is a lack of information on the exact success criteria, but the applications are assessed by the Public Sector Body on Fair Market Value.

There are no programs for research based innovative public procurement to SMEs in Norway.

Comparing Norway and the United Kingdom

To sum up, the text box below compares the main findings when analysing programs for public funding of industry-oriented R&D in Norway and United Kingdom.

The United Kingdom uses a higher share of its GDP on industry oriented R&D than Norway. According to OECD figures 0,131% of GDP in Norway is allocated for industry oriented R&D whereas the corresponding figure for the United Kingdom is 0,163%. In absolute figures the United Kingdom also spends more on funding industry-oriented R&D than Norway, not surprisingly given the difference in size of the respective economies. The United Kingdom spends €3,646mIn a year compared to €360mIn in Norway.

The funding mix of the United Kingdom is somewhat different to that in Norway. The most important instruments are tax incentives, grants and loans or debt financing.

There is at this moment a lack of information on whether or not the grants are open to competition and if there are any restrictions on who is eligible to apply for and receive these grants. Further we lack information on contractual agreements, if private enterprises/industry are required to collaborate with research institutions and if collaborating research institutions are required to contribute with internal funding.

Source: Paul Cunningham, Jessica Mitchell; RIO Country Report (2015): United Kingdom; EUR 27875 EN;. email correspondence with Averil de Souza, BEIS MINISTERIAL CORRESPONDENCE UNIT, and David Golding and Dan Hodges both InnovateUK.

3.2.6 France

Public support for R&D is significant in France as compared to the other countries. If we add the share of public funding for industry-oriented R&D both directly and indirectly the public funding sums up to 0.372% of GDP. This is much higher than Norway with 0.131% of GDP. Thus, the public funding in France is close to €8,000mIn.

As of May 2015, a new strong policy priority was launched. The “Industry of the Future” is to be “the matrix of France’s industrial strategy; it will be heavily funded. Hence, to help companies adapt to the new paradigm, two exceptional measures were announced: “€2.5bn in tax incentives for companies investing in their production base over the next 12 months; and €2.1bn in loans earmarked by Bpifrance for SMEs and mid-tier firms over the next two years: these additional development loans will supplement the €1.2bn already made available to companies investing in Industry of the Future projects”.

France is the OECD country with the highest level of indirect government funding of business R&D as a share of GDP. This is to large extent driven by a substantial tax deduction scheme. Not only is the French R&D tax credit the most advantageous for companies performing R&D activities, but as analysed by the OECD (2013)¹⁸, it is also well-designed, favouring SMEs over large groups and addressing “high-growth companies” needs (with the “young and growing enterprises” scheme). Bpifrance in France is the main administrator of industrial R&D programs on the behalf for the government. The total amount a year is about €800mIn for programs supporting industry-oriented R&D. This means that the funding of Bpifrance sums up to 10% of the total public funding for industry-oriented R&D.

Bpifrance is a financial institution gathering together activities previously delivered by OSEO, the Strategic Investment Fund (FSI), FSI Regions and CDC enterprises. They provide assistance and financial support to small and medium-sized enterprises, facilitating access to banks and equity capital investors, particularly during the high-risk phases: Start-up, Innovation, Development, International, Buy out. They are running several innovation support programs, either for individual companies or for collaborative research and innovation projects. On average, 2500 companies are supported annually through:

- Innovation funding
- Guarantees for bank financing and venture capital
- Investment and operational cycle financing alongside banking and financial institutions
- Equity investment, directly or through partner funds
- Export support through export insurance and financing, and collaboration with Business France

In close dialogue with Bpifrance, we have identified the following programs as the main programs targeting business R&D, rather than innovation or other business development issues:

Innovation Support individual projects

It is divided in two phases:

A competitive grant for feasibility part. The support level differs between €15,000-€50,000 for feasibility (grant) and in individual feasibility projects – though with a maximum of the company’s own equity level.

A zero interest loan or a repayable advance for the RDI part. The amount of support is between €50,000 and €3,000,000. The reimbursement fits the commercialisation plan of the company (eg for repayable advances: over 5 years starting 3 years after the first payment).

¹⁸ OECD (2013), “New sources of growth: Knowledge-based capital”

The program reimbursement on commercialisation of product. It consists of 16 quarterly reimbursements. The reimbursement use GGE calculation methods, consistently with European regulation on State aids (see article 4.5.1.2 paragraphs 78 and 79).

The main success criteria for getting funding are financial data to the applicant, business plans, innovation grade, cash flow forecasts, commercialisation plan and turnover forecast. The applications are assessed by Bpifrance. Bpifrance underwrites the support and returns are included in annual state-subsidies to Bpifrance. There are no requirements as to collaboration.

The Innovation support individual projects program is not comparable to any specific Norwegian programs. Though it will have fitted under the IPN programs. As stated there are no alike loan funding at Research Council of Norway. The closest is support for applying for loans in the Horisont 2020 program. Alternatives are various type of risk capital and low risk loans from Innovation Norway, but these are not targeting R&D.

Innovation Support, collaborative projects

The main funding actor is Bpifrance and the program is organised by Bpifrance. The funding instrument is a competitive grant with calls with ranking. The projects are led by companies but in collaboration with academic partners. The contracts are signed with every single participant. The industrial research components are funded with grants and the experimental development components are funded through repayable advances (with GGE calculation).

There are two sub-programmes:

the Single Inter ministerial Fund ("FUI"), the projects awarded by a competitiveness cluster must lead to the market launch of a product or service within five years, with the R&D work performed within the competitiveness cluster and which is sure to provide national economic advantages.

the Future Investment Programme ("PIA"), the projects are intended to structure the existing industrial groupings in connection with government-funded research and to cause new ones to come out of that,

The internal or external expenditure directly associated with the industrial research and the experimental development of the project are co-financed.

- FUI: up to € 3 mln;
- PIA: starting from € 3 mln

The target group is high risk innovation projects, developed in collaboration with academic partners in companies with up to 5,000 employees.

The main success criteria for getting funding are financial data pertaining to the applicant, business plans, innovation grade, cash flow forecasts, commercialisation plan and turnover forecast. The applications are assessed by Bpifrance and an inter-ministerial body. The French state, through inter-ministerial funding, underwrites the support; any returns go back to the state.

It is also a pre-requisite that the projects are formed as a collaboration between company and academic partner. There is a requirement that the company must roughly match the funding.

The innovation support for collaborative projects is not directly comparable to any Norwegian funding instruments. There are some similarities in terms of IPN with projects that include collaboration. Yet there are differences both in terms of assessment, success criteria and the fact that for achieving funding there is a demand for collaboration with academic partners.

Innovation loan (with InnovFin, Horisont 2020 guarantee).

The funding actor is Bpifrance in addition to the French State and European Investment Fund, and with a guarantee from InnovFin. The loan is running for 7 years with a 2 years' grace period, 20

quarterly reimbursements and straight amortisation of the capital. Interest rates vary with the financial rating of the company and rates can be either fixed or floating. The instrument applied is a loan.

The amount of support is loans between €50,000 and €5,000,000. It has not yet been possible to get an estimate of the total budget for this program. The target groups are SMEs or companies with less than 500 employees as well as companies who have received innovation support beforehand or have filed a patent application. The loan finances non-tangible investments for a market launch. Bpifrance co-signs for 20% of the loan, the French State for 30% whereas the EIF (European investment fund) co-signs for the remaining 50%. There is no requirement of collaterals from the applicants.

The pre-requirements are financial data to the applicant, business plans, cash flow forecasts, commercialisation plan and turnover forecast. Bpifrance assesses the applications. There are no requirements as to collaboration or co-funding.

The RCN offers funding for applying to InnovFin loans. Yet they do not themselves offer loans for innovation commercialisation projects

Seed innovation and investment loan.

The funding actor is Bpifrance in addition to the French State and European Investment Fund. This third type of loan is combined with seed innovation, running 8 years with a 3 years' grace period and quarterly reimbursements. The rates can be either fixed or floating. The instrument applied is a loan.

The loan is provided to individual companies and contracts are made with the company. The support amount is loans between €100,000 and €500,000. In addition, 50% equity funds raised in a 3-months period (for an amount of at least €200,000). The loan is guaranteed jointly. Bpifrance co-signs for 20% of the loan, the French State for 40% whereas the EIF (European investment fund) co-signs for the remaining 40%. Funding from this is provided by professional investors and Business Angels. It has not yet been possible to get an estimate of the total budget for this program.

The target group is small companies with less than 50 employees and younger than 5 years. The pre-requirements are financial data pertaining to the applicant, business plans, cash flow forecasts, commercialisation plan and turnover forecast. Bpifrance assesses the applications. There are no requirements as to collaboration or co-funding.

The RCN does not provide seed innovation and investment loans. Innovation Norway has programs that support seed capital for innovation.

Comparing Norway and France

To sum up, the text box below compares the main findings when analysing programs for public funding of industry-oriented R&D in Norway and France.

France uses a higher share of its GDP on industry oriented R&D than Norway. According to OECD figures 0,131% of GDP in Norway is allocated for industry oriented R&D whereas the corresponding figure for France is 0,372%, largely driven by comprehensive tax incentives. In absolute figures France also spends more on funding industry-oriented R&D than Norway, not surprisingly given the difference in size of the respective economies. France spends around €8,000mIn a year compared to €360mIn in Norway.

The funding mix of France is somewhat different to that in Norway. The most important instruments are tax incentives, loans or debt financing and grants.

The programs selected by Bpifrance are open to competition. And in general, there are few restrictions as to who is eligible. In most cases, very large companies with more than 2,000 employees are not eligible. There are also programs contained within which are designed for supporting R&D collaboration between industry and research institution, thus a project will need the participation of both industry and research institution in order to be considered.

Contractual agreements are made with all participants of a project.

There are programs designed for collaboration between industry and research institutions, and with these programs collaboration is a requirement. Otherwise collaboration is not a requirement, but can be seen as positive when assessing an application.

Research institutions participating in collaboration projects are not required to contribute with internal funding in the projects.

Source: Pierre Bitard, Thomas Zacharewicz; RIO Country Report (2015): France; EUR 27949 EN; Email correspondence with Christian Dubarry, Bpifrance.

3.3 Main characteristics of most important direct individual funding instruments

3.3.1 Grants

In general grants are the most widespread funding instrument across the countries. This has been pointed out through OECD where competitive grants alongside debt financing and loans are viewed as the most important instruments. Furthermore, our contacts at VINNOVA, Tekes, RvO, Innovate UK and BpiFrance all point at competitive grants when they are asked to point out the most important funding instruments.

So, what is the nature of these grants across the six countries in question? First, these are competitive grants. In most of the countries certain deadlines or openings exist within which applicants can submit their projects. In France though the innovation support for individual projects have an open call.

The eligibility requirements for funding differ across countries. In general, the funding instruments are eligible to a large range of entities, e.g. companies with less than 3,000 employees. Company size seems to be the most common restriction to eligibility of companies. Thus, we see that many give particular focus to SMEs, including the Netherlands, the UK and Sweden. One could also argue that France, too, has a particular focus on SMEs since their grant for innovation support for individual projects targets start-up companies and SMEs, but also midsized companies with up to 2,000 employees. If we look at the structural distribution of R&D performing companies, the focus on SMEs in funding instruments corresponds well to the lack of R&D performing SMEs in these countries. On the other hand, Norway has a greater number of SMEs performing R&D compared to the OECD

average and Norway does not have any restrictions on their competitive grants regarding company size.

As for Norway, the restriction on who is eligible to apply and obtain support differs from program to program. Where Innovation project aims at undertakings, the program Knowledge building project for Industry and Centres for Environmental friendly energy research is targeting research institutes but with participation of undertakings. Centres for Research Based Innovation Scheme is targeting universities, research institutions or companies with particularly strong research capacity.

A broad eligibility is also evident in Finland and Sweden, where programs like Challenge driven innovation and Strategic Innovation program are open to companies, research institutes, universities and other legal entities active in Sweden and programs like F€€ling and Witty City are open to all legal entities in Finland.

To most of the funding instruments any R&D performer is eligible to receive funding. Worth mentioning here is "Innovationsprojekt i f€€retag", where the funding is only eligible for SMEs, and the program "Innovaion projects in the business sector" at the RCN which only has funding for undertakings.

If there are multiple partners in a project, then the common approach at Commission level is to make an individual contract with all partners. In Norway this is quite the opposite where a contract is made with the project manager who in turn has the responsibility for the rest of the project members. These proceedings differ across the other countries. In Finland and the Netherlands contracts are agreed upon with the project manager. Whereas France used to have an agreement with the project manager only they now make contracts with each individual recipient.

The applications for competitive grants have various success criteria. Some criteria repeat themselves across the six countries in question. These include relevant research topic, a strong project team and implementation plan or probability of successful implementation of the project, i.e. if the research project is realistic. Yet there are some notable differences.

Central success criteria to funding instruments from Bpifrance¹⁹ are information on financial data, business plans and cash flow forecast. In other words, criteria linked to economic performance of the applicant. Bpifrance also highlights commercialisation plan and turnover forecast as important criteria. In Finland they have a strong focus on trustworthy companies and persons. Tekes runs checks on tax registers and companies' accounts to investigate the truth of information given by applicants. Furthermore, Tekes has a continuous dialogue with applicants and potential applicants. The dialogue is part of Tekes' assessment process. To the other countries, a good application, high probability of implementing the suggested project and a strong research team are all core success criteria.

The assessment process is somewhat alike across the six countries. Applications are assessed by persons from the funding agencies in addition to a panel of experts, referees, a board or a committee. E.g. in VINNOVA an employee assesses the application with the help of three persons with particular insight into the areas concerning the application. They individually assess the application. After that they meet and discuss the application and decide who gets the highest rank. The applicant with the highest score is then invited to an interview before the final assessment is made. At Bpifrance it is Bpifrance that assesses funding instruments with a low limit of support, e.g. the innovation support program for individual projects with a maximum support of €50,000. On the other hand funding instruments with larger level of support, e.g. the innovation support program for collaborative projects with a minimum grant level of €750,000 is assessed by government level officials.

A central element in public support schemes is to stimulate increased R&D collaboration. This is a theme that has been high on the R&D policy agenda in most western economies including the six

¹⁹ The level of detail required by Bpifrance is usually adapted to each case.

countries in question. Therefore, many funding instruments also contain elements or even requirements of R&D collaboration.

Some of the programs mentioned as the most important funding instruments have an outspoken requirement when it comes to R&D collaboration. This includes centres for research based innovation in Norway, the innovation support program for collaborative projects at Bpifrance and the TKI Top Consortia for Knowledge and Innovation in the Netherlands, whereas other funding instruments do not focus on R&D collaboration at all, including the innovation program for businesses in Sweden and the innovation support program for individual projects in France. Yet it has been stated that even though R&D collaboration is not a requirement, it is often viewed as positive in an application.

When looking at collaborative projects the question of funding requirements varies. This differs from country to country as from program to program. TEKES operates from a matching principle, where the percentage of own funding differs. Universities or research institutes contribute 20-40%, whereas companies contribute no less than 50%. From the companies contribution is mostly given in cash, but it can also be in-kind financing. At TKI Top Consortia for Knowledge and Innovation in the Netherlands there is a demand for in cash financing from companies. In France the financial requirements depend on the funding instrument. In Norway there are differences across programs: at IPN it is at least 50% in cash from companies, KPN with 20% in cash from companies, SFI is mostly in kind financing, whereas FME requires a minimum of 50% financing from all partners.

3.3.2 Other direct measures

When identifying the most important funding instruments, Finland, France and the Netherlands highlight instruments other than grants. The OECD points at debt financing and risk sharing mechanisms as being highly relevant, with increasing relevance in the UK as well. A possible explanation to as why UK have not mentioned debt financing and risk sharing mechanisms is that the self-assessment of relevance does not take into account the magnitude of a program, where grants might be of higher costs to national account than debt financing and loans.

The loan and reimbursement programs to Bpifrance are seemingly more tailored to certain groups of companies. As mentioned the three different types of loans all target different groups of businesses. The Seed innovation and investment loan target the small enterprises and start-ups of up to 5 years. The development loan targets intangible investments for the market launch for SMEs with up to 500 employees who previously have received innovation support. Finally, the Zero-interest rate loan targets companies with up to 2,000 employees and low technological projects driven by mature enterprises. These are essentially rather different target groups. There are further differences in terms of the reimbursement programs. One targets companies with up to 2,000 employees which are applying for high risk innovation projects. The other sets no limit on company size, but the high-risk innovation project must be developed in collaboration with academic partners.

The assessment criteria state more or less the same as other Bpifrance programs. That is, information on financial data, business loans and cash flow forecast. In other words, criteria linked to economic performance and commercialisation plan and turnover forecast are important criteria.

We have limited information on soft loans as funding instruments for Finland and the Netherlands. We know that for Finland soft loans are utilised to support development activities that are closer to market than industrial research. Businesses cover between 50-70% of their eligible costs by soft loans, which must be refunded by the company. If the R&D project turns out to be a failure some of the soft loan is converted into a grant. As for the Netherlands, we do not have any additional information on soft loans.

3.4 Tax incentive schemes – indirect funding

The focus of this report is the direct government granting of business R&D. However, to understand the funding of R&D in a country, one must also take into consideration the use of tax incentives for supporting R&D. Over the last 20 years or so, tax incentives have become ever more widespread, and the proportion of government funding of business R&D through tax incentives has become quite substantial compared to direct funding.

In the EU, most countries have introduced one or several tax incentive schemes for business R&D. However, it is noteworthy that some of the European countries with the highest level of R&D in percentage of GNP have not seen the need to adopt tax incentives for R&D. This is the case for Germany, Finland and (with some modification) Sweden. A country with a high level of R&D, namely France, also has the most generous tax incentive for R&D in Europe.

Of the countries covered by this report, Norway, France, the Netherlands and the UK have tax incentives for R&D in place, whereas Finland and Sweden (with a modification) do not use tax incentives to promote business R&D.

Tax incentives for business R&D are not regarded as state aid under the European treaty if they are designed so that they are of a general nature and apply to all businesses. This implies that if national legislation permits it, the total government support for business R&D could be the sum of a grant (up to the permitted level under state aid rules for R&D) plus the advantage of the tax incentive. Tax incentives only apply for entities that are tax liable. This will in most countries imply that universities and public research institutions may not benefit from the tax incentive directly, but might if they establish a tax-liable company to conduct R&D for the market.

The tax incentive in Norway offers a tax credit for R&D at 20% of the eligible costs for SMBs and 18% for larger companies. There is a yearly cap for the eligible cost of NOK 25mln (approximately €2.8mln). If the company has purchased R&D from an approved R&D institution, the cap is increased to NOK 50mln per year (approximately €5.6mln), however the in-house R&D still capped at NOK 25mln.

The tax incentive may be combined with a R&D grant. However, the sum of the value of the tax incentive and the grant may not be higher than the permitted state aid under the EU Group block exemption regulation.

The Netherlands has a tax incentive which is linked to the payroll withholding tax. As the payroll tax is due every quarter, the right to deduct the tax incentive from the payroll tax gives a better liquidity for businesses than having to wait for the following year's tax statement in order to receive the benefit.

The payroll tax deduction amounts to 32% of the first €350,000 of R&D wages and other costs, and 16% of all further R&D costs. For start-up companies, the permitted deduction is 40% for the first €350,000. We do not have information as to whether tax incentives in The Netherlands can be combined with government grants for R&D and under which conditions.

The French tax incentive offers a tax credit of 30% for up to €100mln expenditures per year, and 5% above this level. In addition to this general scheme, France has several different tax incentives for innovation activities. Young Innovative Companies (YIC) are offered a number of tax benefits and payroll tax benefits. The general tax incentive may be combined with government R&D grants, but such grants are deducted from the eligible costs.

The United Kingdom has two tax relief schemes for business R&D. The scheme for SMBs offers a tax allowance of 230% of the eligible costs. As the current corporate tax rate is 20%, this equals a tax support of 26% of the eligible costs. The SMB scheme is regarded as state aid under EU state aid rules. For larger companies, the Research and Development Expenditure Credit (RDEC) scheme

would apply, offering a tax credit of 11% of the eligible costs. The tax incentives may not be combined with government R&D grants.

Sweden does not have a tax incentive for R&D in the usual sense of the term. However, certain foreign experts, amongst them qualified researchers with a position or competence level that would be difficult to recruit in Sweden, may be offered tax reliefs that would also benefit the employer. The taxpayer could receive a 25% reduction in the basis for calculating the income for the first 3 years. The personal income tax in Sweden often passes 50% of the income, but may not be higher than 60%.

Finland had a tax incentive for business R&D for one year in 2015, but it has not been continued.

4 Aligning measures with State Aid rules

In this chapter, we will investigate how central bodies in the six countries in question respond to the ambiguity and complexity of the EU state aid rules. The purpose is to ascertain whether the EU state aid rules for R&D induce countries to organise the funding for industry-oriented R&D, and if the funding is organised differently than it would have been without the state aid rules. These are counterfactual questions, and all answers will have elements of uncertainty attached to them. The aspects we have looked at are, among others:

- How do the state aid rules comply with in funding schemes?
- Have the state aid rules affected how funding is organised? Would the funding have been more generous without the state aid rules?
- Is the distinction between contract research and effective collaboration taken into consideration when offering public funding?
- How are economic and non-economic activities handled by research institutions that perform both, and what is the relation between economic and non-economic activity in terms of turnover?
- How is the sharing of risk, results and intellectual property rights handled in joint research projects between undertakings and public research institutions?
- How is funding of research infrastructure available to businesses and what are the economic conditions for undertakings if they utilise the research infrastructure?

In general, we find that State Aid rules rarely affects the way the magnitude and organisation of public support for industry-oriented R&D. Thus, we conclude that even though State Aid rules are viewed upon as a bump and a bit troublesome the rules are not significant in the design of relevant R&D policy measures. And is not a barrier to public support for industry-oriented R&D.

4.1 General background

Relevant R&D policy measures can be implemented without overstepping EU State aid rules. At least this is the consensus statement from the TAFTIE network²⁰ and thus the statement of key organisations in Europe responsible for implementing R&D and innovation policies and public funding of industry oriented R&D.

²⁰ TAFTIE is the European Association of leading national innovation agencies. Its Members make a major contribution to strengthening Europe's economic performance by supporting product-, process- and services innovation by implementing their countries' national and -many times- international Research, Development and Innovation programmes. TAFTIE consists of 30 organisations from 28 European countries.

Many European funding schemes are established pursuant to EU regulation 651 (2014), the General Block Exemption Regulation, the so-called GBER (see explanation below). Other schemes are notified according to the framework for state aid for research and development and innovation, Communication issued by the Commission of May 21st 2014 (C(2014) 3282). The general opinion in the TAFTIE network is that the GBER is easier to use than the Framework, but that the latter is necessary for innovative and new ways of designing support measures.

A general complaint from the network is that the state aid rules related to R&D are complicated to interpret and use, making it difficult to tell what may pass when considering new types of policy measures that are not directly mentioned in the state aid rules. In addition to the administrative burden of applying the rules, the uncertainty also hampers policy innovation to a certain degree, because it usually seems simpler to stick to conventional measures.

There seems to be a movement in Europe in the direction of using more indirect and reimbursable aid instruments, at the cost of direct grants. Grants are considered effective and easy to assess in relation to EU state aid rules. On the other hand, grants might not be the best way to encourage more open and collaborative R&D and innovation activities with more unclear division of research activities, investments and inclusion of other actors such as environmental organisations, citizens and governmental bodies. Calculating the aid intensity of alternative policy instruments is rarely straight forward.

Open innovation and collaborative R&D activities may include elements of state aid, such as when undertakings access and utilise research infrastructure built and maintained by public funding. Sometimes undertakings and public research institutions have joint projects, and share the outcome of the R&D. Some institutions conduct both economic and non-economic activities, and costs and incomes must be separated for the application of state aid rules. Setting the correct value of access to infrastructure, sharing intellectual property rights without conferring an undertaking with a benefit, and drawing the line between economic and non-economic activities is feasible in principle, but can in practice be a burdensome and difficult task.

These questions must of course be discussed in relation to the basic principles of EU state aid, with R&D as a consideration. These principles are therefore described below, before the findings from the six countries are presented. The findings from the six countries are based on interviews with national experts, as laid out in Appendix B.

4.2 State Aid rules and government funding of business research and development

All the six states covered by this report must take the EU state aid rules as a given framework when designing their different support measures for business related research and development. Indeed, when studying the support measures and the policy mix in each country, the influence that the state aid rules might have had should be borne in mind.

The objective of the EU state aid rules is to establish a level playing field for enterprises in Europe. However commendable this might be in principle, states are at liberty to decide, rather freely, how much they support business related R&D, and whether they will act according to the state aid rules. Thus, state aid rules in relation to business R&D might be interpreted as formalities to be respected when a state decides how generous its business research and development policy is to be. The considerable difference between government funding of business R&D as a percentage of GDP is illustrated in Chapter 2.

4.2.1 The basic principles of EU State Aid rules

The Treaty on the functioning of the European Union Article 107 (1) lays down the general provision against State Aid:

“Save as otherwise provided in the Treaties, any aid granted by a Member State or through State resources in any form whatsoever which distorts or threatens to distort competition by favouring certain undertakings or the production of certain goods shall, in so far as it affects trade between Member States, be incompatible with the internal market.”

4.2.2 Only support to undertakings is regarded as State Aid.

Governments may in principle dispense public funds as they wish. The objective of the EU state aid rules is to ensure that such funds are not spent in a way that distorts competition amongst undertakings. Undertakings are, to put it simply, organisations that sell goods or services in the market place.

The state aid rules therefore do not limit the government from funding publicly owned research or educational institutions, such as universities and research institutions. In Norway, this means that the state is free to fund universities, university colleges and state-owned research institutes, such as the Institute of Marine Research, Statistics Norway and the Meteorological Institute. Such public bodies are now allowed to pass on any of the public funds they have received to undertakings. In Norway, this requirement is formalised in different ways, for example by instruction from the Ministry of Education and Research vis à vis the universities.

Research institutions or research infrastructure facilities are often organised independently from the state, in the form of independent foundations or limited companies. This is the case with the Norwegian Institute for Water Research (foundation) or the research institutes organised as limited companies owned by the foundation SINTEF. Such research institutes with a not for profit objective are deemed to be undertakings in relation to the EU state aid rules insofar as they offer goods or services to the market. The research institution's activities outside the market place are regarded as non-economic activities that fall outside the realm of state aid. The condition for this status is that the institution's accounts clearly distinguish between economic and non-economic activities, and that the institution is able to verify that no cross-subsidisation from government funding to economic activities takes place.

4.2.3 Exceptions to the prohibition against State Aid

Article 107 of the EU Treaty (3) makes exceptions from the prohibition possible: *The following may be considered to be compatible with the internal market:*

- *aid to promote the economic development of areas where the standard of living is abnormally low or where there is serious underemployment, and of the regions referred to in Article 349, in view of their structural, economic and social situation;*
- *aid to promote the execution of an important project of common European interest or to remedy a serious disturbance in the economy of a Member State;*
- *aid to facilitate the development of certain economic activities or of certain economic areas, where such aid does not adversely affect trading conditions to an extent contrary to the common interest;*
- *aid to promote culture and heritage conservation where such aid does not affect trading conditions and competition in the Union to an extent that is contrary to the common interest;*
- *such other categories of aid as may be specified by decision of the Council on a proposal from the Commission.*

Pursuant to Article 107 (3 c) and (3 e), support for R&D activities must to a large degree have been permitted, however within certain limits. The two mechanisms for permitting state aid is by way of notification, or by the EU adopting a regulation making state aid legal. A state may thus notify a support scheme or individual aid to the European Commission. The Commission will then study the case, and may conclude that the state aid in question is compatible with the internal market, and will be granted. Alternatively, the EU might adopt a regulation making certain types of state aid legal. The most important regulation in this respect is the General Block Exemption Regulation (GBER) EU 651/2014, containing rules related to R&D state aid.

If support for R&D does not entail state aid, is compatible with the fundamental freedoms of the Treaty and is not contrary to any EU regulations, the aid can be granted. The notion of state aid²¹ is therefore important when granting support for R&D and when designing support schemes. The main elements in the definition of state aid are very briefly presented in the following:

1. State aid encompasses all public resources, monetary or in kind, both from the state itself and from other public bodies
2. State aid encompasses both direct aid and state aid delivered through intermediaries
3. The recipient must be an undertaking for the aid to be regarded as state aid. An undertaking is somebody who offers goods or services to the market
4. To be regarded as state aid the aid must be selective, in the sense that it favours certain undertakings or the production of certain goods or services
5. The aid must affect trade between Member States to be regarded as state aid, in the sense that it in principle gives undertakings in a member state an advantage compared to undertakings in other member states

Supporting undertakings' R&D is state aid. Supporting R&D in public universities, research infrastructures and public research institutes is usually not regarded as state aid, as these organisations are not typically regarded as undertakings.

4.2.4 The notion of State Aid within the field of research and development²²

The EU Commission has issued a Communication that clarifies the notion of state aid in relation to R&D, dealing with the funding of research institutions, their market activities and their collaboration with businesses. In the following the main points in this communication are presented. This very condensed presentation will of course not reflect the finer points and nuances of the Communication:

1. Research and knowledge dissemination organisations and research infrastructures are recipients of state aid if the conditions of aid granted falls under the Treaty Article 107.
2. If such organisations perform activities of both economic and non-economic nature, the public funding of the non-economic activities will not fall under Article 107 (1) of the Treaty if the costs and funding of such activities can be clearly separated and no cross-subsidisation of the economic activities takes place.
3. Education organised within the national educational system, predominantly or entirely funded by the state, is regarded as a non-economic activity.

²¹ The EU Commission Notice on the notion of State aid as referred to in Article 107 (1) of the Treaty on the Functioning of the European Union (2016/C 262/01) gives guidance on the notion of state aid, see link : http://www.ec.europa.eu/competition/state_aid/modernisation/notice_aid_en.html.

²² 2014/C 198/01 Communication from the Commission — Framework for State aid for research and development and innovation, see chap.2 <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C:2014:198:FULL&from=EN>.

4. Independent R&D, hereunder R&D undertaken in effective collaboration with an undertaking, is regarded as a non-economic activity.
5. Knowledge transfer is regarded as a non-economic activity if the profits of such are reinvested in the research organisation's or infrastructure's non-economic activities.
6. If a research organisation or research infrastructure conducts both economic and non-economic activities, the state aid rules only apply to the economic activities.
7. If a research organisation or research infrastructure is used almost exclusively for non-economic activities, its funding may fall outside the state aid rules. The Commission will consider this to be the case where the economic activities do not exceed 20% of the relevant entity's overall annual capacity.
8. Where research organisations or research infrastructures are used to perform economic activities, the public funding of these will be regarded as state aid, unless 7 applies.
9. If a public funding is channelled through a research organisation or infrastructure to undertakings, and all the funding is passed on to the final recipients, such funding will not be regarded as state aid to the research organisation or research infrastructure in question, but as state aid on the behalf of the final recipient
10. If research organisations or infrastructures offer services to undertakings, without claiming payment at market prices, such services are regarded as state aid to the undertaking insofar as they are financed through resources granted to the institution's or infrastructure's non-economic activities.
11. Contract research at market prices is not regarded as state aid. If no market price exists an alternative method of setting the price must be applied to ensure that the undertaking is not given an undue advantage.
12. Effective collaboration between a research organisation or infrastructure and an undertaking is not regarded as state aid. The essence of the term "effective collaboration" is that the parties have a common objective, a division of labour and share the risks and the results of the project, according to the conditions that are expressed in detail in the definition.
13. Public procurement of research and development services is not regarded as state aid when certain conditions are met.

It is important to notice that tax incentives for business R&D are generally²³ not regarded as state aid. The reason for this is that tax incentives offered to all types of businesses, disregarding their trade, are not selective measures that fall under the definition given in the Treaty's Article 107.

4.2.5 Permitted State Aid for R&D

If a planned state aid measure has been notified, the EU Commission will consider whether the aid in question is compatible with the internal market and set the conditions for the aid. Guidelines for the assessment of planned state aid are presented in a communication from the Commission: Framework for State aid for research and development and innovation (2014/C 198/01). When assessing whether the planned state aid can be accepted, the following criteria will be taken into consideration:

- a) Will the aid contribute to a well-defined objective of a common interest?
- b) Is there a need for state intervention?

²³ The UK designed its first tax incentive for business R&D as a support measure limited to SMEs. Due to this limitation, the tax incentive was regarded as state aid, by both the Commission and the British authorities

- c) Is the aid an appropriate measure?
- d) Will the aid have an incentive effect?
- e) Is the aid proportionate?
- f) Will the aid lead to undue negative effects on competition and trade between Member states?
- g) Is the aid transparent?

State aid can be given to many types of R&D activities, many of which are dealt with in the Framework for State Aid for research, development and innovation mentioned above. The framework also specifies the level of support that might be accepted, along with the duration of the support, details that will not be further elaborated here.

The GBER permits several types of business research, development and innovation support. It is quite common that states, instead of notifying a support scheme, rely on the regulation as a legal basis for making their schemes compatible with the Treaty's Article 107.

The regulation deals with aid for research and development projects (Article 25), investment aid for research infrastructures (Article 26), aid for innovative clusters (Article 27), innovation aid for SMEs (Article 28) and aid for process and organisational innovation (Article 29).

The aid level permitted according to Article 25, which is directly relevant for R&D in the business sector, is

- 100% of the eligible costs for fundamental research;
- 50% of the eligible costs for industrial research;
- 25% of the eligible costs for experimental development;
- 50% of the eligible costs for feasibility studies.

The aid intensities for industrial research and experimental development may be increased up to a maximum aid intensity of 80% of the eligible costs as follows:

- by 10 percentage points for medium-sized enterprises and by 20 percentage points for small enterprises
- by 15 percentage points if one of the following conditions is fulfilled, provided that the project involves effective collaboration:
 - between undertakings among which at least one is an SME, or is carried out in at least two Member States, or in a Member State and in a Contracting Party of the EEA Agreement, and no single undertaking bears more than 70% of the eligible costs,
 - between an undertaking and one or more research and knowledge-dissemination organisations, where the latter bear at least 10% of the eligible costs and have the right to publish their own research results
 - the results of the project are widely disseminated through conferences, publication, open access repositories, or free or open source software

4.3 How are the State Aid rules complied with in funding schemes?

It follows from the previous chapter that supporting undertakings' R&D is considered state aid and as such state aid can in fact be given to many types of R&D activities if the conditions for giving such aid

are fulfilled. As part of our collection of more in-depth information on the most important programs we asked how programs complied with the EU state aid rules.

Our analysis indicates that the EU state aid rules related to R&D are respected by all the six countries in question, their funding agencies and research institutes, when implementing R&D policy measures.

In Norway, the Innovation Projects for Businesses (IPN) is reported as a scheme under the GBER. The same applies for Centres for Research Driven Innovation (SFI). The Research Centres for Environmentally Friendly Energy (FME) and Knowledge-building Project for Industry (KPN) do not entail state aid, and are therefore neither reported under the GBER nor notified under the Framework. The state aid rules have not affected the support level in these schemes or how they are organised.

In Sweden the programs for Innovation Projects in Businesses (IPB), Strategic Vehicle Research and Innovation program (FFI), as well as the Strategic Innovation Program (SIO) all fall under state aid regulation. The IPF follows "*Förordning (2015:208) om statligt stöd till forskning och utveckling samt innovation*" which in turn follows GBER. The SIO and FFI program also follow GBER.

State aid rules have generally not affected the organisation and generosity of these schemes in Sweden. As for the IPF projects the program would probably have been the same without the state aid rules, one of the main reasons being that the level of support is lower than the maximum permitted level in the EU state aid rules. The FFI and SIO include larger projects and large actors, from both the private and public sectors, as Vinnova does not in principle finance more than half a project and research institutions need public financing for their part. This often leaves a relatively small part for businesses and thus it is not a problem with state aid intensity. It is affected to a limited extent.

Finland also complies with the EU state aid rules. We have been informed that they find the EU state aid rules sufficient for the current portfolio of programs and support instruments. In most cases the maximum aid intensity is not regarded as a problem. The general principle is that TEKES does not subsidise R&D activities, but rather wants to stimulate increased private R&D. To that end TEKES does not fund more than half of the eligible costs in R&D projects including businesses. The general level of support to grants is between 40-50% of project costs.

TeKes has informed us that they take great care in following the state aid rules, and therefore are a bit more prudent in their support schemes than what is strictly necessary. Following and complying with the state aid rules is not always easy for Tekes. They have ideas for new kinds of programs spurring open innovation, new kinds of R&D-collaboration and R&D-networks with different actors. Yet the perceived ambiguity and somewhat unclear guidelines, also mentioned by TAFTIE, are regarded as a restraint as to the design and organisation of new and innovative support schemes.

The Netherlands has reported most of its support schemes under the GBER. The Top Consortia for Innovation (TKI) is covered by the GBER Article 25 regarding collaborative projects that consist of fundamental and industrial research, experimental development or a combination. Projects related to innovation advisory services are covered by GBER Article 28. The SME program MIT is also reported as a scheme covered by the GBER. This scheme is currently being studied more closely because undertakings might have received funding from more than one source in violation of the EU state aid rules related to the accumulation of state aid²⁴.

The UK provides support for R&D in accordance with GBER. In general, public authorities are responsible for ensuring that their policy measures and projects comply with the state aid rules. At government level the BEIS (Department for Business, Energy and Industrial Strategy) state aid team is responsible for state aid across the whole of government including local and regional government and the devolved administration. Navigating EU State Aid rules takes time and resource, but it also helps policy-makers ensure value for money and avoid unwanted effects. State aid rules promote a level

²⁴ See <http://www.rvo.nl/subsidies-regelingen/subsidiespelregels/aanvraag-indienen/financiering-subsidieproject/cumulatie-%E2%80%93-samenloop-subsidies>

playing field and ensure United Kingdom to invest well. With strong rules, those who receive advantages from the state won't become overly reliant on aid and will remain incentivised to innovate or make efficiencies.

In France, the programs under Bpifrance are compliant with EU state aid rules. Grants and loans are reported under the GBER. Further the reimbursement advance programs use the gross grant equivalent (GGE) calculation methods consistently with regulation of EU state aid (Article 4.5.1.2, §78 and §79.). The programs have to some extent been developed and designed in accordance with EU state aid rules, and thus have been affected by these rules. Yet the state aid rules are not regarded as seriously limiting factors in the design of support schemes, as the funding does not reach the maximum of the permitted state aid intensity.

Conclusion

In general, the EU state aid rules are respected by the countries in question. Further the EU state aid rules are rarely looked upon as limiting the R&D intensity since funding levels do not reach the maximum of permitted intensity. Mostly the focus of the programs is on stimulating greater investment in private R&D rather than subsidising private R&D investments and it is the general perception that aid intensity levels of around 40-50% are very sufficient to achieve this. Though perceived as sufficient, the EU state aid rules do not seem to be well-suited for new and innovative types of funding schemes targeting R&D collaboration and open innovation.

4.4 Distinction between effective collaboration and contract research

Increasing R&D collaboration is a central research policy concern in the six countries in question. All the countries have measures aiming at bringing research institutions and businesses together in joint R&D projects. The type of collaboration can take many forms yet we will distinguish between effective collaboration and contract research. Empirical evidence suggests that whereas collaboration projects are more demanding and face more barriers than contract research the economic impact from collaboration is significantly higher compared to contract research^{25,26}.

A public funded research institute can perform contract research for an undertaking. The price for such a service should reflect market conditions. If the price is lower, this would entail State Aid, and must either be reported under the GBER or notified according to the Framework. Another type of cooperation could be in the form "effective collaboration". If the public research institution succeeds in commercialising its research, it can sell or licence the results to the collaborating undertaking in accordance with conditions that independent parties would have agreed upon. Organising R&D projects in this way, can reduce the project risk for an undertaking to a significant degree, even if the undertaking must pay for the use of the results that belong to the research institution.

Effective collaboration is by definition in the GBER Article 2 (90) : "*...collaboration between at least two independent parties in order to exchange knowledge or technology, or to achieve a common objective based on the division of labour where the parties jointly define the scope of the collaborative project, contribute to its implementation and share its risks, as well as its results. One or several parties may bear the full costs of the project and thus relieve other parties of their financial risks. Contract research and provision of research services are not considered forms of collaboration.*"²⁷

In Norway, it is common that grants received by undertakings are used for contract research performed by institutes or universities. In fact, it used to be a requirement that undertakings receiving

²⁵ See (in Danish) Economic effects of business collaborating with research institutions. Report commissioned by the Danish Agency for Science, Technology and Innovation (2011)

²⁶ See (Mark, Norn, & Lund Jensen, 2014) Estimating the economic effects of university-industry collaboration.

²⁷ See COMMUNICATION FROM THE COMMISSION Framework for State aid for research and development and innovation (2014/C 198/01)

grants used some of that grant to buy research services from research institutions. This is no longer a requirement, although undertakings often use part of the grants received for contract research.

In Sweden, it is unlikely that R&D grants given to undertakings are used for procuring contract research from research institutions. As for IPF targeting SMEs, the undertakings can use the grant for buying research services from research institutions. According to the program manager for IPF this rarely happens. Other larger scale programs at Vinnova organise the projects in a consortium structure. Within the consortia participants are not allowed to buy research services from each other, but conduct effective collaboration. They are allowed to make subcontractor agreements with entities outside the consortium, though this is rarely done in practice since all needed activities are included in the consortium.

In Finland grants are not passed on. It is possible for undertakings to buy R&D services or technology from research institutions. But this must be specified in the application, where the kind of R&D service that is needed for purchase, from whom and at what expected costs, must be described. If large companies receive a grant it comes with the obligation to buy R&D services from either SMEs or research institutions. At least 40% of the received funding at large companies must be used for buying R&D services.

Tekes also funds joint research projects. They are organised as effective collaboration where Tekes funds each individual participant separately. Tekes is aware of the possibility of increasing the aid intensity in effective collaboration projects, but since the aid intensity is rarely an issue, it does not have a specific focus on the distinction between effective collaboration and contractual research.

In the Netherlands there are no obvious distinctions between effective collaboration and contract research in either the Top Consortia program nor the SBIR program. Looking at research institutions we have picked TNO as example as to how the distinction between effective collaboration and contract research is handled. At TNO they use different standard agreements for collaborative projects and contract research. The agreements for collaborative projects are consistent with the EU state aid rules. The corporate IP & Contracting department at TNO, together with the corporate Strategy department, verify for each project whether the proper agreements are applied. In that sense TNO is very strict with how to distinguish between effective collaboration and contract research.

In the UK, InnovateUK gives attention to collaborative projects that may receive favourable funding. In projects with collaboration the project is defined as:

- A project which involves at least two entities collaborating
- It is a business-led consortium which can involve both businesses and research institutions
- There must be evidence of “effective collaboration”
- The lead partner must be the grant recipient

In general R&D policy has a strong focus on private-public R&D collaboration. Most of the InnovateUK projects are collaborative yet the level of projects that are collaborative depends on the competition and the applicants.

In France, the level of support provided by Bpifrance is dependent on whether the R&D project is based on collaboration or not. As stated in Chapter 3 Bpifrance offers grant schemes and schemes for reimbursement. These schemes are designed in two different ways depending on whether they consist of effective collaboration or not. E.g. grants for innovation support have a maximum amount of €50,000 whereas grants for collaborative projects based on effective collaboration have a minimum amount of €750,000. Yet the distinction between contract research and effective collaboration is not the reason for the distinction. The distinction is related to what kind of R&D and innovation activities the schemes are desired to support, i.e. whether it is R&D and innovation projects at individual level or if the projects are based on R&D collaboration with academic partners.

Conclusion

It appears that there is an awareness in the six countries that organising R&D as “effective collaboration” is a possibility under the EU State Aid rules that could be beneficial for reducing the R&D risk for undertakings. It seems that the permitted State Aid intensity for grant, is sufficient for reducing industry R&D risk. For this reason, the organisation of collaborative research, when this is part of a scheme, is motivated by other factors than the permitted support level.

All the six countries have schemes for stimulating R&D cooperation between businesses and between businesses and research institutions, usually offering higher support levels for joint projects, but generally leaving it up to the parties to organise such projects between themselves, and accepting that the recipient of a grant may decide to what degree the grant is to be used for procuring contract research.

Furthermore, it seems that focus on support and stimulation of transferring knowledge from research institutions to companies is the key driver for effective collaboration set ups. Thus, the possibility of increased aid intensity is an appealing side-effect, but not the main aim when designing programs.

4.5 Economic or non-economic activities at research institutions

Economic and non-economic activities at research institutions must be clearly separated so that cross-subsidisation is avoided. Primary activities of research organisations and research infrastructures are not regarded as economic activities²⁸ and public support of them does not constitute state aid, these include:

- education for more and better skilled human resources
- independent R&D for more knowledge and better understanding, including collaborative R&D where the research organisation or research infrastructure engages in effective collaboration.
- wide dissemination of research results on a non-exclusive and non-discriminatory basis
- Knowledge transfer activities, where they are conducted either by the research organisation or research infrastructure or jointly with, or on behalf of other such entities, and where all profits from those activities are reinvested in the primary activities of the research organisation or research infrastructure.

On the other hand, economic activities include renting out equipment or laboratories to undertakings, supplying services to undertakings or performing contract research. Public support for such activities is regarded as state aid.

How heavily research institutions are engaged in economic activities varies considerably. In **Norway**, the share of economic activity at the technical-industrial institutes for example is approximately 55% of the total turnover. In principle, CRNS in **France** does not engage in economic activities. At RISE in **Sweden**, the share of revenue from companies is around 53% mostly based on contract research; RISE covers research institutes that focus their activities on industry related applied research. In **Finland**, the VTT, the biggest research institute in Finland with nearly 2500 FTEs and a patent portfolio of 1,200 patents, the economic share of VTT's activities is around 33%. In the **Netherlands** TNO is the biggest research institute with more than 3,000 FTEs. The annual report for 2015 states that the level of market revenue from non-governmental actors is \$176,333,000²⁹. Of a total revenue

²⁸ Taken from the communication from the Commission regarding Framework for state aid for research and development and innovation {SWD(2014) 163} {SWD(2014) 164}

²⁹ See TNO annual report (2015), notes to the consolidated balance sheet per 31 December 2015

level of €518,381,000 the share of revenue from economic activity is 34%. Information on **UK** research institutes is lacking.

The differences between economic and non-economic activities are handled somewhat differently across the research institutes we have talked with. In general, they ensure that the accounts clearly distinguish between economic and non-economic activities so it is possible to monitor that no cross-subsidizing occurs.

In **Norway** research institutes are obliged to have accounting systems that are transparent in relation to keeping the costs and incomes from economic and non-economic activities separate. There are no similar formal requirements at universities to have an accounting system separating economic and non-economic activities. However, there is a clear understanding at universities that no cross-subsidising is permitted. Moreover, there is such a strong culture of openness and transparency at the universities that any transgression of state aid rules would be rapidly visible.

The **Swedish** research institutes also have accounting policies that in principle ensure that economic and non-economic activities are held separate. The opinion is that the system works, but that it can sometimes be difficult to separate economic from non-economic activities. In terms of projects within programs, economic and non-economic activities are separated. The volume of the different activities is documented and monitored through reports, budgets, accounting for costs, salary, any subcontracting and overhead cost.

In **Finland**, the distinction between economic and non-economic activities is handled through a sufficient accounting system. Research institutes are obliged to have an accounting policy and system that is transparent and enables ease of inspection. The accounting system of the research institutes are inspected every second or third year. And so far, there have not been any problems related to this issue.

In the **Netherlands** To investigate how the distinction between economic and non-economic activities are handled we have asked TNO what they do. For economic and non-economic activities TNO use different standard conditions and agreements, we assume TNO to do this in order to be able to differentiate the activities in their accounting system. A large part of the non-economic activities is in the framework of (inter)national R&D-programmes (e.g. H2020) which prescribe the cooperation agreement, mostly a CA similar to DESCAs. The non-economic activities, which are mostly partly funded by our regular governmental subsidy, are described in yearly programmes. In their accounting system they use an indicator to make a distinction between the economic and non-economic projects.

In the **United Kingdom**, the study lacks information on how the distinction between economic and non-economic activities is handled.

In **France** CNRS is not engaged in economic activities. CNRS separates the economic into a different legal entity. This solution is not usually taken in the other countries, to our knowledge. RISE stated that this was a possibility but they thought that potential benefits would not make up for the high costs and complex administrative changes needed to put it into effect. CNRS only performs non-economic activities, which is also an explicit part of their constitution. Any economic activity is organised separately under a legal entity called FIST. France Innovation Scientifique et Transfert (FIST SA), established in 1992. FIST is a French public limited company, now a subsidiary of CNRS with 70% ownership while the remaining 30% is owned by Bpifrance. In July 2013, there were 49 employees at FIST. Its mission is to transfer innovative technologies, originating mainly from CNRS, into the industry.

Conclusion

It is our general perception that research institutions conducting both economic and non-economic activities have solid and sufficient ways of handling this. In practice they have an accounting system allowing for separating economic and non-economic activities. From our informants, we hear that

though the systems are sufficient it is often difficult to precisely separate the economic from the non-economic activities. Thus, the division is at times the best possible estimate.

4.6 Sharing risk, results and property rights

This part of the study focuses on various aspects of involvement of public funding. It concerns sharing risk in conducting R&D projects, but also focus on how questions related to the outcome of a research project are handled. Sharing risk often means sharing the costs of a research project, since we are focusing on R&D projects supported by public funding, the level of risks taken by businesses is reduced. Research institutions are funding as part of participating in a R&D project obviously, their level of risk is reduced.

Whereas sharing costs are obvious due to public support, we want to further investigate sharing the risks and costs of publishing academic results and exploiting the results commercially. In the case R&D collaboration, other than contract research, academic results and property rights should be shared. In terms of State Aid rules, businesses should not be given any advantages in exploiting R&D results than what is corresponding to their contribution in a project. And second when businesses are given the right of first refusal to the IPR from a R&D project, how is the value for this set, so that the transfer does not lead to State Aid?

In Norway, the results from joint research projects should be disseminated openly and made publicly available. Results from research projects are sold at market conditions. Alternatively, research institutions can establish their own spin-off to take results to the market. In practice publication is the main channel for sharing results from research projects. IPR and licencing is not always handled in a way which is compliant with state aid rules. There is a lack of professionalism in terms of handling IPR. This has caused research institutions to sell licenses cheaply. This action of selling ideas, knowledge and academic results below market price is not a deliberate one. It is more a question of lacking competence in valuation and understanding of the market.

In Sweden the consortium structure imply sharing and openly disseminating R&D results. The businesses can claim a deferred period if they find it necessary to file for patent or other IPR. R&D projects based on a consortium structure can sell IPR at market price to any business outside of the consortium. If any IPR are handed over to undertaking within the consortium IPR is sold at market level price though. it is perceived as difficult to assess a reasonable market price, a problem the guidelines from the EU state aid rules do not offer a good solution to.

In Finland, in joint research projects the research organisation is expected to publish the results. Companies may ask for a deferred period of a couple of months. Research institutions can sell or licence their R&D to undertakings. Price depends on the type of agreement, but often the price includes property rights, knowhow and competences so as to implement the research. Pricing is settled in a negotiation between the undertaking and the research institution and typically aims for market price. This is a difficult process and not something that Tekes is involved with.

In the Netherlands TNO obtains the IP rights and has the right to settle a patent. The companies acquire a non-exclusive right of use of the results either on a specifically described field of use (in case of one or few companies), or in general. When appropriate companies may opt for an exclusive license on a specific field of use, obviously against a market conformable compensation.

In the United Kingdom where grants are associated with more than one research organisation and/or other project partners, the basis of collaboration between the organisations, including ownership of intellectual property and rights to exploitation, is expected to be set out in a formal collaboration agreement. It is the responsibility of the research organisation to put such an agreement in place before the research begins. The terms of collaboration agreements must not conflict with the Research Council's terms and conditions.

Arrangements for collaboration and/or exploitation must not prevent the future progression of research and the dissemination of research results in accordance with academic custom and practice. A temporary delay in publication is acceptable in order to allow commercial and collaborative arrangements to be established. A set of template agreements which universities and councils have based their approaches on was published by the government. These are known as the Lambert Agreements³⁰.

In France Results from successful R&D projects are published but often with a delay. Further companies pay either up-front cash or through a licence agreement if they want to exploit the commercial potential of R&D results. Alternatively, research institutions, as those included in the CNRS, can enter into knowledge transfer activities with the aim of developing the commercial potential for research through IP rights or filing for patents. In such cases CNRS hands over the process to FIST as described in chapter 4.4. FIST also supports establishing new companies on the basis of R&D results.

Conclusion

Research institutions are expected to publish their results as part of R&D projects. Participating companies can ask for deferred period, but only for a short time. Furthermore companies can buy the rights to utilise the results. Companies participating in joint research projects have pre-emptive rights or have the position of being the first parties to negotiate a fair price. Price determination follows the guidelines from the EU State Aid rules, thus often being settled as market price based on negotiations.

In principle, the sharing of IPR emanating from successful R&D should reflect the efforts of the parties and their economic contributions. If a public research institution renounces its IPR to an undertaking for less than the market value, this would be regarded as State Aid. Our respondents are of the opinion that setting a fair value for IPR is a difficult task, and they believe that the research institutions, generally speaking, are probably overly modest in their valuation of IPR, rather than the opposite.

4.7 Access and utilisation of research infrastructure

Research infrastructure means facilities, resources and related services that are used by the scientific community to conduct research in their respective fields and covers scientific equipment or sets of instruments, knowledge-based resources such as collections, archives or structured scientific information, enabling information and communication technology-based infrastructures such as grid, computing, software and communication, or any other entity of an essential nature to research practices.

If a publicly financed research infrastructure is open for use by undertakings, and no payment is made, the use will constitute state aid. To avoid this, the undertakings must pay for the use at market value. The research infrastructure in most countries is dominantly owned by research institutions. As long as these institutions do not engage in economic activities, the public funding of the infrastructure is not regarded as state aid. If the infrastructure is used for both economic and non-economic activities, the public funding must be split in accordance with the proportion of use for the different types of activities. The one part is then dealt with as state aid, while the other part is not regarded as state aid. If a research infrastructure is used almost exclusively for a non-economic activity, its funding may fall outside state aid rules entirely. For the purposes of the framework for R&D state aid, the Commission will consider this to be the case if the economic activities consume exactly the same inputs (such as material, equipment, labour and fixed capital) as the non-economic activities and the capacity allocated each year to such economic activities does not exceed 20% of the relevant entity's overall annual capacity.

³⁰ <https://www.gov.uk/guidance/university-and-business-collaboration-agreements-lambert-toolkit>

Research infrastructures are sometimes organised as separate legal entities. In such cases the parent entity always puts forward a guarantee for continuous operation. Otherwise, the research infrastructure is organised as a public entity with services available to all. The price settled for buying R&D services by undertakings is calculated either by cost level in addition to a margin or by negotiation, where the involved parties settle for a market price based on the arm length principle³¹.

In Norway most of the public funding of research infrastructures goes directly from the state to universities, hospitals and other publicly owned institutions. State aid problems arise when RCN funds infrastructure at research institutes for which economic activities make up more than 20% of their activities, or when they attempt to set up an infrastructure together with industry. Thus, to RCN the proportion of the institution's economic and non-economic activity plays an important role. If the expected use of research infrastructure by undertakings is less than 20% of the total capacity, it is possible to be more flexible as to funding of the research infrastructure. In some cases, undertakings are involved in establishing the infrastructure; these activities can be supported by grants. In addition, undertakings will finance part of the operational costs through engagements and buying of research services.

In Sweden Vinnova was not allowed to support or finance research infrastructures until May 2015. So far they have only been involved in the funding of one research infrastructure. The conditions here will be that selling services or access will be at market price in accordance with the GBER Article 26. The research infrastructure managed by institutes organised under RISE is accessible to undertakings. Institutes under RISE have around 100 so-called "test and demonstration facilities". These are organised differently, e.g. the facility called AstaZero is based on contracts with undertakings running over the next 3-12 years. The security of long term contracts allows RISE to raise capital from banks as part of the financing. Some facilities are financed by structural funds and regional actors; while others are financed by foundations, e.g. Wallenbergs foundations. All the facilities are available to undertakings. Undertakings buy services at the cost level plus a margin. In some cases, Vinnova has provided support when buying R&D services from these facilities. The support adds up to no more than €200,000 EUR over at least three years. This qualifies under the "De minimis" level.

In Finland research infrastructure is funded through the fiscal budget and is a part of the basic funding for universities and other research institutions. Public funding agencies such as Tekes rarely support research infrastructure. When Tekes funds research infrastructure it funds it as an economic activity, implying that the research institution must find at least 50% of the costs elsewhere. When selling R&D services from research infrastructure the price is settled at market price. If market price is difficult to assess they sell at operational costs plus a margin.

In the Netherlands Access to research facilities is always (maybe with some exceptions) in the framework of either collaborative or contract research projects in which the use of the facilities is performed by TNO-employees. For the use of the facilities the full costs are charged. There are some examples of sharing research facilities between TNO and another research organisation, e.g. a technical university. Besides, TNO is examining whether sharing of facilities with companies, e.g. SMEs is a further opportunity. Occasionally a large research facility which is basically used for contract research is transferred to a spin-off company.

In the United Kingdom three of the seven Research Councils UK have research infrastructure facilities. The Biotechnology and Biological Science Research Council (BBSRC) is working with partners to develop five UK Research and Innovation Campuses, with seven of its strategically funded institutes embedded within them. Since 2011 BBSRC has invested over £100M capital in the development of the campuses, alongside an additional £50M of capital funding for the institutes embedded within them. Among other services, the Campuses provide access to research

³¹ An arm's length transaction is a [transaction in which the buyers and sellers of a product act independently and have no relationship to each other. The concept of an arm's length transaction allows the market to ensure that both parties in the deal are acting in their own self-interest and are not subject to any pressure or duress from the other party. It also assures third parties that there is no collusion between the buyer and seller.

infrastructure. The Natural Environment Research Council (NERC) also offers research infrastructure facilities. The facilities act as a test bed for the innovative solutions. Finally, the Science and Technology Facilities Council also offers research infrastructure.

Any industry can work with a university and the university can apply for access to infrastructure facilities. This application will go through normal peer review and results will be published. A company can also apply for access directly and go through the same peer review process on the understanding that the results must be published for access to be granted. It may be that the company needs time to fully investigate the results before publication to understand if there is commercial worth to the results and if they decide that they cannot publish immediately it is expected that they will pay for the investigation time period later. If it is known that the experiment will have commercial value from the outset industry can access the facilities and pay for the investigation time period in which case the results are proprietary information does not have to be published.

In France CNRS is jointly responsible with universities for around 1,000 test facilities and laboratories. At CNRS the initial cost for research infrastructure is covered by national funding and/or EU funding. In some cases, it is also covered by industry. Around 95% of the approximately 1,000 facilities are established in a joint collaboration with universities. In total there are 15 facilities that are jointly established with undertakings. Jointly here means the sharing of costs and competence needed to establish the facility. In addition, it is possible for a group to occupy a delimited part of the facilities for a longer period; this is called “common laboratories”. This typically involves collaborative R&D activities. There are around 100 common laboratories running at the moment. The French National Research Agency, ARN, is financing the participation of SMEs in these common laboratories. The operating costs for the facilities are financed by the hosting research institute. More than 75% of the operating costs are salaries which are paid by the hosting research institute. Undertakings are also financing the operating costs through buying R&D services. Here they pay the full costs plus a margin.

Conclusion

Research infrastructure is funded by national funding, usually through basic funding as part of funding research institutes. Funding agencies do not play any role in funding research infrastructure. But it is possible to fund undertakings that want to utilise the research infrastructure.

There is a strong focus on not providing indirect state aid in letting undertakings utilise research infrastructure without paying. R&D services are offered at market price or at running cost plus a margin. In some cases, it is possible for undertakings to receive public funding when purchasing R&D services from research infrastructure. One example here is SMEs in Sweden, which can receive “De minimis” funding over three years with the aim of accessing and utilising research infrastructure. Yet this does not violate EU state aid rules.

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Appendix A: National R&D systems

In the following we give a short country-specific presentation of national R&D systems with a focus on the main actors within funding industry-oriented R&D. The text is mainly based on the EU Commission's RIO reports, previously known as ERAWATCH.

Norway

Norway is currently undergoing a rapid change in their economy. The decline in oil prices has demonstrated a need for developing new industries and further developing existing ones to ensure future value creation. This is an offset for an expansive fiscal policy with the aim of promoting employment, growth and structural adjustment in the economy.

Following the expansive fiscal policy is a long-term plan for research and higher education. The plan focuses on:

1. Strengthening competitiveness and innovation capacity
2. Solving major societal challenges
3. Developing research excellence

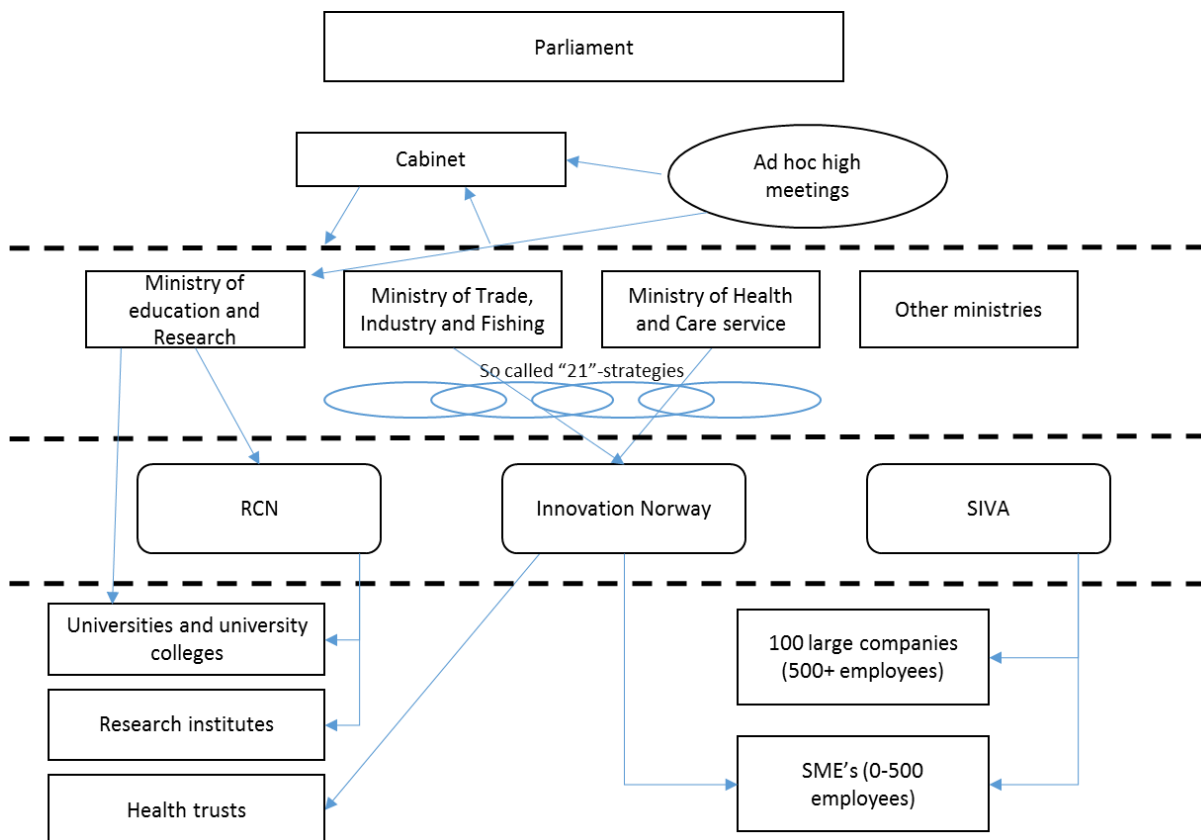
This resulted in a real growth in public R&D funding above 4 % from 2015 to 2016. Estimates for 2016 indicate that the public resource allocation for R&D will climb above 1% of GDP for the first time. The total R&D of GDP is at 1,71% (2014 figures) revealing the real issue in Norwegian research policy; the low R&D level in the private sector.

The Norwegian R&D system is dispersed at ministry level where a broad spectrum of ministries are involved. The main contributor of public funding industry oriented R&D in Norway is the Ministry of Education and Research. Other contributors are the Ministry of Trade, Industry and Fisheries and the Ministry for Health and Care Services. Other important ministries in terms of R&D funding are the Ministry of Foreign Affairs, the Ministry of Petroleum and Energy, the Ministry of Climate and Environment and the Ministry of Agriculture and Food. The Ministry of Defence also has a fairly large proportion of public R&D funding, although heavily concentrated around one performer (FFI, the Norwegian Defence Research Establishment).

At administrative level the R&I system is focused around fewer actors. The main actor is the RCN. They handle more than 25% of public R&D funding, surpassed only by the funding of universities and colleges. Whereas the Ministry of Education and Research and the Ministry of Trade, Industry and Fisheries are the main contributors to RCN. In total RCN administrative funding from 15 ministries.

One aspect of RCN is that the council covers all research disciplines and sectors including support to research based innovation. In addition to funding research activities RCN also has a mandate to advise the government on research policy and to facilitate network and communication between various actors in the Norwegian R&I system.

Figure A.1: National R&D system of Norway



Despite a long period of economic growth and increased R&D investments, there is broad political agreement that Norway needs to develop more knowledge and R&D intensive companies in order to prepare for “life after oil”. The recent steep decline in oil prices has brought the need for structural change on top of the political agenda. A concrete challenge is how to reorient engineers and other highly-skilled workers from the petroleum and offshore industries into other areas.

The Norwegian higher education sector has been characterised by a large number of institutions, many of which have a small number of students and low R&D capacity. This has raised concerns regarding the quality of higher education and research at some of the smallest institutions and a general risk of too much overlap within the national system.

Another recurrent issue of debate is the role of research institutes and the need for consolidation within this sector. This relates to a larger discussion of the division of labour across the entire R&D and innovation system. Some argue that the large research institute sector constitutes a strength and a bridge between R&D activities and users in industry and the public sector. Others are worried that research institutes create a barrier between academia and the industry.

Sweden

Sweden was hit relatively swiftly by the financial crisis. A rather severe drop in GDP of 5,8% in 2008 and 2009 was recovered in 2010 with a growth of 6,0%. Even though weak external demand had a negative impact on the Swedish economy, a strong national demand in terms of strong consumption and construction, low interest rates and an expansionary fiscal policy has held the Swedish economy in a stable and positive position.

The public research budgets were left largely unaffected by the financial crisis. The level of R&D financed by the government has increased annually since 2005, even in 2011 when public research budgets faced a moderate contraction. Sweden is still at the top in international rankings in R&D and innovation. Thus, they are at the top in the 2012 Research Excellence Composite Indicator and are reckoned an innovation leader together with Germany, Denmark and Finland in the Innovation Union Scoreboard. Sweden has long since reached the 3% target for total GERD as a share of GDP and this level of investment remains constant despite the financial crisis.

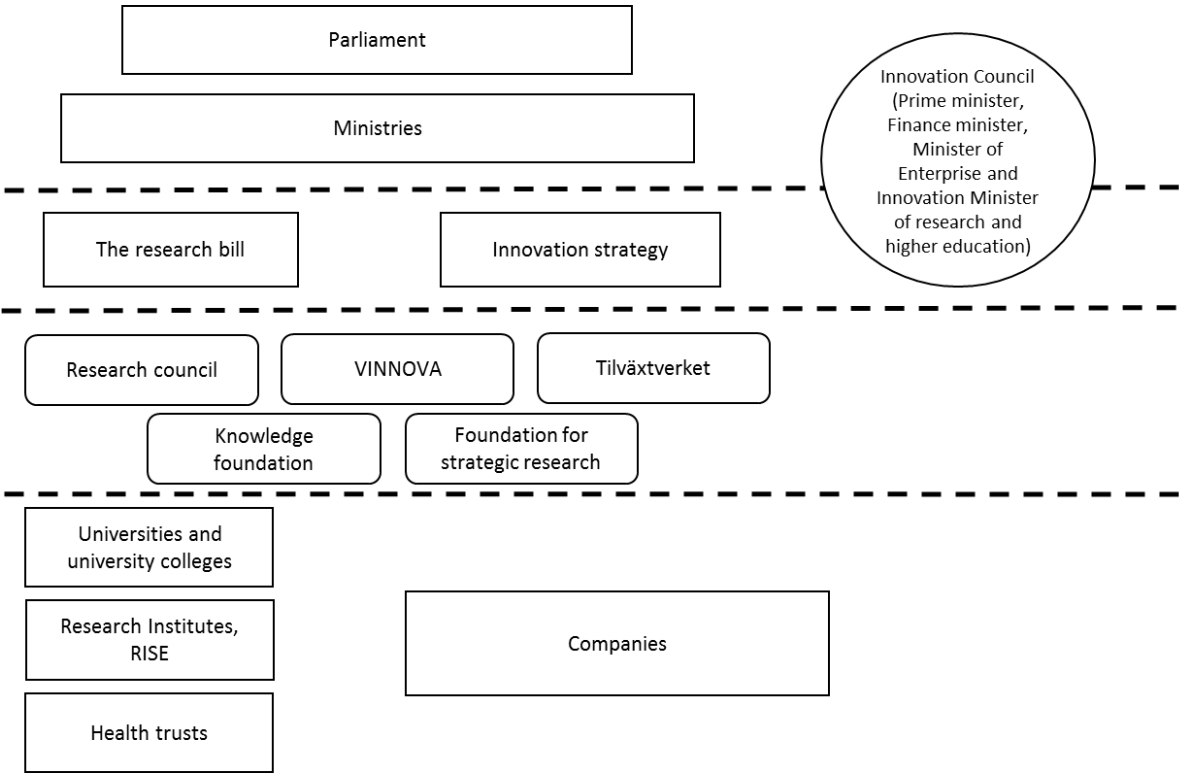
In general, the Swedish R&D system is diverse when focusing on funders of R&D. The system is decentralised and lacks central coordination, with the academic sector in a dominating role on the performer side and a diverse policy formulation and implementation landscape. To systemise and align the research and innovation funding from government levels, the Research Bill and a National Innovation Strategy have been implemented. The main policy directives emanate from these. The development and configuration of the Research Bill and the National Innovation Strategy emerge as a complex backward and forward iterative process of upward and downward consultations between central bodies in the R&I system.

The government bodies are the Research Policy Council (part of the Ministry of Education) and the Innovation Policy Council (part of the Ministry of Industry, Energy and Communication). Other key actors are various funding ministries, as well as the central public agencies such as VINNOVA (the Swedish Governmental Agency for Innovation Systems), the Research Council, The Energy Agency and Tilväxtverket. Vinnova particularly focuses on innovations linked to R&D, and it carries out a series of programs targeted towards both academia and the business sectors.

In addition to the funding agencies it might be worth mentioning the broad range of R&D funding foundations, often semi-public. These include a diversity of foundations with different offsets and histories, e.g. the Knowledge Foundation supporting research and innovation in the smaller, non-university HEIs (de nya läroseter), the Foundation for Strategic Research funds research projects with an established potential for innovation. And finally there are private foundations such as the Wallenberg Foundations.

On the level of R&D performers, universities and university colleges add up to two thirds of public funded R&D. The public funding of R&D adds up to 0,92% of GDP. The private sector accounts for 70% of the GERD in Sweden. Research in the private sector is performed primarily by a few large multinational companies with more than 200 employees. Research institutes and independent consultancies constitute a second category of research performers in the private sector.

Figure A.2: National R&D system of Sweden



There are few concerns for the development of Swedish R&D policy. There is no focus on stimulating or enhancing the level of private R&D investments. Yet there is a focus on ease of access to low risk financing and venture capital which aims to promote research based innovation.

The most notable issue in Swedish R&D policy is the focus on reducing the dependency of BERD on multinational companies. About 80% of Swedish business R&D is performed by a few large multinational companies with more than 200 employees with most of it concentrated in firms with >1000 employees. In 2013, 89 firms with >1000 employees accounted for 63% of Swedish BERD. The financial difficulties of Finland and the collapse of Nokia daunted Swedish R&D policy makers and they are eager to reduce the trend of dependency on multinational companies.

Finland

Economic growth in Finland has been slow for a longer period. Since 2012 Finland’s GDP has continuously declined due to both sectoral and structural challenges combined with a weak international economy. The GDP is expected to contract by 0.1% in 2015 following negative GDP growth rates in 2012 at -1,4%, 2013 at -1,1% and 2014 at -0,4%. The cumulated loss in the global market has declined by 32% between 2008 and 2013. Further it is expected that industry output is down 25% in 2017 compared to 2007. Despite this Finland still ranks as a high income country with a GDP per capita 37% higher than the EU-28 average and still ranks highly as an Innovation Leader on the Innovation Union Scoreboard.

Though Finland still ranks highly among developed countries it could be about to lose its position. Nokia’s tumble led to a collapse in the electronics sector where turnover was down by 48% from 2009 to 2013. Combined with the economic recession there has been a remarkable decline in both public and private R&D. GERD has dropped from 3,75% of GDP in 2009 to expected 3,1% of GDP in 2015. Government R&D funding declined by 13% in real terms from 2010 to 2014.

The Finnish R&D system is centralised. National guidelines, strategies and funding are strong guidelines for national R&D policy. Yet a mix of national and local administration allows for regional differences and a relatively high level of autonomy.

The role of the private sector in the Finnish R&I system is strong. The share of GERD performed by the BES (Business Enterprise Sector) was 68%, and 66% was funded by the BES in Finland in 2013 despite the recent decrease of the share (Statistics Finland, 2015). Public research organisations perform about 19% and the higher education institutions around 23% of all R&D activities in the country. There were 4,425 foreign affiliates in Finland in 2014, covering about 23% of the turnover of all companies, and 17% of the Business sector R&D expenses. SME's role in R&D is not very strong; their share of R&D expenditures was 23% in 2014.

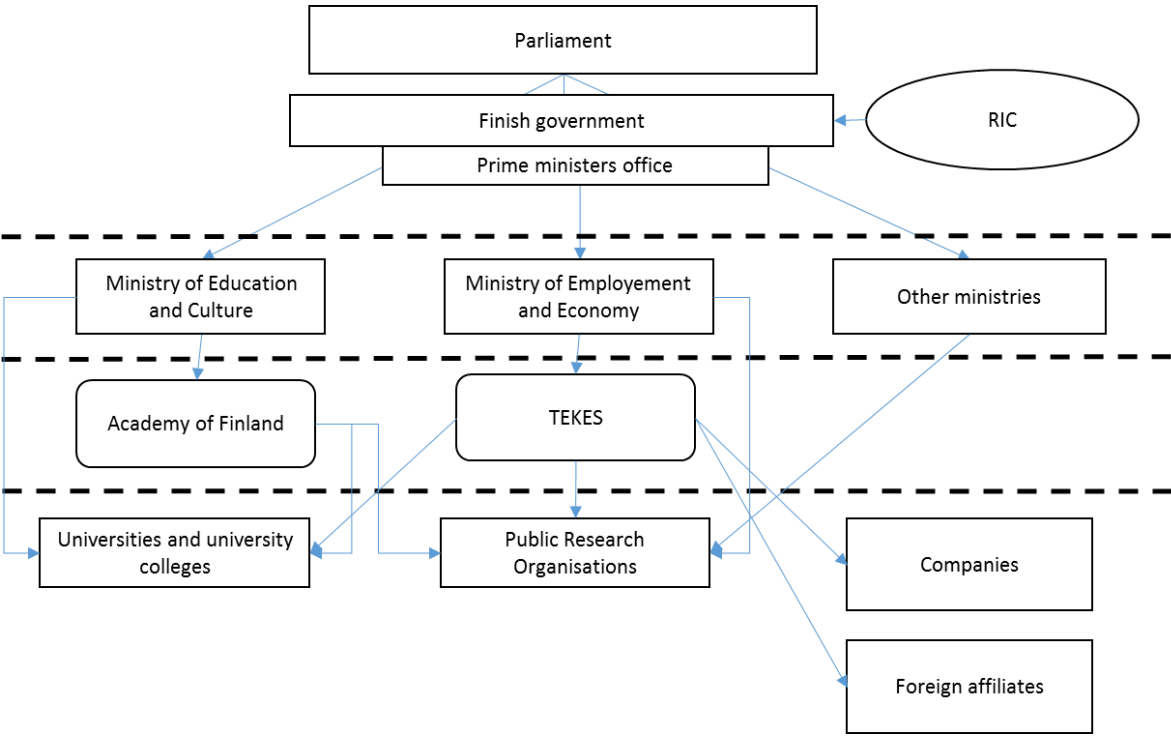
The Finnish research and innovation system is divided into four operational levels. The Parliament of Finland and the Finnish government control the highest level. In matters related to research, technology and innovation policy, the latter is supported by a high-level advisory body, the Research and Innovation Policy Council. A stable centre-of-government research and innovation structure is in place in Finland, providing a quite predictable policy and budgetary framework on a multi-annual basis, ensuring a coordinated implementation. Public R&I policy is backed up by networks involving all relevant stakeholders, such as industry, regional and local authorities, parliaments and citizens. This is the case on the political level as well as and especially on the operational level. The new government, however, has not yet clearly defined its R&I strategies.

The second level consists of the ministries, of which the Ministry of Education and Culture (MEC) and the Ministry of Employment and the Economy (MEE) play the main role in research and innovation policy. MEE is responsible for planning and budgeting innovation policy. MEC is responsible for matters related to higher education and science policy. Together these ministries account for 87% of governmental research and innovation funding. In 2016, MEC's share of governmental R&D was 60% whilst MEE's was 27%. MEC's share has increased during recent years mainly due to additional funding of the Academy of Finland, and cuts in funding of VTT and Tekes (Statistics Finland; R&D funding in state budget 2016).

On the third level of the Finnish Innovation system there are the competitive R&I funding and the R&D funding agencies, Academy of Finland, Tekes - the Finnish Funding Agency for Innovation, Sitra - the Finnish Innovation Fund and state-owned financing companies Finnvera, TESI and Finnish Industry Investment Ltd (FII). Yet FII, Sitra, Finnvera and TESI are not seen as relevant to this study as their target and objective is not industry related R&D.

The fourth level is comprised of organisations that conduct research: universities (14 in total), public research organisations (12 in total) and polytechnics, also known as universities of applied sciences (26) and of course private companies. Here foreign affiliates play a central role since they conduct 17% of the reported Finnish private R&D.

Figure A.3: National R&D system of Finland



Finland's R&I system has demonstrated successes in knowledge exchange and science-based entrepreneurship, along with a well-established venture capital market. The current policy approach includes demand-side measures (such as public procurement for innovation), while the majority is still supply-side instruments. Much emphasis has been placed on increasing the performance of public policies for R&I and internationalisation through joint activities and strategic programs; the new Team Finland and the Council of Strategic Research are prime examples of this.

Finland's R&I system faces different challenges. First the level of innovation seems low compared to the high level of R&D investments. Thus, there is a focus on increasing innovation to boost productivity and competitiveness; turning high level private R&D into exports and productivity growth is a central challenge. The focus is to improve and stimulate the current limited investments in non-R&D innovation. Second there has been a cut in public funding for stimulating industry-oriented R&D. The funding for R&D for boosting renewal of industries declined by 35% from 2011 to 2014. The latter budget shows a continuation of the recent trend in R&D budget cuts. Thus, a new growth mode for public and private R&I investments is required. Finally Finland needs a swift implementation of R&D&I policy and governance plans. There is a need for more coordination of R&D policy development in Finland. Reforms concerning universities (2010) were followed by the Polytechnic reform (2011) and the reform of research institutions and research funding (2012). These were immediately followed with a new university funding model (2013). In addition, both the Academy of Finland and TEKES have been evaluated with the intent to reform these.

The Netherlands

The economic situation for the Netherlands has been challenging since 2008, but it is now showing signs of recovery. The GDP grew in both 2014 and 2015. One of the strengths of the Dutch economy is the access to natural resources, such as shale gas, and the fact that Holland is a trading nation with exports to a wide range of countries. Thus, the Netherlands is not vulnerable to the collapse of other nations' economies.

On the Innovation Union Scoreboard the Netherlands is leading the group of countries known as innovation followers. Among Holland's strengths is the science base which reflects high rankings on number and quality of scientific papers. On the other hand, there is a definite weakness in the lack of business investments in R&D and non-R&D innovation. Here the composite indicator places the Netherlands on the level of Greece, Bulgaria and Norway.

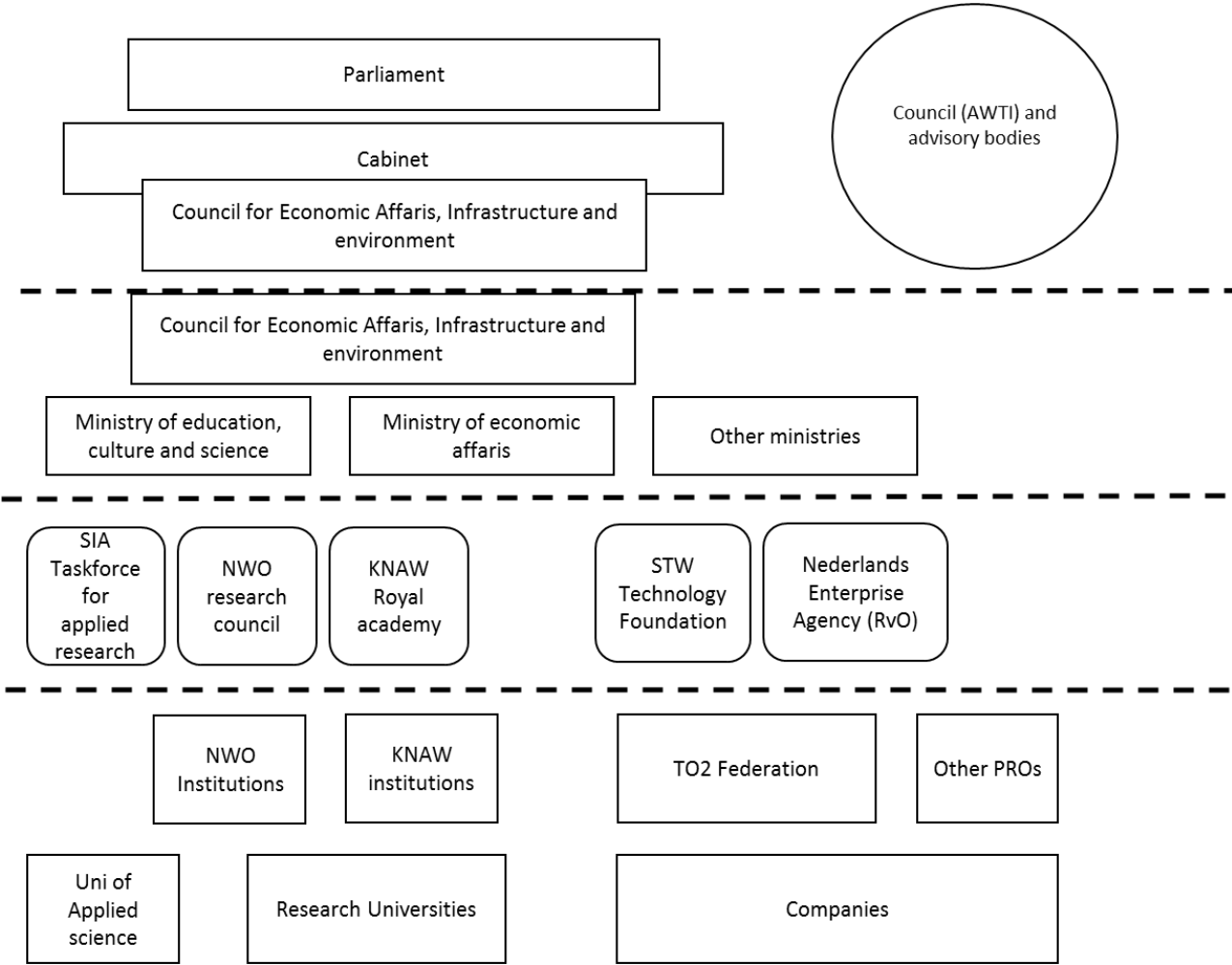
As with other countries the R&I system of the Netherlands is centralised. There are activities at regional and local level, yet the overall system is centralised around two ministries. The Ministry of Education, Culture and Science and the Ministry of Economic Affairs are the main actors at government level. Worth mentioning is that the R&D system has undergone a reorganisation in order to implement a set of measures specifically directed at innovation and increasing R&D intensity.

At the next level the Netherlands Organisation for Scientific Research, the Technology Foundation, the Taskforce for Applied Research, the Royal Netherlands Academy for Arts and Sciences and the agency of RVO are responsible for managing and implementing policies.

The research performers are somewhat different to those of other countries. It is not the actors that differ so much as how they are organised. In addition to universities of applied research and research universities there are umbrella organisations for research institutes performing basic and strategic research, called NOW and KNAW respectively. Another central umbrella organisation is the TO2 covering the TNO (The Netherlands Organisation for Applied Scientific Research) DLO (Dienst Landbouwkundig Onderzoek, the agricultural research institute) and the large technological institutes, the so called GTIs (Deltares, ECN, NLR and MARIN). Further there are a range of other public research institutes and companies conducting R&D in the Netherlands.

In total the structure of the national research and innovation system of the Netherlands can be presented as:

Figure A.4: National R&D system of The Netherlands



Though the Netherlands seems strong with regard to its research base the lack of private funding is affecting its position on the Innovation Union Scoreboard. Its main focus on challenges for the R&D system encompasses company utilisation of the research and the Dutch stronghold within academic research. This includes utilising public knowledge infrastructure, in particular by SMEs. It is important to increase the private investments in R&D and improve the framework condition for innovative start-ups and improve the access to finance.

United Kingdom

The UK economy is slowly recovering from the effects of the 2008 financial crisis. The latter years have shown signs of annual GDP growth along with improved levels of employment. Yet the Brexit referendum challenges these recent trends. It is still too early to state the consequences at the time of writing. Thus we will focus on the status of the UK’s economic position and the UK’s R&I system, but it must be borne in mind that these might face comprehensive changes in the near future.

The UK R&D system is centralised. This is so even though the regional autonomy has been increased. The overall spending levels are set through the “Comprehensive Spending Review” also known as a CSR process carried out by HM Treasury. Each CSR covers a three year period with the purpose of clearing expenditure limits and defining key areas for improvement. The CSR confirms the size of research funds and thus wields resource allocation in the UK R&D system.

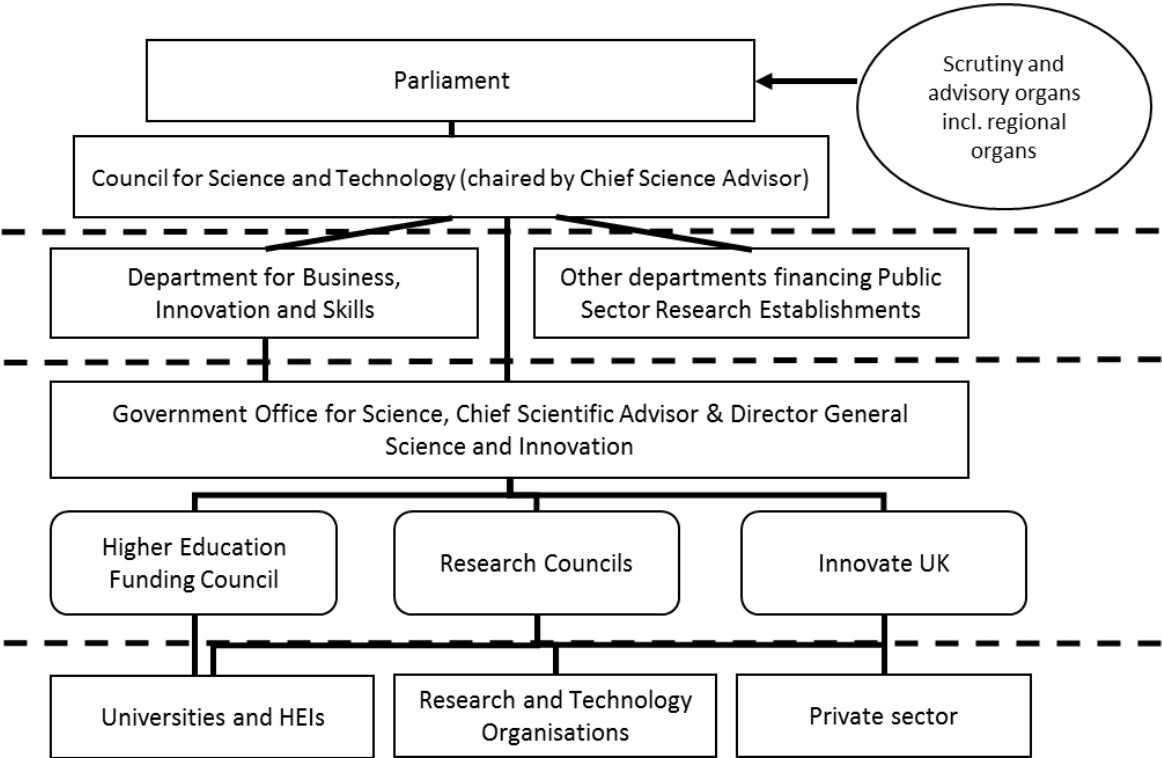
At the executive level the Department for Business, Innovation and Skills (BIS) plays the lead role. The department is home to the Government Office for Science which is headed by the Government's Chief Scientific Advisor (CSA). The CSA in turn chairs the Council for Science and Technology (CST) as well as reporting directly to the Prime Minister.

The main provider of research funds for the public sector is the BIS. They distribute the funding in accordance to the CSR. The BIS allocates the UK's science budget via the Research Councils, who in turn support R&D at HEIs and their own institutes, and provide research grants for programs, projects and research centres. Furthermore, the Research Councils maintain their own research facilities in the UK and abroad. In addition, the BIS has the oversight of the core range of innovation support policies implemented.

The HEIs are the largest performer of research in the UK. They undertake a broad range of activities in terms of teaching, research and activities linked to the so-called third mission. Successive governance changes have led to changes for many public sector institutes and laboratories. They have undergone a shift from contractor status to "arms-length" executive agency status. Due to this change many now reside either partially or fully in the private sector, under a variety of complex contractual arrangements.

Figure A5 shows a simplified representation of various levels in the UK R&D&I system. The figure identifies the Department for Business, Innovation and Skills as central. From here resources are allocated through the Government Office for Science, the CSA and the Director General Science and Innovation. Resources are allocated to the private sector as well as to Research and Technology Organisations through Research Councils and Innovate UK. When identifying the most important funders of public funded industry oriented R&D, these two, along with the BIS, are the organisations that we will engage in dialogue with.

Figure A.5: National R&D system of United Kingdom



The UK’s R&D system has demonstrated successes in knowledge exchange with extensive collaboration between public, private and non-profit sectors. The collaboration has been effectively managed through formal programs, ad hoc activities and a large number of science parks and incubator environments. Furthermore, the system addresses ESA priorities through strong performances on research infrastructure, open access, international collaboration and researcher mobility.

Yet the UK R&D system also faces some challenges. Among those are the need for increase the level of investments in R&D, in both the public and private sectors. Further R&D specialisation and commercialising of public R&D and boost scale ups including high-growth innovative enterprises are pointed out as important focus areas. Finally ensuring human resources to science and technology. These measures are not different to those of the other countries in question in this study.

Yet the main issue in British R&D policy is the pending impact and effects of Brexit. As of now the UK is the top beneficiary from the EU Framework Program. Further, they seek increased influence on future research and innovation policy. e.g. by trying to strengthen the ERA as a single market for research and knowledge. This is obviously hampered by the decision to leave the EU. What the full consequences will be is obviously difficult to assess, yet there is little doubt that this will have a substantial impact on British R&D policy in years to come.

France

The national economy of France was hit moderately by the economic crisis. A drop in GDP was recorded in 2009, whereas the economy was at a standstill in 2008, 2012 and 2013, with growth rates of around 0,2-0,3%. Yet the investments in R&D were kept on a steady growth level and have been since 2006. The GERD to GDP ratio is 2,26%, whereof 1,46% stems from private investments in R&D. The public investments in R&D have been decreasing from 0,93% of GDP in 2009 to 0,7% in 2014.

Currently the French R&D system is undergoing significant restructuring. The most notable changes lie within the National Research Strategy (March 2015) and the National Higher Education Strategy (October 2015), both part of the Law on Higher Education and Research (22nd July 2013). They guide the development of concrete objectives regarding research, education and innovation priorities.

The French R&D system is somewhat complex and consists of a rather powerful central government as well as regional and devolved institutions. The interaction between government and the other actors is organised through 6-year contracts called State-Region Plan Contracts (CPER). There is an ongoing restructuring of the R&D system to clarify the system's functions and to enhance system performance. This clarification implies three levels of action, namely: i) policy-making, ii) implementation (funding and programming) and iii) execution (enforcement of regulation).

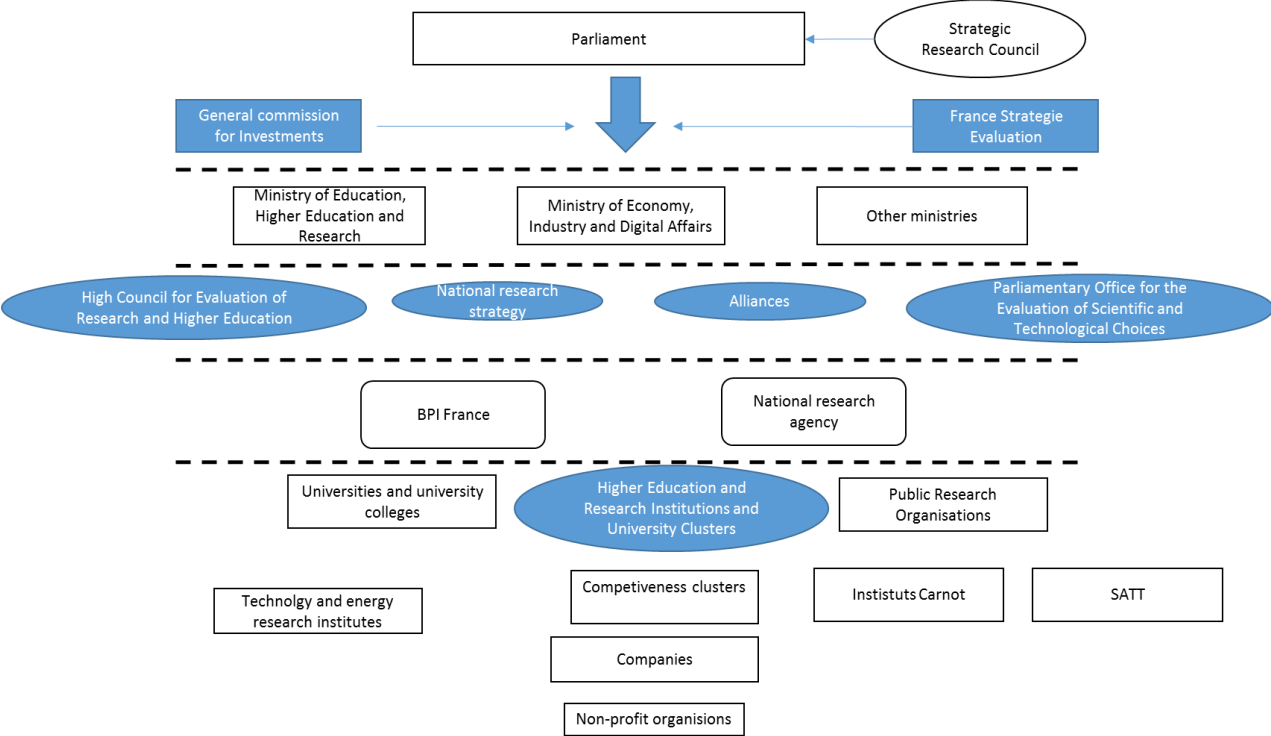
The central ministries involved at policy level are the Ministry for Education, Higher Education and Research (MENESR), which designs and coordinates research policy; the Ministry for the Economy, Industry, and Digital Affairs, which is responsible for industrial research and plays a specific role concerning business R&D. The innovation policy is divided between the two ministries. In addition, under the direct authority of the Prime Minister, the highly endowed High Commission for Investments (CGI) plays a complementary structuring role. There are also several counselling and evaluation bodies involved in developing and lobbying for development of R&D and innovation policy.

The fundamental channel for research and innovation funding is the general budget of the inter-ministerial Mission on Research and Higher Education (MIREs). The MIREs brings together funding from the Ministry for Education, Higher Education and Research (MENESR), the Ministry for the Economy, Industry and Digital Affairs as well as funds from several other ministries (Defence, Culture and Communication, Ecology, Sustainable Development and Energy, and Agriculture, Agrifood and Forestry). Further, the MENESR has responsibility for controlling the eligibility of the expenditures exposed by companies in the framework of the R&D tax credit (CIR). But they are still under strict control from the Ministry of Finance.

At the funding level, there are a vast number of agencies. In the figure below we have pointed out the two most important agencies for this analysis, BPI France and the National Research Agency (ANR). ANR funds research projects on a competitive basis and through public-public and public-private partnerships and covers basic research, applied research, innovation and technology transfer. Whereas BPI France provides support for R&D and innovation projects to businesses, especially SMEs. Between the agencies and the policy level is a broad range of actors marked in blue. These bodies complete evaluations of the R&I system in France.

On the third level, we find the R&D performers. These include the private sector, higher education institutions, government research institutions and an institute sector located in-between the private and public sectors. In addition, several of these performers are gathered in associations, e.g. The ASRC (Association des structures de recherche sous contrats / Contract Research Organisations Association) is a representative organisation that gathers a large share of the private research performers. Another example are the Higher Education and Research institutions and University Cluster organisations.

Figure A.6: National R&D system of France



France has increased its R&D level throughout the last decade. Yet it still lags behind somewhat on the Innovation Union Scoreboard, where France is currently placed as an innovation follower. The identified challenges for France's R&D system are to increase the impact of R&D incentives on innovation. France utilises a broad spectra of instruments for supporting private R&D, but the impact is not always obvious. A second issue is to further stimulate the links between the academic world and industry. And finally, there is the challenge to strengthen scientific excellence.

Appendix B: List of informants

Norway

Organisation	Name	Position
The Research Council of Norway	Frode Georgsen	Special Advisor
The Research Council of Norway	Asbjørn Mo	Department Director
The Research Council of Norway	Sander John Tufte	Department Director

Sweden

Organisation	Name	Position
VINNOVA	Daniel Johansson	Head of Analysis Department
VINNOVA	Anna Orbak	Legal director
VINNOVA	Carl Naumberg	Program manager
VINNOVA	Christina Kvarnström	Program manager
VINNOVA	Vilgot Claesson	Program manager
Tilväxtanalys	Enrico Deiaco	Director
RISE	Olof Sandberg	Director of finance and strategy

Finland

Organisation	Name	Position
The Ministry of Employment and the Economy Research and Innovation Council	Heikkinen Erja	Counsellor for Science Affairs, Head of Team
The Ministry of Education and Culture	Petteri Kauppinen	Counsellor of Education
Tekes – the Finnish Funding Agency for Innovation	Pekka Sivonen	Executive Director of Digitalisation Strategies and Programmes
Tekes – the Finnish Funding Agency for Innovation	Ari Suomela	Legal Affairs Director
Tekes – the Finnish Funding Agency for Innovation	Christopher Palmberg	Program development manager
Tekes – the Finnish Funding Agency for Innovation	Esa Panula-Ontto	Director for Funding Large companies and public research
VTT	Anne-Christine Ritschkoff	Executive Vice President, CTO

The Netherlands

Organisation	Name	Position
Rijksdienst voor Ondernemend RvO Nederland (Business and Enterprise Agency)	Arnold Meijer	Head of Eurostars program
Rijksdienst voor Ondernemend RvO Nederland (Business and Enterprise Agency)	Cock Schenk	Advisor Entrepreneurs and Innovation
Rijksdienst voor Ondernemend RvO Nederland (Business and Enterprise Agency)	Pieter de Bruijn	Senior advisor policy intelligence
Rijksdienst voor Ondernemend RvO Nederland (Business and Enterprise Agency)	Geert Baarsma	Senior Legal Officer
TNO	Albert van der Stern	Manager EU Affairs

UK

Organisation	Name	Position
Innovate UK	David Golding	Head of European and Global Engagement
Innovate UK	Dan Hodges	Head of Economics and Evidence
University of Manchester	Dr Elvira Uyarra	Senior Lecturer
BEIS	Averil de Souza	

France

Organisation	Name	Position
BPI France	Christian Dubarry	Head of European affairs
The Ministry of Research	Dominique Larrouy	
CNRS	Roy Pierre	Director Innovation and business
CNRS	Lison Demichilis	Legal Officer for European Affairs

Appendix C: Abbreviations

BEIS	Business, entrepreneur, innovation and skills department
BERD	Business Enterprise Expenditure on R&D
BIA	User-driven Research based innovation scheme
CNRS	Center for Scientific Research (French: Centre national de la recherche scientifique)
FFI	Strategic Vehicle Research and Innovation program
FME	Environment-friendly Energy Research
FTE	Full Time Equivalent
GBARD	Government Budget Allocations for R&D
GBER	General Block Exemption Regulation
GOVERD	Government R&D expenditure
HEI	Higher Education Institution
HERD	Higher education R&D
IPB	Innovation projects in businesses
IPN	innovation projects in the business sector
IPR	Intellectual Property Rights
KPN	Knowledge-Building projects for Industry
mIn	Million
NABS	Nomenclature for the Analysis and Comparison of Scientific Programmes and Budgets
OECD	Organisation for Economic Co-operation and Development
OFU/IFU	Public and Industrial research and development contracts
PRO	Public Research Organisation
R&D	Research and Development
RCN	Research Council of Norway
RvO	Netherlands Enterprise Agency
SFI	Centres for Research-based innovation

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