

# **R&D Policy and Firm Heterogeneity:**

## **An Analysis of the Norwegian Tax-credit Scheme SkatteFUNN**

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# An Analysis of the Norwegian Tax-credit Scheme SkatteFUNN



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# Abstract

R&D policy instruments, such as subsidies and tax incentives, have the objective to increase private firms' R&D investments, and hence the economic performance and competitiveness of national innovation systems. Norway, like many other OECD countries, has an active R&D policy that aims at increasing the R&D intensity of the economy. The tax-incentive scheme SkatteFUNN, active since 2002, is one of the major R&D policy programmes supported by the Norwegian Government.

The recent literature on R&D policy evaluation investigates the effects that tax incentive schemes have on firms' innovation efforts, and typically points out the existence of a positive impact on companies' R&D expenditures (input additionality) and technological performance (output additionality). However, much less attention has so far been devoted to the study of the *motivations* that drive firms to apply to these R&D programmes, as well as other effects that these may have on firms' strategies and capabilities in a broader sense (so-called *behavioural additionality*).

Another limitation of this literature is that it is mostly represented by quantitative studies that focus on the average effect of R&D policy for the whole economy, without paying attention to the extent to which these effects differ across firms. Firm heterogeneity is a key conceptual pillar in innovation studies, and it is reasonable to expect that the impacts of R&D policy vary substantially depending on companies' capabilities and knowledge base.

Motivated by these gaps in extant literature, this thesis presents a qualitative analysis of the Norwegian tax-credit scheme SkatteFUNN, that has the objective to investigate firms' motivations and behavioural additionality effects, and how these differ for different groups of firms and in different sectors.

In a comparative case study analysis, I collected interview and survey questionnaire data on 20 Norwegian firms that have recently received SkatteFUNN support for some of their R&D projects. These 20 companies were selected from the population of SkatteFUNN approved projects, provided by the Norwegian Research Council, according to three criteria: (i) their

previous experience with R&D (experienced vs. non-experienced firms), (ii) the sectoral context in which they operate (high- vs. low-R&D sectors) (iii) their size (large vs. SMEs).

The results indicate that the motivation to apply to SkatteFUNN varies with R&D experience: firms with prior experience are more likely to apply in order to reduce the costs of their R&D projects or increase their scale, while firms without prior R&D experience are more motivated to apply in order to secure necessary funds to initiate new R&D projects.

Regarding behavioural additionality, the firms with no prior R&D activity were found to have experienced the strongest change to their behaviour, since the SkatteFUNN support made it possible for them to set up a new technological strategy and hence build up new routines and capabilities.

On the whole, the thesis concludes that heterogeneity plays an important role: firms' responses to R&D policy programmes differ substantially, and this dimension should be taken into due account when designing and evaluating this type of policy schemes.



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# 1 Introduction

What does a small bakery in Råde, a zoo in Kristiansand, and Norway's largest producer of weapons and ammunition have in common? For one thing, they have all received public support for research and development (R&D) through the Norwegian tax-incentive scheme, SkatteFUNN. But why did so different companies apply to the scheme, and what effects did they experience?

According to the Lisbon agenda, Norway is committed to increase its investment in R&D up to 3% of the gross domestic product (GDP), of which 2% is supposed to be private R&D expenditures. In the government's arsenal of R&D policy instruments, the SkatteFUNN program is a "catch-all" scheme that is intended to benefit all firms in the economy, regardless of their characteristics and sectoral affiliation. It is the largest programme focused on stimulating private R&D in Norway, and is responsible for approximately 20% of the total funding - paying out nearly NOK 1 400 million (approx. EUR 175 million) in 2013 (Cappelen et al., 2007; NFR, 2014).

Internationally, the focus on innovation policy has grown steadily since the turn of the new millennium, and more than 20 OECD countries have by now adopted R&D tax-incentives like SkatteFUNN. After a slump in the political attention in Norway, the commitment to innovation was reemphasised in the 2013 parliamentary election. However, there is an on-going debate on how the government can best improve the level of innovation and economic growth. The newly elected government improved the conditions for the SkatteFUNN program, although the R&D target as a percentage of GDP has been criticised since it depends largely on the industry structure, and so it does not serve well as a specific policy objective and indicator for benchmarking exercises. The critique of the target is compacted by the fact that the majority of Norwegian industry is engaged in sectors that traditionally perform little formal R&D, while at the same time being innovative in a variety of different manners (Fagerberg et al., 2009; Wicken, 2009).

Further, it has also been pointed out that Norwegian small and medium sized enterprises (SMEs), that benefit the most from the SkatteFUNN scheme, are above the OECD average in terms of R&D activity, whereas large Norwegian enterprises lag behind their counterparts in



OECD countries. So far, just over 10 000 different firms have received SkatteFUNN approval, but the distribution of these firms across size and sector is far from uniform, and many of the technological locomotives like Telenor and Statoil are actually not taking advantage of the scheme.

Evolutionary growth theorising views firms as heterogeneous actors, and sees the variation this creates as fundamental for the further creation of novelty and innovations (Fagerberg et al., 2005). Although many academics argue that this assumption should be at the foundation of innovation policy design (Lundvall and Borrás, 2005), this is certainly not the case when it comes to the formulation and design of R&D policy. In fact, R&D policy schemes are largely rooted in a mainstream understanding of innovation policy according to which intervention is supposed to correct failures and externalities in the knowledge market. The fact that R&D policy interventions may lead to substantially different effects for different firms and in different sectors is seldom taken into consideration.

Previous evaluations of the SkatteFUNN scheme have found that the effect varies systematically between the firms (Cappelen et al., 2007), but they offer only limited discussion of why this variation occurs and what this consequently might entail for the total impact of the policy on the country's economic performance and social welfare. In general, the typical mode of evaluating the effects of R&D tax-incentives has been quantitative, through micro-econometric studies investigating the degree to which the public policy support leads to increased private investment in R&D and generates more innovation. However, these econometric exercises focus on "average" results in a large sample of firms, and consequently have a limited ability to uncover heterogeneity of firms' response and effects.

Motivated by these questions, this thesis is devoted to the investigation of how and why firms' response to SkatteFUNN tax-incentive varies, with the aim of contributing to our knowledge of R&D fiscal incentives, and in particular its effectiveness and appropriateness as a means to stimulate innovation and economic growth. Specifically, the thesis focuses on two dimensions that have received only limited attention in previous research in this field: the *motivations* that drive firms to apply to these R&D programmes; and the broader effects that these may have on firms' strategies and capabilities, i.e. the so-called *behavioural additionality*. The work focuses on these two dimensions and investigates the extent to

which, and the possible reasons why, these factors differ between firms that already have R&D experience and capabilities vs. companies that do not have this prior experience and want to innovate for the first time.

The thesis is structured as follows. The first chapter begins with an overview of the Norwegian context, which shapes both firms' conditions and the design of policy, and a presentation of the SkatteFUNN programme and the main results from previous evaluations of the scheme. Chapter 3 presents the concepts and theories that have informed the design and evaluation of the policy, and also includes a general overview of the status of empirical evidence from tax-incentive policy evaluations. In the fourth chapter, I identify shortcomings of the extant evaluation literature, and present additional theories that illustrate these gaps and introduce propositions that could lead to a more realistic approach. At the end of the chapter I make my theoretical argument and formulate my two main hypotheses for the empirical analysis. Chapter 5 describes my research design and explain how I selected my cases and collected the data. I also discuss validity, reliability, and ethical considerations of my research. In the sixth chapter, I present my main findings and discuss how these relate to extant theory. The final chapter summarises the main conclusions of this research and discusses some potential implications of the findings.

## 2 Background

The development of innovation policy in Norway has evolved alongside the advance of theories on innovation (Mytelka and Smith, 2002), new technological opportunities (OECD, 1998; Fagerberg et al., 2009) and national and international economic conditions (Borrás and Lundvall, 1997; Spilling, 2010). Traditionally policies have centred on increasing research and development (R&D) activities, and have fallen under the remit of industrial policy. The systemic perspective, with its emphasis on processes of learning and the creation and transfer of knowledge, has broadened the policy focus to include the intricate relationships between the knowledge producing organisations and regulating institutions of the innovation system (Edquist, 2005, pp. 185; Spilling, 2010, pp. 12, 14).

These factors have had a visible influence on the evolution of innovation policy in Norway and they continue to do so today. In the following I will take a brief look at the economic structural condition that has shaped Norwegian policy on innovation.

### 2.1 Innovation patterns in Norway: historical background

The Norwegian industry structure, or pattern of specialisation, has developed along three different paths. Firms across these paths differ significantly in their form of organisation, knowledgebase and the social groups they involve, constituting different innovation systems. The emergence and adaption of each path has presented different and sometime opposing firm needs, and over time a large and somewhat fragmented public support infrastructure developed. Distinctive components of the institutional set-up cater to the different paths' incentive structures for innovation (Fagerberg et al., 2009).

The *small-scale decentralised industrialisation path* shaped the Norwegian economy during most of the 1800s. Born of the first Industrial Revolution, the agents of this development path were usually small-scale companies that relied on “*traditional knowledge and forms of organisation*” (Wicken, 2009b, pp. 34). Firm activity was usually characterised by strong localism, concerned with local supply and demand, governed by local rules and norms and

reliant on local knowledge. They typically invested little of their own revenue in innovative activities (Fagerberg et al., 2009; Wicken, 2009b).

With the advent of new knowledge and technology in the late 1800s, early 1900s, opportunities presented itself for exploiting the rich natural resource endowments in Norway. Industrial application of chemical processes, electricity and the combustion engine, were among the novelties that enabled firms of the *large-scale centralised industrialisation path* to exploit economies of scale and scope (Fagerberg et al., 2009; Wicken, 2009b). These firms needed more formal organisational structures to manage their large-scale enterprises and relied on more science based and “codifiable” knowledge (Wicken, 2009b). Although these firms were innovative and employed highly educated labour, only a few firms developed in-house R&D departments and most relied on foreign technology transfer and foreign capital (Fagerberg et al., 2009). As some firms closed in on the international knowledge frontier, investment in in-house R&D rose, but this is a relatively modern phenomenon, and throughout most of the 1900s the majority of innovation activity involved interaction with actors external to the firm. The important role these large-scale firms played in Norwegian economic development meant that a lot of the institutional set-up and public organisations were adapted to accommodate their needs (Fagerberg et al., 2009; Wicken, 2009b).

The emergence of the third development path in the 1960s was again spurred on by new technology and application of knowledge (i.a. electronics, ICT and automation systems). Typical firms representing the *knowledge-intensive network-based development path* were smaller companies with a high R&D intensity, and it is often difficult to separate their R&D activity from production (Wicken, 2009b). The R&D intensive approach to innovation in these “new” industrial sectors involved highly formalised knowledge and basic research, and the firms had strong ties to public R&D institutions. Albeit policy attempts to foster the development of new industries in Norway this path never established a strong independent foothold and was instead absorbed into the older paths. The limited in-house capabilities, as well as favourable technology policy agreements, gave rise to a huge demand for R&D among the large-scale firms, especially from the petroleum sector. In effect, the growth in oil and gas related R&D displaced R&D efforts from other industries. The R&D intensive firms received a lot of political attention during the 1970s and -80s, but the wind turned during the 1990s, as a more neutral policy was adopted. Today, these types of firms have an important

position in the Norwegian economy, but to a larger degree as technical enablers and problem-solvers for the large-scale companies (Wicken, 2009a, 2009b).

The evolution of Norway's economic structure has had a strong impact on the development of the public support system, but at the same time that system has had an influence on the national constraints and opportunities of different sectors. Fagerberg et al. (2009, pp. 15-16) argues that these industrial systems coexist and that they all retain some influence on today's national innovation system.

## **2.2 Industry and innovation policy in Norway**

As illustrated by this brief historical overview, the national organisational and institutional set-up has developed over a long period of time, and innovation policy in Norway has far-reaching roots in pre-war industry policy and post-war technology policy.

Prior to the 1960s the main policy focus was to protect failing and stagnant sectors, and to support industries with competitive advantages. “[T]here was little interest in linking technological innovation with national industrial strategy” (Wicken, 2009a, pp. 89). Even though R&D had a low priority, the government worked to improve the productivity of the local industries, through various regulation and public institutions. Examples of this range from the creation of local savings banks and agencies that could provide business competence to small firms (Småindustrikontorer), to institutes for technology diffusion (Statens teknologiske institutt) and education (Wicken, 2009b, pp. 44-43).

As with most of the other European countries at the time, Norwegian policy became more focused on R&D as a driver of economic growth, during the 1960s. Policy became more dedicated to develop new industries and new competitive advantages, instead of just sustaining old ones. Public funding for private R&D increased and it became a goal to harmonise public R&D with developments in industry. The 1980s saw a substantial influx of public R&D funding and between 1983-93 it increased by more than 80 per cent. By the end of the decade efforts were made to facilitate and promote development in specific technologies, where R&D activity was key. Through procurement and concession laws the government was already practicing sector specific protectionism, but the 1960s saw even

more focused intervention, as attention turned to building up, so called, “national champions”. This kind of targeted policy continued well into the 80s, albeit with changing technological emphasis. Even though this type of policy lost some of its traction as the concept of “innovation systems” permeated policy thinking in the early 1990s, it is still visible today (Wicken, 2009a; Clausen, 2009).

In Norway, influence from OECD (1997, 2005) and the EU (European Commission, 1995) played a large part in defining innovation policy as an explicit policy field and in developing policies in suit with the new understanding (Spilling, 2010). Already during the 1990s “innovation” and “innovation systems” were discussed in parliamentary committees and white papers (St.meld. nr. 36 (1992-1993), 1993; NOU 1996: 23, 1996; St.meld. nr. 39 (1998-1999), 1999), and several initiatives have heralded the growing importance of a broader innovation policy. In 1993, the State Industrial and Development Fund (SND) was created by merging four different funding institutions. The same year saw the integration of five autonomous research councils into one; the Norwegian Research Council (NFR) (Clausen, 2009).

Even though a broader approach to innovation was introduced with the systemic perspective, stimulating R&D activity remained a central policy goal. New incentives for private sector R&D and commercialisation of research were proposed (NOU 2000: 7, 2000; NOU 2001: 11, 2001; St.meld. nr. 20 (2004-2005), 2005) and new instruments for the facilitation and promotion of this were implemented (i.a., SkatteFUNN) (Spilling, 2010; Aanstad and Spilling, 2010). This was in line with international trends (Aanstad and Spilling, 2010), and in accordance with the Lisbon Agenda (European Commission, 2006) Norway was aiming at R&D expenditures at 3% of GDP – 1% public and 2% private. This goal contributed to strengthen policy efforts towards stimulating private R&D investment.

Today almost half of the R&D is performed by the private sector, but it is still a far way to go to reach the target of 2/3. Solberg et al. (Solberg et al., 2014), from the Nordic Institute for Studies of Innovation, Research and Education (NIFU), find that approximately 25 per cent of public R&D funding goes to “business oriented” R&D-support. However, they emphasise that R&D funding for other activities and institutions, not defined as business oriented, also help private R&D efforts. There has been a growth in this type of funding, but much weaker than for other types over the past 10 years. Furthermore, even though the level of public

support for private R&D has increased the level of private R&D compared to GDP is the same as it was 25 years ago, and the reliance on resource based industry is just as strong (Solberg, 2014; Solberg et al., 2014).

Following the government's plan of exercising a more broad-based, or "holistic" innovation policy (NHD Plan, 2003), steps were made to further simplify and reorganise the various policy instruments available, gathering many of the smaller organisations and programs under the domain of "Innovation Norway" (formerly SND).

The "holistic" plan that was introduced in 2003 was followed up in 2008 with a parliamentary white paper on innovation (St.meld. nr. 7 (2008-2009), 2008) that went further to incorporate the systemic approach and to expand the policy field. Even though this paper, and the consequent policy initiatives that were introduced, represented a considerable development for Norwegian innovation policy, it remains a quite unclear and low-prioritised policy area. As Aanstad and Spilling (2010) points out, the political emphasis on innovation seems to have declined throughout the decade and a lot of the plans have been characterised by rhetoric. This marginalisation does not seem to have been caused by opposing political approaches to innovation policy, but rather by deep-rooted conflict lines on research-, regional-, and economic policy (Aanstad and Spilling, 2010, pp. 33-34, 41, 43).

Innovation policy received little attention in the parliamentary elections of 2005 and 2009 (Aanstad and Spilling, 2010), but this changed in the 2013 election, where the conservative coalition government accentuated their commitment to facilitate private R&D and innovation in their coalition platform (Kallerud and Sarpebakken, 2013; Solberg-regjeringens politiske plattform, 2013).

It is still unclear how we can design an effective holistic innovation policy, but in order to respond to specific Norwegian conditions, a first step for policy makers might be to acquire a better understanding of the innovation system as a whole. The lack of a broad review of how the current policy apparatus perform in relation to the national pattern of specialisation has been criticised, e.g. by illustrating the limitations of the 3% target (Aanstad and Spilling, 2010, pp. 43-44).

Norway's ranking on innovation scoreboards vary a lot between different scoreboards, but according to the German "Innovation indicator" Norway has moved from 14<sup>th</sup> to 7<sup>th</sup> place between 1995 and 2010 (Indikatorrapport, 2012, pp. 30). The economic development in Norway has relied substantially less on investment in R&D than other high-income economies in Europe, and a lot of the R&D performed has been publicly funded. R&D activity represent easily available data and is a popular measure for innovation, but R&D is merely one of several factors affecting innovation (Fagerberg et al., 2009). Furthermore, the propensity to do R&D and the relative value of R&D compared to other innovation activities varies across sectors (Castellacci, 2008; Malerba, 2005; Pavitt, 1984), and Norway has been dominated by sectors where R&D intensity traditionally have been low (DFØ, 2006). Fagerberg et al. (2009, pp. 10) show that even though the actual R&D investment levels are low Norwegian firm-level R&D investment match that of other high-income economies when adjusting for variance in national industry structures. Considering this, and the notion that innovation is more than the output of R&D investment, R&D as a share of GDP provides a weak platform for developing innovation policy (Aanstad and Spilling, 2010, pp. 44).

In a review of the major R&D programs in Norway, Clausen (2009, pp. 364-66) found that subsidies emanating from the main Norwegian R&D programs were significantly more likely to end up in large firms with a proven R&D track record. It seems that the policy on fostering national champions still has a strong standing in Norwegian innovation policy, and it is pointed out that little is being done to help young and small firms confronted with financial market failure. However, the dataset used was based on 2001 figures and did not include data from the Norwegian tax-credit scheme, SkatteFUNN, that was designed to focus in particular on SMEs (Cappelen et al., 2010; NOU 2000: 7, 2000).

## **2.3 The Norwegian tax-incentive program: SkatteFUNN**

### **2.3.1 History and description**

In order to reach the 3% R&D intensity goal, it was important to increase private R&D activity in Norway, and one of the instruments proposed in the "Hervik-committee" policy paper (NOU 2000: 7, 2000) was the establishment of a tax-credit scheme. This recommendation led to the creation of the SkatteFUNN-program, in 2001. However, in order



to be in compliance with EU/EEA<sup>1</sup> regulations on state aid the program needed a few adjustments and became active first in 2002. The program is warranted by Norwegian tax law and regulations (Skatteloven, 1999 §§ 16-40 to 16-41; Cappelen et al., 2010; DFØ, 2006).

SkatteFUNN is a tax-credit scheme that allows firms with approved R&D projects to deduct up to 20% of their R&D expenses directly from their payable taxes. The program can be described as a “catch all-instrument”, as it was designed to be project-, region- and industry neutral, as well as easy to administer and apply for (Cappelen et al., 2010). In their economic survey of Norway, OECD (2007) favours this neutral approach, contrasted to the “*long [Norwegian] tradition of including regional, social and sectoral goals in industry policy*” OECD (2007, pp. 112).

SkatteFUNN can be seen as a continuation or expansion of the FUNN-program, which offered subsidies to buy external R&D services from universities and R&D institutes. SkatteFUNN still aims to facilitate cooperation between firms and R&D institutes by offering higher maximum deductions for these types of projects, but this type of cooperation is no longer a requirement for support (DFØ, 2006).

Since expenses tied to income production already are deductible by Norwegian tax law (Skatteloven, 1999 § 6-1), some R&D-costs can be deducted (Skatteloven, 1999 § 6-25) regardless of the SkatteFUNN-scheme. The method of deduction varies from SkatteFUNN and must either be deducted from income (enhanced allowance), or as amortisation of assets. Deductions from income production cost and SkatteFUNN-projects rely on two independent sets of rules and the tax-credit offered by SkatteFUNN comes in addition to those warranted by § 6-1 in the tax law. With a corporate tax of 28%, the total deduction could in some cases cover almost 50% of R&D costs (DFØ, 2006, pp. 10, 82-83; Skattedirektoratet, 2014, pp. 602-04; Ot.prp. nr. 1 (2001-2002), 2001, pp. 24, 36).

### **2.3.2 Rules and function**

Since the program is “rights based” and operated through the tax system, there are no budgetary limitations forcing the SkatteFUNN-secretariat to “pick winners”. The firms themselves decide which R&D projects they want to apply for and as long as the projects

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<sup>1</sup> Norway is not part of the European Union (EU), but has agreed to harmonise laws and regulations in certain areas, through the European Economic Area (EEA) agreement.

meet certain criteria, and fall within the definitions of R&D used by the Norwegian Research Council (NFR), they are entitled to the deduction. This definition is established in the legal regulations of the program (FSFIN Forskrift til skatteloven, 1999 § 16-40-2), and the core requirements are as follows; the project descriptions must be focused and delimited from normal operations; they must seek to obtain new knowledge or skills, or recombine previous knowledge and / or skills; and the project must be valuable for the firm in developing new products, services or processes (DFØ, 2006). As pointed out by Cappelen et al. (2010, pp. 98), the R&D definition at hand is not that different from the one used in the Frascati manual.

Since 2003 both small and large enterprises have been eligible for the program, but the large firms can only deduct 18% of their expenses, while the small firms can deduct the full 20% (Skatteloven, 1999 § 16-40 paragraph 2; FSFIN Forskrift til skatteloven, 1999 § 16-40-5).

Even though the projects may be as large as the firm likes, and span several years, there are a few caps in place that limit the number of years a project can receive support, as well as the maximum yearly deduction basis. Based on precedence projects can be approved for a five-year timeframe, but it is possible to apply for an extension. Tax-credits, from internal R&D costs can be calculated from a maximum sum of NOK 8 million (approx. EUR 1 million), whereas tax-credits from R&D purchased from approved universities and R&D institutes can be calculated from up to NOK 22 million (approx. EUR 2,75 million). The upper limit, however, is NOK 22 million, so even if the project runs up external costs of NOK 22 million and internal costs of NOK 5 million, the deduction will be based on the NOK 22 million cap (Skatteloven, 1999 § 16-40 paragraph 2). R&D personnel usually represent the highest cost related to R&D projects, and so a maximum hourly wage is set to NOK 600 and a maximum number of hours per year is set to 1850, per person. Another cap is indirectly imposed by EU/EEA state aid regulations (EØS-loven, 1992 Art. 61 and 108; ESA Guidelines on State Aid, 1994) setting limitations to total public R&D support for small and medium sized enterprises (SMEs) and large enterprises (Cappelen et al., 2010; DFØ, 2006).

These limitations make the program relatively more valuable for small firms that usually invest under the NOK 22 million cap anyway. The program regulations have gone through a

few alterations since 2002<sup>2</sup>, especially in regards to the caps, but has at its core remained fairly stable. One argument for anchoring the scheme in the tax system was in fact to make it more resilient to shifting budget policies (Cappelen et al., 2010, pp. 97-98; DFØ, 2006, pp. 81).

The tax-credit is directly deducted from the payable taxes, but also firms that are not in a tax position are eligible for the program. In these cases the credit is paid out as a negative tax or a grant. Since the scheme works through the tax system the accrued costs must await approval and the credit is usually paid out the following year. However, the level of probable tax-credits can be considered when calculating the advance tax, and firms can thus cash out some of the tax-credit the same year as the cost incurred (Cappelen et al., 2010, pp. 98; DFØ, 2006, pp. 89).

The responsibility for the program is divided, but the SkatteFUNN-secretariat is situated in the Norwegian Research Council (NFR). Project approval is given by NFR, but is informed by initial recommendations from Innovasjon Norge (Innovation Norway). Although there exists a body of appeal, many of the rejected applications are instead resubmitted and approved, after the necessary clarifications and adjustments are made. Once the project is approved firms are responsible for delivering progress reports and separate project accounts for each year. The control and approval of the R&D costs, constituting the deduction basis, falls under the responsibility of the Norwegian Directorate of Taxes, who in turn relies extensively on auditors' approval of project accounts (Cappelen et al., 2010; DFØ, 2006).

Project approval is retroactive for incurred project costs from the same year. Permissible costs include personnel and indirect costs, R&D services purchased from approved institutes, project specific machinery and equipment and other operating expenses, all defined in the SkatteFUNN regulations (FSFIN Forskrift til skatteloven, 1999 § 16-40-6). It is, however, a requirement that these costs are deductible according to the tax law (Skatteloven, 1999 chapter 6) on determination of general income (DFØ, 2006).

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<sup>2</sup> In 2003 the scheme was opened up for large enterprises. In 2007 a maximum hourly wage of 500 and the individual man hours pr. year limit was introduced. In 2009 the deduction cap for internal R&D was raised from 4 to 5,5 million, and the cooperation cap was raised from 8 to 11 million. In 2011 the maximum wage was raised to NOK 530 and social cost calculation was reduced. In 2014 the maximum wage was increased to 600 per hour and the maximum deductions raised to 8 and 22 million, respectively.

### **2.3.3 SkatteFUNN in numbers**

SkatteFUNN is the single largest R&D-support initiative in Norway, based on proceeds and number of firms supported (DFØ, 2006). According to calculations done at NIFU, SkatteFUNN tax-credits constitute 20 per cent of the public “business oriented” R&D-support (Solberg, 2014; Solberg et al., 2014).

The scheme has been active for over a decade and the number of applications has exceeded 30 000. In their 10<sup>th</sup> annual report the SkatteFUNN-secretariat presented figures outlining some of the development of the scheme (NFR, 2012). Based on this, and numbers from their most recent reports (NFR, 2013; NFR, 2014), the tally shows that 24 619 individual projects were initiated by 10 343 individual firms, between 2002 and 2013. For the period of 2002 and 2012, total tax deductions (paid out 2003-2013) amount to NOK 12 100 million (approx. EUR 1 512,5 million).

The number of applications and approved projects has dropped a lot from its peak in 2003 and has maintained a relatively stable level since 2007. Both the budgeted and the actual deductions followed this trend with a peak in 2004, declining until 2007, but have seen a strong growth since then. The raise of the maximum deduction cap in 2009 might explain some of this growth.

As mentioned the program appears to be especially beneficial for small and inexperienced R&D performers. Between 2007 and 2013 roughly 80% of the active SkatteFUNN projects belonged to firms with less than fifty employees (NFR, 2014). Solberg et al. (2014, pp. 23) highlights the success of Norwegian R&D policy in fostering R&D activity in SMEs, but are critical to the apparent neglect of large firms. Today, Norwegian SMEs are highly ranked when it comes to R&D investments as a share of GDP, while the large enterprises score far below average.

### **2.3.4 Evaluations**

There have been two large evaluations of the Norwegian tax-credit scheme. Commissioned by the NFR, at the behest of the Ministry of Finance, Statistics Norway (SSB) and subcontractor Norlandsforskning (Nordland Research Institute) undertook a large evaluation of SkatteFUNN between 2004 and 2008. The objective was to assess the schemes

performance in accordance with the intended effects; increasing private R&D investment; generating innovation; and stimulating knowledge based value creation in Norway. The effect of SkatteFUNN on the attainment of these goals was evaluated in several nuanced subprojects (Cappelen et al., 2008, 2010).

At the end of 2005 the same ministry asked the Norwegian Directorate for Financial Management (DFØ)<sup>3</sup> to conduct a separate evaluation of the financial management of SkatteFUNN. This was seen as a supplement to the SSB evaluation (DFØ, 2006).

Through a difference-in-difference regression approach, Hægeland and Møen (2007) found that private investment in R&D was higher in firms that have been treated (i.e. received SkatteFUNN support). The positive effect on investment was found to be driven by small R&D performers from sectors that traditionally have a low R&D propensity (Cappelen et al., 2010, pp. 101).

While the SkatteFUNN program stimulates innovation in the form of new production processes, and to some degree new-to-the-firm products, Cappelen et al. (2007) found that the projects did not appear to contribute to increased patenting, or new-to-the-market products. The types of innovation the scheme contributes to are associated with a lower spillover potential, so the overall social return can be expected to be low. It was also pointed out that sectors with high R&D propensity experienced the strongest positive effect on their output (Cappelen et al., 2010, pp. 101-02).

Alsos et al. (2007), from Norlandsforskning, argue that by affecting internal conditions in the firm, the SkatteFUNN scheme has a positive effect on R&D behaviour in firms with limited R&D experience (given that they had a good knowledge base, well developed dynamic capabilities and an entrepreneurial orientation). Experienced R&D performers, on the other hand, did not report similar changes (Cappelen et al., 2010, pp. 102).

The scheme seems to have a limited positive effect on collaboration. Hægeland and Møens (2007) research show that few firms initiate collaboration with approved R&D institutes as a result of SkatteFUNN, and those with a history of collaboration do not increase this activity.

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<sup>3</sup> DFØ administers the state's economy regulations, and acts as an expert body. In 2011 they changed their name from Government Agency for Financial Management (SSØ).

Findings by Cappelen et al. (2007) strengthen this notion with evidence of limited stimulation of inter firm collaboration (Cappelen et al., 2010, pp. 102).

DFØ (2006) considered the administration of SkatteFUNN to be relatively efficient, but identified a few serious risks associated with the financial management of the program. Through interviews they encountered a “*clear attitude to SkatteFUNN where «everyone knows» that it is easy to deduct too many work hours*” (DFØ, 2006, pp. 10). Most of the risks were related to issues with inflation of the deduction basis, and challenges for assessing the actual costs. Some of these problems were tied to the inter-organisational set-up of the program and some were linked to the regulation. Among several recommendations DFØ proposed that the tax-credit scheme should be changed into a subsidy program, under the control of one single entity (DFØ, 2006, pp. 10-15).

These risks open up for tax-motivated abuse of the scheme and some of the risks identified by DFØ (2006) were investigated by SSB. Fjærli (2007, pp. 23-24) reported that auditors found it difficult to control actual R&D expenses, and with some degree of certainty his analysis showed that when compared to the national R&D statistics, SkatteFUNN projects appear conspicuously more costly. This difference seemed to be more pronounced among the smallest firms, but based on the available data the same effect in larger firms could not be adequately tested. However, some “free rides” are to be expected with any kind of public subsidy scheme. When the cost of stronger control outweighs the benefits, a certain level of trust is necessary (DFØ, 2006, pp. 6-7).

All in all, the SSB evaluation concludes that the scheme:

*“... mainly works as intended. The scheme is cost-effective and it is used by a large number of firms. It stimulates these firms to invest more in R&D, and in particular, the effect is positive for small firms with little R&D experience. The returns on the R&D investments supported by the scheme are positive and generally not different from the returns to other R&D investments”* (Cappelen et al., 2010, pp. 107).

Based on the market-oriented nature of the resulting innovations, they do however question what type of market failure is corrected through the scheme. The process- and new-to-the-firm product innovation the scheme stimulates does not represent a lot of technological spillover potential. They further point out that the firms that responded to the scheme by increasing their own R&D investments could have done so either because they want to

capitalise on the price reduction on R&D, or that they with the help of the scheme can overcome some financial market failure. The latter is supported by the fact that the majority of the tax-credits are paid out as grants, indicating firms with liquidity constraints. However, since this pay-out first comes the year after the costs incurred, it could be argued that the correction of the failure is limited (Cappelen et al., 2010, pp. 106).

Even though a positive change in firm behaviour often is used as a justification of the scheme, Alsos et al. (2007) does not develop the limited theoretical relationship between changes in firm behaviour and the market failure rationale. There is mention of system perspective rationales for public intervention, but their findings are not linked to any specific “system failures”. They do however point out a positive correlation between change in behaviour and positive changes in R&D input and output (Alsos et al., 2007, pp. 31, 106-107).

## 3 Literature review

The literature<sup>4</sup> I review in the present chapter represents the academic basis used by policy makers and stakeholders to develop and evaluate innovation policy. I will begin by presenting the theoretical foundations for innovation policy and the rationale for public intervention. I will then continue with an outline of the various approaches and policy instruments, with specific attention to R&D tax incentives. I will finally conclude the chapter by presenting the typical evaluation exercise that is carried out in the current literature.

### 3.1 Why do we need innovation policy?

As more and more policy makers acknowledge that technological change is an important determinant for economic growth (Abramovitz, 1986) more and more governments have developed specific innovation policies set on stimulating future growth (OECD, 2010).

It has been long assumed that some of the economic growth (all that could not be explained by factors in the models used) could be explained by technology. However, the share of its influence was significantly underestimated until the late 1950s (Verspagen, 2005). As a response to the inadequate exogenous growth models inspired by Solow (1956), two different approaches were taken to develop endogenous models that could better explain long-term growth. Both “*neo-classical endogenous growth theorising*” and “*evolutionary growth theorising*” acknowledge the importance of technological change for economic growth, as well as the important role played by public policy in this respect, but there are also some fundamental differences in the two approaches’ theoretical foundation. In a few words, one could say that the neo-classicalist trade a lot of realism for increased calculability, while the evolutionary approach has a trade-off in the opposite direction (Verspagen, 2005, pp. 492).

#### 3.1.1 Neo-classical endogenous growth theorising

The neo-classical approach use representative agents in their models, making the growth process a whole lot more predictable. These homogeneous agents—assumed to be perfectly

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<sup>4</sup> I identified the relevant literature by “snowballing” from the references used in text-books and “handbooks” on innovation. In order to make sure I presented the most relevant theories and empirical studies, I also used “Google Scholar” in combination with “Thomson ISI web of science”, to confirm that I both included seminal work and more recent contributions.



rational—act under low uncertainty and exhibits maximising behaviour. This enables the neo-classical models to be built on micro foundations (Castellacci, 2007). Since perfect competition and symmetric information is assumed to result in a Pareto efficient equilibrium, working markets are expected to function optimally (Gök, 2010, pp. 86). Romer (1990) argued that technological change was one of the determinants for economic growth and that most of this change was attributed to individuals “acting on market incentives” (Backman et al., 2007, pp. 4-5). Furthermore, he treated knowledge as information (symmetrically allocated in a perfect market) and assumed that once these new technologies were created they could be readily available for all and could be reused at no further cost. This would mean that there is a spillover of knowledge and technology in the marketplace, and thus growth could be explained because the societal marginal benefit of a new technology would be larger than the private one (Backman et al., 2007, pp. 5; Gök, 2010, pp. 87).

### **3.1.2 Evolutionary growth theorising**

In general, evolutionary growth theorising asserts that economic growth is a result of increased variety in the market, created as innovative ventures are explored (Castellacci, 2007). Contrary to neo-classical thought, information is necessarily seen as asymmetric and a driver for variety creation. This variety undergoes a constant selection process where entities best adapted to the environment are rewarded, while the rest are weeded out. This selection process is usually taken care of by market forces (Verspagen, 2005).

Because of the assumed uncertainty and information asymmetry firms are seen as heterogeneous, and possess different ability to create, absorb and exploit knowledge (Gök, 2010, pp. 92). The actors are thus limited by bounded rationality, so the growth process is seen as unpredictable. Depending on how radical the innovation is in relation to the existing technological paradigms, the growth process can be characterised by either saltationist or gradualist evolution. This systemic approach takes on a non-reductionist position where the micro-and macro levels are interrelated and influence each other in a dynamic process. In addition, the evolutionary process of technological change is considered to be non-deterministic and never ending as opposed to the new growth theory perspective where it is assumed that some degree of equilibrium eventually will be reached (Castellacci, 2007).

## 3.2 Rationale for public intervention

*“It could be argued that technology policy, like most other policies, could only be justified if it generates a net increase in social welfare”* (Heijs, 2003, pp. 446). From the late 1800s there was increasing suspicion towards the idea that self-interest and social interest more or less harmonised under natural liberty (Medema, 2007). Today, two different approaches are being used to justify how intervention can increase social interest: market- and system failure. These are not mutually exclusive and both require attention from policy makers (OECD, 1998).

### 3.2.1 Market failure

The traditional rationale for governments to intervene in markets has been tied to market failures. Efficiency of markets may be less than optimal in such cases where externalities (or spillover effects), information asymmetries, barriers to entry or indivisibilities are present.

Under the neo-classical assumptions of perfect competition, Arrow (1962, pp. 619, 623) demonstrated how a market fails to provide socially optimal investment in knowledge creation, because of the limited appropriability, uncertainty and indivisible character of knowledge. However, this gap in public and social optimal investment in R&D can be mitigated by public intervention in some shape or form, that change the private marginal return of R&D investment (Hauknes and Nordgren, 1999). Since the neo-classical models see input and output as identical, policies that either reduce cost or increase returns are equally applicable. However, the assumption that non-rivalrous knowledge has positive externalities dictates that policies should be general in order to reach the socially optimal level of R&D investment. The market failure rationale provides clear policy advice, but offers a limited understanding of knowledge and technology creation (OECD, 1998, pp. 45-48).

In addition to this, Hall (2002, pp. 36, 38-39, 48) points out that investment in R&D is likely to suffer from financial market failure because of the uncertainty imbued in R&D. Moral hazard and asymmetric information can lead to very expensive external capital, especially for small and new firms.

### **3.2.2 System failure**

The evolutionary approach has led to a growing understanding of innovation as a systemic activity, where learning processes constitute a central element (Edquist, 2005). In their search for new opportunities firms rely on both internal and external sources of information. Successful innovation is thus affected, not only by the firms' own performance (affected by market failure), but also by the quality of interaction with other actors (affected by system failure), i.e., if the interaction between knowledge producing actors is weak it could affect the pace of innovation (Hauknes and Nordgren, 1999).

Edquist (2005, pp. 187) identifies a provisional list of activities that influence the development, diffusion and use of innovation. Many of these activities take place through complex interrelations between the institutions and organisations in the system, and various conditions can constrain these types of activities. Some of the proposed systemic failures presented by Hauknes and Nordgren (1999, pp. 9-10), include learning failures, dynamic complementarities failures, appropriability traps, variety-selection trade-offs (Malerba, 1997), infrastructural provision and investment failures, transition failures, lock-in failures, institutional failures (Smith, 2000) and network failures (Carlsson and Jacobsson, 1997).

Policies originating in the system failure rationale focus on improving the institutional set-up of the system, in order to facilitate increased innovation opportunities for the firms. The systems approach opens up for new possibilities for stimulating innovation, but policy makers need to acquire intimate knowledge of their system's peculiarities in order to make improvements (Hauknes and Nordgren, 1999).

## **3.3 Policy instruments**

There are various definitions of "innovation policy" in play, but according to Spilling (2010, pp. 12) they are all concerned with how to facilitate and promote activities conducive to development, distribution and use of new knowledge and technology. It consists of a diverse mix of measures spread across a wide policy landscape (Berger et al., 2012, pp. 167), such as research-, technology-, regional- and educational policy" (Edquist, 2001).

Following a broad definition, there are three dimensions that should be considered when implementing an innovation policy. The first is the wider economic context including fiscal-, trade- and competition policy. The second dimension covers existing innovation policy like education and trade regulation. Finally, policies designed to handle the fallout of transformation (e.g. social-, labour- and regional policies), should be taken into account (Backman et al., 2007; Lundvall and Borrás, 1997)

Lundvall and Borrás (2005, pp. 611-12) argue that innovation policy can be split into two different categories based on the aforementioned theoretical foundations. The neo-classical economics perspective emphasise policy affecting framework conditions for innovation, incentivising improved innovation effort at the firm level. In accordance with the assumption of perfect information and rational actors (in the absence of market failure), innovation possibility frontiers are considered set and improvement can only occur by increasing effort (Metcalf, 1995).

The other category, underpinned by evolutionary economics, takes on a more systemic perspective and sees innovation policy as a combination of a broad spectre of policy fields. Based on the assumptions that actors are not a homogeneous group, but make their choices based on imperfect information and bounded rationality, this approach considers the innovation potential frontier of firms to be dynamic (Metcalf, 1995). In addition to market failures this perspective also considers systemic failures, i.e., shortcomings of the organisations and institutions that facilitate development, adoption and use of new knowledge (Metcalf, 2005). Policies with this foundation aim at improving competence as well as incentivising effort (Lundvall and Borrás, 2005).

Backman et al. (2007, pp. 3) divides innovation policies into general and specific instruments. Since some policies can have both specific and general characteristics, this is not necessarily an easy task. While general instruments provide the framework, specific ones provide a more targeted approach (e.g. support for specific industries or technologies).

There are many ways to facilitate and promote public and private innovation. Some of the general policies suggested by Backman et al. (2007, pp. 10-21) are strengthening of IPRs, supporting intermediary institutions, improve and expand infrastructure, incentivise entrepreneurial behaviour, investment in higher education and basic research, secure

provision of venture capital and increase labour mobility. Some of the specific policies they mention are investment in regional innovation systems, support of cluster formation and development of knowledge centres, incentivising university spinoffs and promotion of public-private relationships (Backman et al., 2007, pp. 23-26).

### **3.3.1 R&D tax-incentives**

Support for private R&D can take both a direct and indirect form. By choosing a direct approach governments can offer support to selected projects or industries via grants, loans, stipends, or via direct procurement of R&D. These methods aim at raising the private marginal rate of return, and place a large information requirement on the government agency that has to ensure effective use of the subsidy (Gulbrandsen, 2005). On the other hand, indirect instruments work by reducing the cost of R&D and are considered to represent a more neutral approach, as they usually are available for all firms in the economy (OECD, 2010; David et al., 2000; Hall and Van Reenen, 2000).

The R&D tax-incentive approach has become widespread throughout the OECD. With more than 20 countries adopting such programs a growing share of innovation policy resources can be seen funnelled this way. It is also believed to be of the most efficient ways to remedy the private underinvestment in R&D (OECD, 2010).

Tax incentives can be given as a direct deduction of the tax payable (tax credits), or as a deduction from the taxable income (enhanced allowances). What qualifies as an R&D project must be determined, and what types of expenditures that can be subsidised must be asserted. To provide maximum incentive for the companies a broad definition of R&D could be used, and all R&D related wages, expenditures, capital investments and acquisition of intangibles could be included. However, this approach may not lead to more innovation, than with a more restricted policy. Governments must choose if the incentive is to be equally available to all that meet the R&D project criterion, or whether some target groups, such as SMEs, should receive additional incentives. Finally the deductible amount can constitute all R&D expenditures (volume), or outlays over a certain amount (incremental) (OECD, 2010).

However thoroughly the policy is designed, it does not necessarily mean that it will produce higher levels of innovation and lead to economic growth. One challenge is that R&D funding,

in general, have been known to drive up the wages of R&D workers in markets where access to high skilled R&D workers is limited (Cappelen et al., 2012, pp. 338; Grossmann and Steger, 2013, pp. 162). Another issue is that tax incentives might “crowd out” private investment instead of leading to additional innovation efforts (Clausen et al., 2008, pp. 2). Additionality can be defined as “*the change in industry-financed R&D spending, or change in company behaviour or performance that would not have occurred without the public program or subsidy*” (Clausen et al., 2008, pp. 2). Naturally, the increased popularity of innovation policies has brought with it an increase in innovation policy evaluation<sup>5</sup>.

### 3.4 Evaluation of R&D policy

In general, policy programs can be understood as “*set[s] of technical activities managed to reach social objectives*” (Arnold, 2004, pp. 4). The justification for innovation policy instruments rest on the failure of the system and of markets to provide socially desirable levels of innovation, assumed to increase economic growth. It then stands to reason that evaluation of a specific program should involve checking the “appropriateness of the means” in correcting the failure, as well as the impact or results (summative element) and effectiveness (formative element) of the implementation (Arnold, 2004). Evaluations are an important part of the policy cycle, and ideally the findings will feed back into the revision and adjustment of the policy (Howlett et al., 2009).

#### 3.4.1 Measurements

Usually based on surveys, pre-existing data sets and interviews, evaluations of R&D tax incentives employ a range of analysis, from econometrics to counter-factual approaches – tools that are “*considered appropriate to the very concepts of additionality*” (Berger et al., 2012, pp. 173). To get a better understanding of the interplay between public and private R&D, additionality is usually divided into different types (Clausen et al., 2008).

If the policy effort is justified by the market failure rationale, a successful policy must increase the level of input- or output additionality to be successful. *Input additionality* relies on statistical comparison to estimate whether public funding leads to an increase in private

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<sup>5</sup> Arnold (2004, pp. 4) also point to the adoption of the “new public management” concept in policy administration as a cause for increased evaluation activity.

R&D investment or displace private funds. In order to achieve an additionality effect, private investment in R&D must increase with more than it would without public intervention. This measurement is based on the assumptions that there is a positive relationship between input and output of innovation; there are constant and indivisible returns to scale; and that the source of investment does not affect output (OECD, 2006, pp. 12; Gök, 2010, pp. 89).

However, input additionality is not sufficient for achieving the social objective of economic growth. For a policy to be successful the cost (including alternative cost) of funding R&D cannot be higher than the increase in social return. In order to ascertain this, there must be some measurement of the increase in outcome of R&D.

*Output additionality*, is similarly based on statistical comparison, and is achieved if the level of innovation is higher with the support, than without. However, defining which indicators to measure in order to determine the effect of the output is not easy. For instance can a failed R&D effort still provide valuable knowledge for the actors involved, increasing the stock of “latent-innovation”. It is also difficult to measure the externalities of a new product, process or service, and even more so for less tangible outputs. By concentrating on the output within the boundaries of the firm evaluators have been able to operationalize the measurement, however, at the cost of accuracy Both input and output additionality are central measurements in most policy evaluations and rely on neo-classical assumptions (OECD, 2006).

A less developed, but increasingly popular concept, is the measurement of *behavioural additionality*. The concept was proposed to provide a more nuanced evaluation of public funding, i.e., open up the “black box” of input- and output additionality, and explain how public funding affects not just the project, but the entire organisation. Behavioural additionality seeks to explain changes in the knowledge base, strategies, routines or capabilities of a firm, and it can be defined as the persistent change in firm behaviour caused by the public funding (Antonioli and Marzucchi, 2012; OECD, 2006; Gök, 2010). The effect can also be considered in firms that interact with the treated firm etc., but since the concept already is so broad, Antonioli and Marzucchi (2012) recommend that measurement should be delimited to the changes in the firm behaviour that is related to the policy goal. Most operationalisation of the concept focuses on a few variables and relies on comparative

statistics and the *ceteris paribus* assumption for estimating the level of change (Gök, 2010, pp. 97).

To get the full picture the different additionality effects have to be considered together. Beyond the assumed relationship between input and output additionality, there has been hypothesised synergy effects between the three concepts (Antonioli and Marzucchi, 2012), and Clausen et al. (2008) were able to show how these were interrelated, and also indicated possible directions of influence. First off, they split input additionality (IA) into direct and indirect IA. Without any direct IA, there can be no talk of additionality, as the effects would be achieved anyhow. Furthermore they point out that behavioural additionality is a prerequisite for indirect IA (e.g. in the form of R&D focus and R&D capability) and output additionality (e.g. as potential- and realised absorptive capacity). They suggest that “*these relationships may vary depending on characteristics of the firm or their environment*” (Clausen et al., 2008, pp. 20).

### **3.4.2 Empirical evidence**

In an analysis of innovation policy evaluations Berger et al. (2012, pp. 177) combines purpose and timing, topics covered and related measure types, to create three classes of evaluation. According to these classifications, evaluations of R&D tax incentives usually are of the “holistic type”, which looks at both summative and formative aspects. The evaluation is usually planned in the design phase of the policy and look at both form-factors that can improve the programme, as well as goal attainment and impact assessments. Few evaluations, however, focus on the appropriateness of the policy instrument, beyond the program goals.

Ascertaining whether R&D tax incentives do in fact lead to crowding-out or additionality is difficult, as the various studies have used different data sources, looked at different support programs, have been conducted in different countries and industries and applied different methods. However, the bulk of the existing research has been based on econometric approaches and most demonstrates a positive average effect on R&D activity (David et al., 2000; Hall and Van Reenen, 2000; Cerulli and Poti, 2012). The majority of these studies have focused on the input- and output dimensions (Antonioli and Marzucchi, 2012). The statistical approach solves the problem with causal inference, but is thus unable to say much about the variation in firm response to a policy.



In a survey of the micro-economic literature, Castellacci and Lie (2014) investigate the effects of R&D tax-credits on firms' innovation activities, across sectors. By comparing empirical results from high- and low-tech industries, they find that SMEs and firms in the service sector and low-tech industries on average obtain a stronger estimated effect of the tax-credits. Firms in high-tech industries experience a lower effect, especially in countries with an incremental tax-incentive model.

Since the effect is strongest in industries that traditionally are less R&D-intensive, work with low-opportunity mature technologies and represent less spillover potential, the current programs could be considered inefficient if the goal is to reach an optimal level of innovation. In order to design programs better suited to further the national technological frontier, Castellacci and Lie (2014) proposes that policy makers should begin to consider sector specific conditions.

## 4 Literature gaps and hypotheses

This chapter points out some important limitations and gaps in the literature reviewed in the previous chapter. I will present some theories, rooted in evolutionary and Schumpeterian economics, that provide some new insights as to how these gaps may be tackled in order to improve the framework for policy evaluation. At the end of the chapter, I will conclude by presenting the two main hypotheses of how and why responses to the Norwegian tax-credit scheme vary, and that will subsequently be analysed in the empirical part of the thesis.

### 4.1 Gaps in extant literature

The main issue I want to emphasise is the lack of attention to firm heterogeneity in R&D policy studies, which has limited the ability to evaluate the appropriateness of policy programs. Tax-incentive programs are usually designed to be broad, “catch-all instruments”, catering to firms from all sectors and often all types and sizes. It can, however, be questioned if this is appropriate, considering that most economies comprise a diverse group of firms that, based on distinctive conditions, have different needs and motivations, guiding their response. Elfring and De Man (1998, pp. 290) suggest that even though theories of the firm argue “firm heterogeneity”, policy makers seem to design innovation policy on the assumption of “firm homogeneity” (Clausen, 2013).

As most of the studies of R&D policy have been quantitative and employed econometric methods, the main focus has been on the “average additionality effects”. The statistical solution solves the causal interference problem associated with counterfactual analysis, but takes a lot of nuance out of the results. By adding up the effects and considering the average additionality effects, an evaluation is unable to realistically consider the interplay between the effects, as they could be concentrated in different parts of the population. As a result there is little knowledge of how heterogeneity across firms and sectors affect the policy response of firms.

The lack of attention to the heterogeneity of firms’ responses to R&D tax incentives is reflected in two further limitations of the extant literature. The first is that almost no attention

has been given the motivation of firms to apply for support, i.e., the reasons why a firm chooses to apply to a tax deduction scheme, and what it wants to achieve with the support. While it is assumed that the firms that receive support suffer from some form of market failure, there is little or no research on whether this in fact is the case, and whether the associated constraints represent the underlying motivation a firm has for applying for the tax-credits.

Motivation can be understood as a construct of needs or desires, coupled with an expected reward, which in turn are conditioned by the internal and external influences a firm operates under. With this definition, “motivation to apply” could provide important insights as to why firms respond so differently to tax-incentives, but a more nuanced theoretical framework is necessary to understand how the different conditions vary, and to investigate how they influence firm behaviour.

Relatedly, a second important limitation is that most studies in the literature have focused on input- and output additionality, since these effects are more readily measurable through quantitative and econometric analysis and are directly related to the neo-classical market failure rationale. Only a few have instead looked at the behavioural additionality effect a firm experience, and the ones that have are usually strictly delimited. By behavioural additionality I refer to the “persistent” change to a firm’s strategies and capabilities, which result from the new knowledge introduced as an effect of the public support.

## **4.2 Knowledge and heterogeneity**

If innovation is to be understood as the creation, use and diffusion of knowledge, the ability of the firm to learn constitute a cornerstone of innovation. Teece (2000) highlights the distinction between information (“content”) and knowledge (“context”); *“Knowledgeable people and organizations can frame problems and select, integrate and augment information to create understandings and answers”* (Teece, 2000, pp. 40). Thus, acquiring information is not the same as acquiring knowledge. Sometimes knowledge needs to be bundled or embedded in products in order for firms to capitalise on it, but knowledge in the shape of competence and skills are just as valuable. Furthermore, knowledge can have different attributes, and often the transfer cost of knowledge can be high. As such, knowledge can be

considered a complex, but crucial economic asset. An asset that actually increases in value the more it is used, granted that the use does not place the same knowledge in the hands of competitors. The development of new knowledge can also make old knowledge obsolete, and with the increasing rate of technological change, firms are increasingly exposed to this type of “moral depreciation” of their intellectual capital (Lundvall and Johnson, 1994; Lundvall, 2004; OECD, 2004).

As mentioned in chapter 2.3, the emergence of *knowledge intensive network-based* firms was a response to the rapid development of information- and communication technology, but was also “pushed” by the low cost associated with flexible specialisation, as opposed to the more rigid organisation associated with economies of scale. A third phenomenon that conditioned this response was the increasing need for firms to continuously develop incremental innovations, in order to survive (Lundvall and Johnson, 1994). According to the OECD (2004) the firms involved directly with the production and sale of knowledge constitute one of the fastest growing sectors in the OECD countries. This, together with the broad increase in demand for skilled labour, has led this new economy to be dubbed the “knowledge economy” (OECD, 1996; OECD, 2004).

For a long time there has been a bias towards treating knowledge as a scientific or technical outcome of a linear process that begins with formal R&D. This has led to a correspondingly biased attention from evaluators and policy makers, which have concentrated their energy on measuring and improving formal R&D. Several dimensions of knowledge have in this way been neglected (Jensen et al., 2007).

Lundvall and Johnson (1994, pp. 27-28) distinguished between four different types of knowledge that all are combined in the process of innovation. Considering that the way to learn a specific type of knowledge varies across different mechanisms and channels, this categorisation provides a useful framework for understanding innovation. *Know-what* relates to what can typically be considered facts. *Know-why* concerns natural and social principles and “laws of motion”. *Know-how* refers to the skills needed to do something. Finally, *know-who* pertains the social network and trust necessary to find out who knows what, and what to do (Lundvall and Johnson, 1994; Jensen et al., 2007).

The transfer of knowledge is important for innovation, and these four types of knowledge differ in terms of how tacit, or “sticky” they are. The concept of “tacit knowledge” was introduced by Polanyi (1966) and refers to the fact that not all knowledge can be articulated or be satisfactorily described and can only be captured fully through repeated practice in the appropriate context. Very little knowledge is completely public or completely private, as even explicitly codified knowledge have to be identified through search, and often cannot be fully understood out of context. *Know-what* and *know-why* can potentially have a very transferable character, as *know-what* can be stored and accessed in various databases, and a lot of *know-why* can be made publicly available in the form of theorems. *Know-how* and *know-who*, on the other hand, can only be documented to a certain degree, as it is difficult to separate the necessary set of skills and competence from a person that performs the specific function (Lundvall and Johnson, 1994; Lundvall, 2004).

Lundvall (2004) mentions that it can be useful to distinguish between “tacit” for the lack of incentives to codify, and “tacit” by nature. From a social perspective codification is desirable, as it enhance the degree to which knowledge can be disseminated. However, even though a piece of knowledge can be codified does not imply that the firm will want to make it explicit. Besides making the knowledge more manageable within the firm, the process also opens up for the possibility that competitors get access to the knowledge.

These different types of knowledge have to be learned in different ways, and Jensen et al. (Jensen et al., 2007, pp. 680) proposed two different modes of learning that correspond with the types of knowledge. The “*science, technology & innovation*” (STI) mode produce highly codified know-what and know-why, while the *doing, using & interacting* (DUI) mode is focused on the experience-based creation of know-how and know-who. The STI approach usually involves formal processes of R&D, either at the basic or applied level. The DUI mode focus more on the learning outcomes that can be attained from informal interaction, either with other knowledgeable people, or with knowledge embodied in products, like machinery and equipment. There is a long tradition for considering innovation purely as a result of STI learning processes, but more recent conceptions peg innovation as a more interactive process involving both internal and external sources of knowledge, placing emphasis on both STI and DUI modes (Lundvall, 2004; Jensen et al., 2007).

Learning can be both intentional as a result of costly and targeted search and it can be a by-product of regular operations, but various types of learning are usually interrelated. These capabilities will gradually develop with experience. Furthermore, the cumulative traits of knowledge and learning, can lead to path-dependency, in which knowledge production follow certain trajectories (Lundvall and Johnson, 1994; Lundvall, 2004; Malerba, 1992).

The differences between the four types of knowledge have to some researchers suggested that there may be significant variation between different sectors' knowledge base. Certain opportunities and constraints associated with the technologies a firm is working with, and both the learning mode and outcome of innovation can be expected to follow particular technological trajectories. These differences are mirrored in the various innovation modes and outcomes, and several contributions have been made to explain these sectoral patterns systematically. A seminal contribution in this respect is Pavitt's (1984) taxonomy, where he by comparing the sources of knowledge with the nature of the technology produced, identifies four specific groups of firms and sectors. Castellacci (2008) further developed this taxonomy, and found that particular innovation modes were concentrated in specific sectoral groups. Jensen et al. (2007) also found that typical low-tech firms and firms in the service industries were less involved with STI-modes of learning (Dosi, 1988; Lundvall and Johnson, 1994; Lundvall, 2004; Malerba, 1992).

Jensen et al. (2007, pp. 690) indicated that firms that focused exclusively on formal STI mode learning would miss out on valuable gains from the DUI focused learning, and that strategic measures can be taken to facilitate DUI learning by adapting appropriate routines and the organisational structures. With the rapid development of technologies and increased access to knowledge, it is exceedingly important for firms to be able to navigate through the plethora of available knowledge. Firms have always managed knowledge, though perhaps without defining it as such, but today the need for a clear and strategic management to meet the challenges of the knowledge-economy is paramount (OECD, 2004).

According to the OECD (2004) knowledge management not only has a positive effect on innovation, but also on other activities in the firm, such as labour productivity. The widespread adoption of knowledge management practices have been strongest in high- and medium-high tech industries and is also more pronounced in large firms. With the positive effects, and this skewed uptake in mind, they argue that some of the variation between OECD

country performance and productivity might be explained by a “knowledge management gap”.

#### **4.2.1 Dynamic capabilities and corporate learning**

In order to stay ahead in the new knowledge economy Teece (2000) argues that firms must strengthen their processes for accumulating, shielding, transferring and integrating knowledge, and in order to efficiently manage knowledge a firm needs certain dynamic capabilities in place.

The concept of dynamic capabilities was developed by Teece et al. (1994, 1997) with the goal of better explaining how competitive advantage is attained and maintained. There are several different conceptualisations and interpretations of dynamic capabilities (Stefano et al., 2010), but it is part of the strategic management literature, and with its focus on the effective exploitation of firm resources it is considered a contribution to the resource-based view (RBV) of the firm.

The RBV sees firms as heterogeneous bundles of resources (tangible or intangible inputs to production) and has focused on the competitive advantages that can be obtained by effectively exploiting these firm-specific resources, i.e., by aligning complementary activity systems with firm-specific resources (Eisenhardt and Martin, 2000). However, Teece and Pisano (1994, pp. 538) argue that effective exploitation of resources, by itself, does not lead to competitive advantages, and the “dynamic capabilities” view contribute to the resource-based perspective on accumulation of resources, by adding the dimension of “timely and appropriate response to the changing environment”.

The concept is concerned with strategic management response to shifts in the environment the firm is situated in. Teece and Pisano (1994) suggest that the firm’s current practice, or routines (processes), its innate resource endowment (position) and the strategic alternatives available (paths) define this strategic dimension. The capabilities of the firm constitute its processes and position, and by “*appropriately adapting, integrating, and reconfiguring internal and external organisational skills, resources, and functional components toward changing environments*” (Teece and Pisano, 1994, pp. 541) firms can develop and maintain competitive advantages. It is, however, only by affecting operational capabilities (e.g.

workflow automation or supply chain management) that the dynamic capabilities can contribute to the output of the firm (Helfat and Peteraf, 2003).

In order to create and maintain an advantage over competitors firms endeavour to sense and act upon opportunities, and develop appropriate capabilities faster than their rivals. The dynamic capabilities should be constructed from “difficult-to-replicate non-tradable assets” in order to defend the edge it represents (Fosfuri and Tribó, 2008; Teece, 2000). Knowledge assets are crucial towards this end, and according to Sauuila and Ukko (2014) dynamic capabilities mainly consist of such intangibles.

The environment the firm is situated in affects the potential strategic paths a firm can take, and their relative attractiveness. Among these factors, Teece (2000, 2007) calls attention to the strength of the appropriability regime, the phase of industrial and technological development, the degree of regulation, and the firm’s relative position to competitors regarding complementary assets. These factors affect the potential premium associated with knowledge management and dynamic capabilities.

Since capabilities cannot be bought in the marketplace, they have to be built, or learned, inside the firm (Teece and Pisano, 1994). Since many of the organisational routines are based on tacit knowledge, Nelson and Winter (1982) understood that experience-based learning accounted for many of the changes in organisational routines. Since tacit knowledge and capabilities are “stored” in routines, we can consider routines a main unit of analysis for change in firm behaviour. The different experiences with new knowledge introduced through the policy intervention, and the varying ability to learn from these, will be highly heterogeneous. Antonioli and Marzucchi (2012, pp. 132) refer to a few empirical studies where differing patterns of behavioural additionality have been identified across different sectors, innovation categories, and firm sizes. This implies that much of the strategy and capability diversity stem from path-dependency, and reflect unique circumstances that have led the different firms towards certain routines.

Determined by its processes and position, the development and evolution of dynamic capabilities can thus to a large degree be said to depend on a firms cumulative experience and learning processes, both targeted and arbitrary (Fosfuri and Tribó, 2008). Eisenhardt and Martin (2000, pp. 1114-1115) point out that codifying the experiences of both failures and



successes improves the adoption of that knowledge into more regular practice, or routines. They also argue that the pacing of the experience has an impact on the ability to learn from them.

It is necessary to consider the dimension of time in order to say anything about how competitive advantages are obtained. As pointed out by Zahra and George (2002), “when” a firm develops a capability will affect whether it will contribute towards a competitive advantage. They point out that as industries or technologies mature dominant designs often appear. Nelson (1991) refers to this as extinguishing of strategic diversity. In order to gain comparative advantage from a capability it must thus be deployed well in advance of its competitors, and the position must be defended.

A capability will usually go through many transformations before it actually may provide any advantage. Helfat and Peteraf (2003) introduced the concept of capability lifecycles in an attempt to characterise the evolution of a capability. They suggest that after the initial founding, development and maturity stages, capabilities can branch into retirement, retrenchment, renewal, recombination, replication, redeployment, or a combination of these. Branching is initiated either to seize opportunities for growth or change, or in response to threats that could render the capability obsolete. The opportunities or threats can come from inside or outside the firm, and must be strong enough to induce an alteration of the current trajectory (Helfat and Peteraf, 2003).

Branzei and Vertinsky (2006) use this concept of capability lifecycles together with Zahra and Georges (2002) concept of pay-off schedules to develop a typology of capabilities, to assist strategic management. They believe that by making strategic learning efforts in the direction of capabilities that present immediate pay-offs, inexperienced and resource constrained firms can quickly improve their situation.

When it comes to innovation centric capabilities most of the existing studies have only focused on one or two aspects. Through a literary review, survey and accompanying factor analysis Sauuila and Ukko (2014) identify seven aspects of “innovation capability” that firms should be attentive to. They discovered that a participatory leadership-culture was especially conducive to innovation. In addition they recognise ideation and organising structures, work

climate and well-being, know-how development, regeneration, external knowledge, and individual activity, as important focus areas.

### 4.3 Inter-sectoral heterogeneity

When it comes to analysing the effects of R&D policy on firms' innovation, a first relevant dimension to investigate is the existence and extent of differences across sectors. Both theoretical contributions and empirical studies support the idea that different industries have very different ways of innovating, and that this is related to differences in knowledge base, which actors are involved and the relationship between them, and the relevant institutions that affect innovation (Castellacci, 2008). Furthermore, the maturity of an industry will affect the competitive environment, e.g. through new-firm formation and the degree of a dominant design. Together, these influences constitute particular conditions that are associated with different incentive structures for engaging in R&D.

The premise of heterogeneity in evolutionary theory can explain much of the different innovation patterns between sectors. Knowledge production and learning processes are essential in explaining change, and heterogeneous agents with bounded rationality will have different ways of utilising different knowledge bases, and for different reasons. Under uncertain conditions and in a dynamic environment these different characteristics will work to maintain these heterogeneities, and contribute to the creation of variety (Malerba, 2005).

Sectors vary in several respects: industries do for instance rely on different *knowledge bases with differing characteristics*. The knowledge underlying the technology of one sector may for instance be more or less tacit, specific or complimentary, than the knowledge associated with another technology. *Technological opportunity* available under a given technological paradigm is another related element that varies. The higher the opportunity for innovation is, the higher the incentive to invest in R&D. Another factor is the *appropriability conditions* available to an industry. Here, firms in sectors with high appropriability conditions should be disposed towards investing in innovation. If the knowledge has *cumulative properties*, companies that have previously invested in innovation are expected to gain relatively more from additional investment than newly innovating companies (Malerba, 2005).

Another dimension is the industry's position in the vertical production chain; whether the sector is a supplier or producer of knowledge and technology, in the economy as a whole. Pavitt's (1984) taxonomy took account of this by looking at a sector's source of innovation, and its appropriating mechanisms. He identified four types of sectoral patterns: Supplier-dominated, scale-intensive sectors, specialised suppliers, and science-based sectors. The earlier in the production chain a new knowledge or technology is introduced, the larger the spillover effect becomes. This will in turn increase the social value as the knowledge is reused to produce new knowledge.

Castellacci (2008) builds on the above-mentioned traits and concepts, when he introduces a taxonomy that includes both manufacturing and service industries. By using the two concepts of "dominant regime and trajectory", and function in the vertical production chain as either provider or recipient of knowledge, he divides industries into four sectoral groups: (i) Advanced knowledge providers, (ii) mass production goods, (iii) supporting infrastructural services, and (iv) personal goods and services.

(i) The group of "*advanced knowledge providers*" (AKP) includes specialised suppliers within manufacturing, and providers of solutions and knowledge in services. Most often built up of SMEs, this group is highly capable of creating complex knowledge and represent the supporting knowledge base of the entire economy. The knowledge they produce is often developed in close cooperation with their users and customers.

(ii) Industries that are scale-intensive and / or science based are labelled "*mass-production goods*" (MPG). This group of industries usually have a large degree of in-house R&D, and usually consists of large companies. These sectors are still quite early in the value chain and embed knowledge in intermediate goods. In a sense they act as carriers of the technological paradigm.

(iii) So-called "*supporting infrastructural services*" (SIS) have a more limited ability to do in-house R&D, and attain a good portion of their new knowledge through acquisition of machinery and equipment. The group is made up of large firms that provide physical and distributive infrastructural services, as well as network infrastructure services. These services produced in these sectors are important for the diffusion of knowledge in the economy.

(iv) The last group of industries, “*producers of personal goods and services*” (PGS), mainly consist of SMEs that deliver consumer ready goods and services. The companies in these sectors are at the end of the knowledge production value chain, and usually rely on technology developed elsewhere. Traditionally there is very little internal R&D activity in this group (Castellacci, 2008; Castellacci, 2010).

As some sectors can be seen as presenting more opportunities, less complexity and associated risk, better appropriability conditions, and higher cumulativeness, it seems clear that certain sectors benefit more from their R&D efforts than others, in terms of returns on investment relative to value added. This is in line with the patterns that emerge from the aforementioned taxonomies, which show that it is much more likely to find firms engaged with R&D in AKP and MPG sectors, than in the SIS and PGS groups. Sectors in the “physical infrastructure” leg of SIS, and in the PGS group may be highly innovative, but traditionally they rely on other modes of innovation than formal R&D.

#### **4.4 Intra-sectoral heterogeneity**

Although firm-level heterogeneity is an important aspect underpinning the variety-selection process, the “sectoral innovation system” and “technological regime” literature has to a large degree portrayed firm behaviour as industry-specific (Drejer and Leiponen, 2007).

There are at least three different perspectives on innovation that can be used to emphasise the importance of firm-level heterogeneity, and which may have relevance to investigate firms’ heterogeneous response to R&D policy schemes. The bounded rationality of firms, postulated in evolutionary economic theory, imposes restrictions on firms’ search for threats and opportunities, and their perception of potential value. The resulting “localised” search could possibly explain the different strategies observed. The dynamic capabilities perspective explains differences among firms as a deliberate attempt to achieve competitive advantage, and these capabilities are also expected to vary based on innate differences in knowledge and experience (Drejer and Leiponen, 2007).

In their study, Drejer and Leiponen (2007) do not deny that external factors, such as technological and commercial opportunities and constraints, can have an effect, but they

stress that industries are far from homogeneous when it comes to the innovation mode of firms. They find that multiple modes of innovation can be identified within most industries, and only a minority of the industries observed displayed a dominant regime. This intra-sectoral heterogeneity was consistent across high- and low-tech, and manufacturing- and service sectors. They conclude that, in terms on innovation behaviour, firms within the same industry cannot be treated as a homogeneous group, and suggest that *“firms’ strategic differentiation or local search activities overcome pressures in the technological environment towards homogeneous behaviour”* (Drejer and Leiponen, 2007, pp. 1221).

By excluding local search in “rugged landscapes” as a likely cause, they suggest that the observed firm-level variation is a result of deliberate strategic differentiation and their initial resource and capability endowment. Wrapping up their concluding remarks they also point out that the description of innovation behavioural patterns offered by Pavitt’s taxonomy seems to describe firm-level differences, instead of industry-level regimes.

Similar findings have been made by Peneder (2010) and Clausen (2013), but they look at slightly different aspects, and they find that both firm-level and industry-level factors contribute to heterogeneity. By focusing on the firm-level distribution of different innovation modes within industries, instead of looking at average behaviour at the industry-level, Peneder (2010) found the firms in the same industry constitute a huge variety of innovation types, but he was at the same time able to identify systematic differences between distinct technological regimes. He argues that heterogeneity in innovation behaviour is produced by both firm- and industry-level factors. These factors are interrelated, and contingent on the firms’ ability to match the competitive environment imposed by the technological, social and economic influences with appropriate strategy and structure (Peneder, 2010).

In his recent work, Clausen (2013) looked at the extent to which approaches to, and outcome of, innovation differed between firms in the same industry. His findings suggest that when it comes to firms’ perception of their opportunities and constraints, and their search for these, “technological regimes” have a limited influence. However, he did find that technology does impose boundaries on what a firm actually can create – In his own words:

*“... ‘technological regimes’ (Malerba and Orsenigo 1996; Breschi, Malerba, and Orsenigo 2000), ‘sectoral patterns of technical change’ (Pavitt 1984) and ‘sectoral innovation systems’*

*(Malerba 2005) have an influence on the organisational capacity to innovate, especially when it comes to product innovation” (Clausen, 2013, pp. 536).*

These results have implications for the theoretical development, as “technological regime” and “resource-based” theorising appears to complement each other, as well as for policy design, where the assumption that industries consist of homogeneous actors should be questioned.

## 4.5 Hypotheses

The theories presented in this chapter underline the need for a more nuanced approach to R&D policy evaluation that acknowledges that the characteristics of different types of knowledge and learning lead to heterogeneous firm behaviour. In order to explain why Norwegian firms respond so differently to the SkatteFUNN scheme, this thesis focuses on two relevant aspects: the first is how and why firms’ motivation for applying to the R&D tax incentives scheme varies among sectors, as well as among firms; the second is the extent to which firms that benefit from tax incentives schemes such as the SkatteFUNN experience markedly different behavioural additionality effects.

First, in order to explain how the motivation varies, it is necessary to identify a variable that may function as a good proxy for the concept of heterogeneity. The latter is in fact a broad and encompassing concept, as noted in the previous sections, and it is then important to point out the specific aspect of heterogeneity that this thesis will focus on (while disregarding other potentially important aspects). To gauge the appropriateness of a R&D policy it seems reasonable to distinguish the companies that apply to the SkatteFUNN program on the basis of their previous experience with R&D, namely to distinguish between *R&D-experienced firms* (i.e. companies that have already carried out R&D projects in the past at the moment of applying for SkatteFUNN support), and non-R&D-experienced firms (i.e. new innovators that apply for the first time to the scheme). In other words, we can use the level of *experience with R&D* as a proxy to take into account the different capabilities and knowledge resources that distinguishes established and persistent innovators from new and less experienced innovators. Based on the literature summarised in the previous sections, it is likely that firms with no prior R&D experience have yet to develop formal R&D capabilities, or are likely to

be subject to financial constraints and lack funding to invest in R&D. Furthermore, it is reasonable to expect that non-R&D experienced firms will be overrepresented in industries that mainly are recipients of advanced knowledge (e.g. personal goods and service providers), and that their innovation efforts, if any, have been based on the DUI mode of learning rather than formal R&D investments.

By focusing on this dimension as a sort of main explanatory factor, we can point out two general hypotheses, one referring to firms' motivation to apply to tax deduction schemes, and the other on the behavioural additionality effects that different companies will experience.

The first hypothesis intends to test how R&D experience affects the motivation to apply for SkatteFUNN tax-credits, i.e., how this motivation differs between established innovators and new R&D performers:

### **Hypothesis 1:**

*R&D experienced firms, which have already developed formal R&D capabilities in the past, are more likely to apply to SkatteFUNN in order to reduce the costs of their R&D projects or to expand their scale.*

*Non-R&D experienced firms, on the other hand, are more likely to apply for SkatteFUNN in order to secure the necessary funds they need to cover sunk costs and start investing in R&D.*

The second hypothesis shifts the focus on behavioural additionality, and it has thus a more dynamic character than the first hypothesis. As defined above, by behavioural additionality I refer to the persistent changes in a given firm's technological and managerial capabilities brought by the participation in a R&D support programme. The increased capability that a company develops thanks to the R&D support will, among other things, also affect and shape its motivation to apply to other R&D programmes in the future, since it is reasonable to expect that a new innovator, after having carried out R&D for the first time and made the necessary investments in R&D facilities, will become more interested and prone to continue to invest in R&D in the future and hence participate again in R&D incentive programmes, such as SkatteFUNN.

Comparing again the group of established innovators with previous R&D experience and the group of new innovators without prior R&D experience, it is not easy to formulate an *ex-ante* hypothesis on whether the behavioural additionality effects will be stronger for the first or for the latter group. On the one hand, R&D experienced firms can draw upon their stock of existing knowledge and capabilities and build upon their previous experience, resources and results – so we may expect them to experience learning by doing and cumulativeness effects over time. On the other hand, however, non-experienced firms might also be expected to experience the strongest behavioural additionality effects, since they start from a lower capability level, and therefore have more to learn and a larger catch-up potential and scope for imitation. Hence, instead of formulating one single proposition, I think it is more appropriate to point out two opposing propositions that should be verified and investigated on the basis of the empirical evidence in the specific Norwegian context:

**Hypothesis 2a:**

*R&D experienced firms will experience stronger behavioural additionality effects, as the public support will build upon their previous knowledge, capabilities and resources.*

**Hypothesis 2b:**

*Non-R&D experienced firms will experience stronger behavioural additionality effects, since they have more potential to learn and bigger scope to catch-up.*

As described in the next chapter, the thesis will investigate the relevance of these two hypotheses by making use of qualitative methods of research and carrying out a large number of in-depth face-to-face interviews with Norwegian companies that have carried out SkatteFUNN-funded R&D projects during the last few years.



# 5 Data and methodology

In this chapter, I will explain some of the choices I have made regarding data and methodology, and I will clarify how I selected, collected and analysed the data. This is done with the intention of assessing the validity of the research, and by providing the reader with transparency to strengthen the reliability of my findings. I will begin this chapter by discussing the qualitative case study approach and the appropriateness of this methodology. Then I will move on to the selection of my samples and presentation of the cases. The data collection section describes the methods and processes of gathering data. Towards the end of the chapter, I will present the process of analysis, before I discuss validity-, reliability- and ethical issues in the final section.

## 5.1 Case study framework

The nature of my research question guided my choice of method and since I sought to understand “how” and “why” the firms respond differently, I decided a comparative case study would be well suited for my needs. By structuring my research around the study of a few cases I was able to do an in-depth examination of the phenomenon in question (variation in firms’ responses to SkatteFUNN) and how various contextual influences might explain the observed variance. By comparing cases I aimed at identifying patterns of differences and similarities, and to ascribe some of these to specific contextual influence (Baxter, 2010; Ragin and Amoroso, 2011; Yin, 2009). To the best of my knowledge there exists very little qualitative research on policy evaluation, thus this thesis represents an important novelty, by contributing with deep data analysis.

Within a case study framework it is possible to apply several methods at once, both qualitative and quantitative, and although I have used a survey to complement my interview data, my primary data is based on qualitative approaches (Punch, 2005). Thagaard (2009, pp. 17-18) points out that qualitative methods are more apt for deep and context aware research of social phenomena, and in order to obtain detailed insight into the respondents’ thoughts and experience with SkatteFUNN, I chose to conduct interviews with representatives from each firm. Even though the focus of the interviews was chosen through a thorough and

critical review of relevant theory and empirical data, the flexible attributes of this method allowed for an exploratory element. Initial findings revealed new topics and dimensions that called for a closer examination, and I chose to follow this up with a more structured and restrictive survey.

The natural progression of the thesis might indicate a linear research design, but the process has been dynamic and evolved over several cycles, as new theory and data has been introduced. Nonetheless, it has been important for me to work with a model for the research in order to stay rational and critical in my pursuit of answering the research question.

Based on the relevant theories and empirical evidence I developed my research question with the intention of contributing to our understanding of tax-credits as a policy instrument. The focus of the research question and the deductive nature of my thesis made a comparative case study a well-suited approach.

## **5.2 Sources of data**

### **5.2.1 Selection of cases**

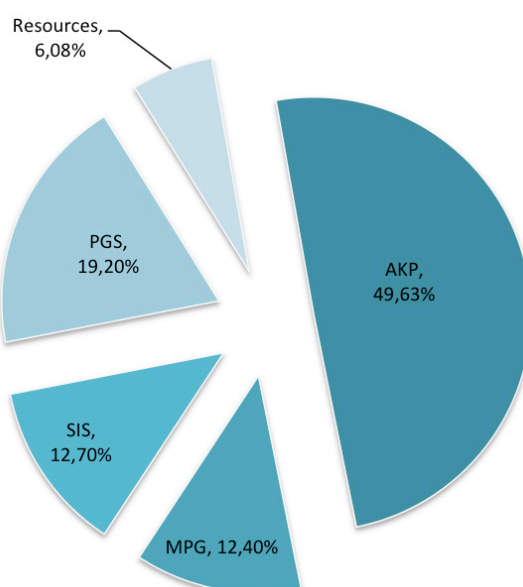
I considered all firms that had concluded SkatteFUNN projects within the last 5 years as relevant for the study. In my attempt to say something about the variation in firms' response to the tax-credit, I made a purposive quota sampling of my cases (Punch, 2005; Thagaard, 2009) through a two-step process.

First, I generated a random sample of 150 firms from the total population of firms with approved SkatteFUNN projects. The data on the total population of SkatteFUNN projects was kindly provided by the Norwegian Research Council. Table 1 and figure 1 show the population of new projects approved between 2011 and 2013, for all manufacturing and service sectors. The sectoral groups adopted here are the same pointed out in the previous chapter in relation to Castellacci's (2008) taxonomy (see section 4.3 in the previous chapter). A description of the correspondence between NACE sectors and the sectoral groups of this taxonomy is available in Appendix C.

Table 1. Sectoral group distribution of new SkatteFUNN projects, 2011-2013

	2011	2012	2013	2011-2013
<b>AKP</b>	49,5 %	50,9 %	48,7 %	49,6 %
<b>MPG</b>	12,9 %	13,5 %	11,1 %	12,4 %
<b>SIS</b>	11,4 %	12,5 %	13,7 %	12,7 %
<b>PGS</b>	18,6 %	17,8 %	20,8 %	19,2 %
<b>Resources</b>	7,5 %	5,4 %	5,6 %	6,1 %
<b>SUM</b>	100 %	100 %	100 %	100 %

Figure 1. Average sectoral group distribution of new SkatteFUNN projects, 2011-2013



The second step of the data collection process was to select a random sample of firms from this population according to three selection criteria: (i) the sectoral group to which each firm belongs, (ii) level of R&D experience (experienced vs. non-experienced firms), and (iii) firm size (large vs. SMEs). These criteria reflect the theoretical assumptions underpinning the research question. The high level of variety between cases is based on the most different design approach, and it was chosen in order to analyse variation in light of specific contextual influences. I aimed at focusing on a relatively large sample of around 20 cases (firms), in order to meet the selection criteria and also to improve the foundation of the analysis. In fact, according to Ragin and Amoroso (2011), analysis based on theoretical sampling improves with the number of observations of the specific phenomenon.

Although a few firms did not respond to my invitations, I eventually managed to get in contact with 20 firms that agreed to participate in the interview and also respond to the survey questionnaire. The distribution of these companies according to the three criteria noted above satisfactorily resembles the overall characteristics of the population of SkatteFUNN projects (see table 1 and figure 1 above). My final sample of selected case studies consists of 6 firms in the AKP sectoral group, 4 in the MPG, 3 in the SIS and 7 in the PGS types of sectors (each with 1 large firm). The latter group is slightly overrepresented in my sample as compared to the population. This was in order to attain a better balance between experienced (12 cases) and non-experienced (8 cases) R&D performers. I will discuss my findings with caution since they are not intended to be representative of the whole economy, but rather selected case studies intending to provide new insights on firms' response to SkatteFUNN .

### **5.2.2 Access to data**

Gaining access to the firms proved to be a challenging task. Not only was it time-consuming to identify firms that could be qualified as representative in my study, but also identifying the key respondent within the firm and establishing contact with that person was often difficult. Issues with gaining access to the case and informants are not uncommon, and are discussed in the literature (Thagaard, 2009).

I relied on web-searches to locate both relevant firms and the respondents. After combing through examples of successful projects on official NFR websites<sup>6</sup>, I began a more targeted search, using the Google search engine to look for various combinations of “industries” and “+skattefunn”. Quite a few firms mention SkatteFUNN project approval on their company website newsfeed or annual reports. Others were identified in online industry publications and municipal reports on R&D.

I expected firms to be a bit wary, since the phenomenon I am interested in is tax-related and can be considered a sensitive topic, so I took precautions to underline my purely academic interest. I feared that by contacting these firms from a private e-mail provider like g-mail, my request could easily have been halted in a spam filter, or been considered “less than serious”.

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<sup>6</sup> E.g. [www.skattefunn.no](http://www.skattefunn.no) and [www.kunnskapsbrikker.no](http://www.kunnskapsbrikker.no)

By reaching out to the firms through my NUPI<sup>7</sup> e-mail account, I was hoping to borrow some of the institutes “gravitas” for my purposes. I contemplated asking SkatteFUNN to reach out to a selection of firms on my behalf, but after considering how an association with the program administrators could invite biased answers, I chose not to pursue this avenue.

I was often able to identify the SkatteFUNN project leaders, but when I could not reach out to them directly I called the company switchboard, or got in touch through intermediaries, usually at the front desk. As recommended in the literature I kept my initial contact short and to the point, and followed up with a more detailed introduction letter (Yin, 2009) presenting the outline of my research project and the implications of participation.

### **5.2.3 Presentation of cases**

In this section I provide a cursory presentation of the different cases. Since most of them have had several projects, and some are in the works, I will not go into project specifics. In an attempt to illustrate the outcome of the selection criteria, each case will be presented in relation to the expected conditions of their sector (following NACE<sup>8</sup> designations), as well as firm specifics such as size, main activity and R&D experience. The firms are identified to increase the reliability of the study, and to better present the result of the selection process. In the analysis the various positions and experiences will be anonymised, in order to maintain confidentiality.

The cases are presented in the same order as in table 2, arranged by sectoral group – following Castellacci’s (2008) taxonomy. The data set consists of 4 cases from the “mass production goods” (MPG) group, 3 cases from the “supporting infrastructure services” (SIS) group, 6 cases from the “advanced knowledge providers” (AKP) group and 7 from the “personal goods and services” (PGS) group.

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<sup>7</sup> NUPI stands for the Norwegian Institute of International Affairs, and is the research institute where I have been conducting my thesis work, as part of an internship.

<sup>8</sup> NACE stands for “Nomenclature statistique des Activités économiques dans la Communauté Européenne” and is a European sectoral classification. Based on the SIC2007 codes used in Norway, I have chosen to present the sectors by NACE code at the two-digit aggregation level.

Table 2. An overview of my sample

Firm	NACE code (level 5)	NACE designation (level 2)	Description	Experience with R&D prior to SF	Number of SF-projects	Sectoral group	Size (employees)	Founded
Kebony Norge AS	16.100	Manufacture of wood and of products of wood and cork, except furniture; manufacture of straw and plating materials	Development and sales of wood and curing materials for wood production.	Yes	4-6	MPG	60	1997
Nordic Mining ASA	07.290	Mining of metal ores	Exploration for coal, minerals and ores, as well as mining operations and technology development.	Yes	4-6	MPG	3	2006
Eramet Norway AS	24.102	Manufacture of basic metals	Operate smelting plants in Norway for the production and sales of alloys and other products.	Yes	1-3	MPG	625	1999
Henriksen Mekaniske AS	25.110	Manufacture of fabricated metal products, except machinery and equipment	Mechanical engineering of specialised equipment for ships and boats.	Yes	9<	MPG	44	1997
Ansur Technologies AS	61.900	Telecommunications	R&D, operation and sales of solutions for telecommunications and satellite communications.	No	7-9	SIS	9	2005
Telio Holding ASA	61.100	Telecommunications	R&D, operation, and sales of voice over IP networks and IP-based telephony solutions.	Yes	1-3	SIS	67	2003
Sporveien Oslo AS	45.200	Wholesale and retail trade and repair of motor vehicles and motorcycles	Focus on understanding passenger transport.	No	1-3	SIS	749	1924
Posicom AS	62.010	Computer programming activities	Development, production and sale of information and communications systems	Yes	4-6	AKP	41	2000
Catenda AS	72.190	Scientific research and development	R&D of ICT solutions for the construction sector.	Yes	1-3	AKP	9	2009
Abalonyx AS	72.190	Scientific research and development	Development and sale of chemical products, processes and services.	No	7-9	AKP	3	2005
Induct Software AS	62.010	Computer programming, consultancy and related activities	Development and sale of software solutions as well as related consultancy services.	Yes	1-3	AKP	21	2007
Beerenberg Corp. AS	33.150	Repair and installation of machinery and equipment	R&D, manufacturing, sales and maintenance of specialised supplies for the offshore sector	Yes	4-6	AKP	1388	1979
Medistim ASA	26.510	Manufacture of computer, electronic and optical products	Conducting R&D distribution and sales of medical equipment	Yes	4-6	AKP	41	1984
Lindum AS	38.320	Waste collection, treatment and disposal activities; materials recovery	Manage and sort waste, including R&D on recycling of recovered materials.	Yes	9<	PGS	69	2001
Nortura SA	10.130	Manufacture of food products	Working for a rational and efficient production, processing and marketing of carcasses, by-products of slaughter, processed goods, wool and livestock.	Yes	9<	PGS	6221	1931
Nøgne-Ø Det Kompromissløse Bryggeri AS	11.050	Manufacture of beverages	R&D, operation and sales of beverages	No	4-6	PGS	22	2002
Halvors Tradisjonsfisk AS	10.209	Manufacture of food products	Sales and processing of fish and fish products	No	4-6	PGS	8	2008
Mediehuset Nettavisen AS	58.130	Publishing activities	Operating information services	No	1-3	PGS	76	2000
Sørlandsbadet AS	56.101	Food and beverage service activities	Operating restaurant, and convenience store. Provide services and personnel leasing in connection with the operation and management	No	1-3	PGS	51	2005
XXLofoten AS	93.291	Sports activities and amusement and recreation activities	Operate activities within the tourism, conference and teaching	No	1-3	PGS	6	2005

## **Mass production goods (MPG)**

### **Kebony Norge AS**

This medium sized firm is situated in the “manufacture of wood and of products of wood and cork” sector, and has found its niche in the development of curing materials. Because of their level of production and reliance on chemical knowledge this firm shares MPG sectoral group traits. The wood and cork product sector has traditionally relied on acquisition of new knowledge, and has a low degree of cumulativeness associated with its knowledge base, but when you account for the opportunities presented by the union with chemicals, the level of R&D, as well as appropriability and cumulativeness is expected to be high. The firm did base its technology on acquired patents, but today they command their own R&D department and continuously improve and develop new products. They had already been engaged in R&D a few years before they applied for SkatteFUNN-support.

### **Nordic Mining ASA**

This is a micro firm focused on the exploration for coal, minerals and ores, as well as mining operations and technology development. The scale intensive character of the sector and traditional reliance on knowledge and technology developed elsewhere place it in the MPG group of sectors. The company has no active operations *pro tem.*, but are engaged in R&D and exploration. Since the company was founded in 2006 they have had on-going R&D. Some of this is in-house, but because of the small size of the firm they rely extensively on collaboration and contracted experts.

### **Eramet ASA**

Eramet is from another sector with MPG characteristics, namely the “manufacture of basic metals”. They operate smelting plants in Norway for the production and sales of alloys and related products. This large firm has for over a decade built up a lot of competence, and the knowledge base of the sector in general is considered to be highly cumulative. Although the firms in this sector acquire a lot of their technology from upstream knowledge providers, they often have a lot of intramural R&D activity. They have had between 1-3 SkatteFUNN-projects, and already had experience with R&D when they applied for their first.

### **Henriksen Mekaniske AS**

This firm has had very many SkatteFUNN-projects, and was also undertaking R&D before the tax-incentive was established. The NACE designation of “manufacture of fabricated metal products, except machinery and equipment”, represents another sector found in the MPG group. This medium sized firm is involved with scale intensive mechanical engineering of specialised equipment for ships and boats. Traditionally the sector shows a reliance on the acquisition of machinery and equipment, but this firm has relied mainly on intramural R&D and customer and user interaction.

### **Supporting infrastructure services (SIS)**

#### **Ansur Technologies AS**

This micro firm operate within the “telecommunications” sector and engage in R&D, operation and sales of solutions for telecom and satellite communications. This sector is representative of SIS group, and usually has a high level of in-house R&D. Furthermore, the means of appropriability employed are usually a balance of formal measures like patenting and copyrights, and the cumulativeness is considered to be high. This company has a lot experience with internal and cooperative R&D, and has a technological lead in several aspects of the industry. They applied for SkatteFUNN-support for the firm’s first R&D project, but both of the founders had extensive R&D experience from earlier endeavours.

#### **Telio Holding ASA**

Telio is a medium sized company also located in the “telecommunications” sector. However, their focus is on R&D, operation, and sales of voice over IP networks and IP-based telephony solutions. The opportunities offered by the ICT development in this area are good, and even though the sector is dependant on a lot of acquisition of external knowledge and technology, some intramural R&D is necessary to secure first mover advantage. The sector is found in the SIS category, and services from these sectors typically contribute to the dissemination of knowledge across the economy. The company has been doing R&D for over a decade, but only had a few SkatteFUNN projects.



### **Sporveien Oslo AS**

This is a large firm from the “wholesale and retail trade and repair of motor vehicles and motorcycles” sector. Their operation and R&D is both concerned with maintenance and acquisition of new technology, as well as improving their understanding of the industry and their users. The sector can be classified as a SIS industry, but is in the “physical infrastructure” sub-group, as opposed to the two “network infrastructure” cases above. The firm fits the traditional mold of the sector and place a greater emphasis on external sources of knowledge, but they have been doing some R&D, even though they didn’t classify it as such until their first SkatteFUNN project. In the sector, appropriability conditions are usually limited and the underlying knowledge is not considered very cumulative, but within the niche Sporveien is doing R&D the conditions are better.

### **Advanced knowledge providers (AKP)**

#### **Posicom AS**

Posicom is a technical solution provider in the “computer programming, consultancy and related activities” sector. This firm falls into the category of AKP, representing a group of firms that usually have a high level of technological capability. For over a decade they have developed, produced and marketed specialised information and communication systems, and have been able to diversify their product for different sectors. A typical trait for all of the AKP sectors is close cooperation with customers, and together with internal R&D, these sources of knowledge are at the top of Posicom’s list. They were engaged in R&D before they got their first SkatteFUNN project approved, but did not always define their work in that way.

#### **Catenda AS**

Established in 2009, Catenda is a small SINTEF spinoff in the “scientific research and development” sector. This NACE designation encompasses a broad variety of technologies, but this firm is mainly concerned with R&D of ICT solutions for the construction sector. The coupling of ICT with construction presents a high level of technological opportunities, and with a cumulative knowledge base and good appropriability condition the propensity to do R&D is high. This case shares the conditions of other AKP sectors. Their employees are almost exclusively researchers with prior experience and knowledge of the field, and in some

areas the firm is pushing the international knowledge frontier. The firm had R&D experience before they applied to SkatteFUNN.

### **Abalonyx AS**

This firm is also part of the “scientific research and development” sector, but focuses on the development of graphene products and processes. This is a micro-firm that focuses on improving existing processes in order to produce new and improved products.

Nanotechnology is still a very undeveloped field and is considered a high opportunity area in the literature. Furthermore, innovation in this field can be said to require R&D activity, as production at this stage is inseparable from laboratory activity. This firm had no R&D activity prior to their first SkatteFUNN project since that was the same year they started up, but the founder and small staff all had extensive R&D backgrounds. This firm can also be found in the AKP category, and is characterised by high cumulateness and strategic means of appropriation, (i.e. a mix of secrecy and complexity of design).

### **Induct Software AS**

Classified by NACE level 2 as situated in “computer programming, consultancy and related activities”, this company is another AKP type firm that advance the supporting knowledge base of other sectors. They develop and consult on their own methodology, embodied in a process oriented software solution. The ICT sector in general is traditionally characterised by high R&D intensity, good technological opportunities, and high cumulateness. This firm have only had a few SkatteFUNN projects, but had extensive R&D experience before those. The most common approach to appropriation of intellectual property is strategic mix. In addition to ICT, this small firm relies on in-depth knowledge of the processes they advise on through their methodology, and have affiliations to world-renowned experts.

### **Beerenberg Corp. AS**

This large firm has built its experience over a long period of time. It falls in under the “repair and installation of machinery and equipment” definition, and represent the AKP-M category. They have a long tradition of manufacturing, sales and maintenance of specialised supplies for the offshore sector, and began their R&D activity long before their first SkatteFUNN project. The high demand for technologically diverse specialised supplies offer a lot of opportunities, and the technical knowledge base required is considered highly cumulative. For this sector the use of patenting is a prevalent method of appropriability. As with the

AKP-S group, firms in the AKP-M category traditionally rely extensively on R&D in their innovative efforts.

### **Medistim ASA**

This final advanced knowledge provider is conducting R&D, distribution and sales of medical equipment. The “manufacture of computer, electronic and optical products” designation, together with the technologies they are involved with, place them in the AKP group of sectors. With several decades of experience, this firm has extensive technological capabilities, and is in fact a world leader in some niches. The firm had extensive experience prior to their first SkatteFUNN project. High levels of reinvestment of turnover in R&D, extensive use of patenting and a high degree of cumulativeness are typical in this sector.

### **Personal goods and services (PGS)**

#### **Lindum AS**

This case is built around a medium sized firm in the business of waste management. Lindum engages in R&D on recycling of recovered materials, and the sectoral designation of “Waste collection, treatment and disposal activities; materials recovery” place the firm in the PGS group of sectors. The sector has traditionally portrayed a low innovation activity, and the knowledge base of the sector is considered to have limited cumulativeness. Nonetheless, this firm was doing R&D even before they got SkatteFUNN support, and have their own R&D department with a diverse portfolio of projects. They see a lot of technological opportunities as virgin material becomes increasingly scarce.

#### **Nortura SA**

This large firm is situated in the “manufacture of food products“ sector, and belongs in the PGS group. These close-to-the-market sectors usually rely on the acquisition of knowledge through machinery and equipment. In this specific sector the knowledge base has traditionally been considered to be of limited cumulative quality, and appropriability efforts have mainly been based on formal measures. However, this firm has a diverse knowledge base, and has measures in place to identify, manage and develop this knowledge internally. They are working for a rational and efficient production, processing and marketing of their products, throughout the value chain. This firm has been engaged in R&D for many years,

long before SkatteFUNN was established, and they have several decades of experience to draw from.

### **Nøgne-Ø Det Kompromissløse Bryggeri AS**

Concerned with the “manufacture of beverages”, this firm is also found in the PGS group, and traditionally the sector resembles the “manufacture of food products” commented on above. The firm is small, but has designated R&D personnel on staff. They had already begun their first R&D project on their own, but later got the same project approved by SkatteFUNN. In addition to conducting product related R&D, they focus on how they can adapt existing production equipment to work better with Norwegian raw materials. The sector is very mature and firms need to diversify their product in order to improve and maintain their market position. Innovation in intermediary products enables most of the opportunities in this sector.

### **Halvors Tradisjonsfisk AS**

This is another micro firm in the “manufacture of food products“ sector. The firm is engaged in sales and processing of fish and fish products. As mentioned above, this sector is part of the PGS grouping, and the propensity to engage in R&D is expected to be low. Their first R&D project was supported by SkatteFUNN, and since then they have had several new projects with support from both NFR and Innovation Norway. Through a combination of traditional and new knowledge they have made innovations in its production process, in order to meet the modern consumer. Situated in one of the largest export sectors in Norway, this young firm has successfully introduced their products in the international market.

### **Mediehuset Nettavisen AS**

This is a medium sized firm from the “publishing” sector. Their research is relatively exploratory, and is part of the blossoming field of “big data” that holds the promise of a lot of opportunities. The sector shares the characteristics of other PGS sectors, but the ICT related technology presents a bit higher propensity for internal R&D, as well as higher levels of appropriability and cumulativeness. They were partly engaged in similar projects before their first SkatteFUNN project, but did not define or understand them as R&D until they were introduced to the tax-incentive scheme.

### **Sørlandsbadet AS**

Is a medium sized firm registered in the “food and beverage service activities” sector. However, a lot of their operation is centred on recreation activities offered at their location. This is also where their R&D takes place, so the lone NACE designation is not an adequate indicator of the sectoral conditions for innovation this firm deals with. Nevertheless, both sectors are expected to provide much of the same conditions. The sector falls into the “service” arm of the PGS group, and is usually recipients of advanced knowledge. Even though opportunities, R&D intensity, appropriability means and cumulativeness are all considered to be low within the sector, Sørlandsbadet has had a successful SkatteFUNN-supported R&D project, and has applied for support for new ones.

### **XXLofoten AS**

This micro firm arrange tourism activities, conferences and seminars, and are thus located in the “sports activities, amusement and recreation activities” sector. This sector can be located in the PGS group, and is usually not active R&D performers.

What little innovation that takes place in this sector usually comes from sources external to the firm. In this case the R&D is focused on the relationship between actors within relevant sectors, and can be considered a type of organisational innovation. Their R&D efforts also began with a SkatteFUNN project.

## **5.3 Collecting the data**

In this section I will present my process of obtaining data. To prepare for the interviews, I relied on document analysis and carried out a few interviews with experts and policy-makers in Norway. The main data collection work consisted of two steps; first, I did a personal interview with each company of the selected sample noted in the previous section; secondly, I followed up these interviews with a survey that I e-mailed to the companies a few days after the interview, in order to check the reliability of their responses and refine some of the incomplete information I previously got from them. The data were collected between November 2013 and the middle of March 2014.

### **5.3.1 Preparation**

#### **Contextual interviews**

In order to incorporate a different perspective and also to provide some context, I conducted two interviews with actors influencing the users of the SkatteFUNN scheme. One was held with two representatives from the SkatteFUNN secretariat, and one with two representatives from Nofas AS, a consultancy firm specialising in enabling R&D efforts in private companies.

These interviews varied somewhat from the ones conducted with the users. They both lasted upwards of 60 minutes, and had a somewhat different structure. I wanted the conversation to cover the same topics and theoretical assumptions the users talked about, but I allowed for greater flexibility and was more willing to veer off topic. In this way the semi-structured form was less strict than for the case interviews. Since both of these actors were asked to make more complex assumptions about the contextual influences I was looking at, as well as comment on my working hypotheses, I chose to arrange my questions so that these “heavier” abstract ones were saved for last. This pyramid structure was used in combination with the funnel structure, where more sensitive questions also are reserved for the later stages of the interview (Dunn, 2010).

By prompting for examples I tried to invite these actors to provide more narrative answers that could better illustrate their points, but confidentiality considerations limited this to some degree. The insights provided were none the less valuable, and contributed to a shift in the focus of my thesis.

#### **Document analysis**

As mentioned above, I relied in part on document analysis for preparing for the interviews, and I covered sources on the various users and their projects, as well as documents pertaining to the scheme itself. I relied extensively on online sources and found my material on company websites, industry journals, the Norwegian company registry, firm analysis providers, pamphlets and annual reports.

Thagaard (2009, pp. 62) describes this process as “content analysis” of documents created for a different purpose than the research it is being used in. I followed this guideline and only

used publicly available documents, refraining from requesting more project-specific documents from the firms or the SkatteFUNN-secretariat. The information presented in the documents presents a lot of different aspects of the phenomenon under study, though not all can be considered relevant for the thesis. It did however provide a good background for the interviews by describing different opinions, settings and events, influencing the firms at different points in time (Thagaard, 2009; Yin, 2009).

The analysis I performed was limited and only intended to make me better acquainted with the conditions of the firms and their take on their own R&D projects. Since I was aware that the texts might affect my perception of the firms and that they were produced within certain contexts and for specific purposes, I tried to read them critically (Yin, 2009).

### **5.3.2 Step 1: Personal interviews**

In order to improve my understanding of the underlying conditions affecting the firms, I relied extensively on interviews with key personnel, such as General managers, R&D project managers and chief executive, technology, and financial officers. All informants had deep knowledge of their SkatteFUNN projects.

Data collection through interviews is often the primary approach in qualitative studies (Punch, 2005) and can provide valuable insight into less tangible aspects of the unit under study. Thagaard (2009) highlights the ability of interviews to capture informants' experiences, views and understanding of a phenomenon.

By learning how the informants perceived their R&D situation, what motivated them to apply, and how they experienced the R&D process, I was hoping to get a better understanding of the conditions and motives that influenced their response to the tax-incentive.

Interviews can be structured in different ways and are very malleable in the face of different research projects (Kvale, 2007). For my interviews with the firms, or users of the scheme, I chose a semi-structured approach. This meant that the accompanying interview guide would not have to be followed "verbatim". Instead I categorised primary and secondary questions by the topics I wanted to investigate. Even though the interviews were conducted in

Norwegian, the native language of all the respondents and myself, I took care to simplify the language used in my questions and provide examples where I needed to use more specific terminology. While the primary questions were meant to broach each topic, the secondary questions usually functioned as reminders for me and were occasionally used as prompts in case the conversation digressed too much off topic. Through the letter of introduction the informants had already been informed of the focus of my thesis and this helped to delimit our conversations. My approach opened up for informants to provide input on topics not pre-determined in the interview guide, and for me to follow-up these if deemed relevant. This approach did, however, lead to slight variations in the focus paid to different topics from one interview to the next. Overall, the flexibility of the semi-structured interview made possible a more natural conversation between the informant and me, improving our rapport throughout the interview (Dunn, 2010; Kvale, 2007; Punch, 2005).

Another design element aiming at improving rapport was to use a “funnel” structure for the line of questioning. By starting off with more general questions and saving the more sensitive ones for last, I tried to make the informant relaxed and comfortable. In this manner, I also attempted to get the informants to warm up by talking about their company history and R&D projects (Dunn, 2010).

I prepared myself for the interviews by familiarising myself with the interview guide and checked it for shortcomings by testing it on a fellow student and my thesis supervisor. In addition, I sought to get to know the firms beforehand through cursory analysis of various documents – a process described in more detail in the next section.

Conducting the interviews were a challenging and time consuming process. The interviews lasted for approximately 30 minutes, giving me room for 8-10 primary questions, a few follow-up questions, and some time to pursue random topics. Transcribing this took between 6-8 hours for each. I estimate that I have spent nearly a month in total, traveling to and from, conducting and transcribing the interviews but the process provided me with rich and detailed insight into my 20 cases.

In order to facilitate a favourable environment for the respondents I offered to conduct the interviews at their office or via phone. Although I preferred to conduct them face-to-face in order to better build and gauge the rapport between us, a few interviews were conducted via



phone or video calls. This was a necessary evil that allowed me to study cases all across the country. Since I was unable to interpret body language and other cues for these interviews, it was harder to develop and sustain rapport. As a consequence of this, a more formal dialogue developed, and the interviews tended to have a shorter duration.

I decided to use an audio recorder as my main tool for registering the data. By doing this I could pay better attention to the conversation, and I believe it helped me stay more critical. This was intended to improve the flow of the conversation, but I was also aware of the possibility that the informants might inhibit their responses. To counter this I assured the participants that I would keep the files secure, that I would be the only one listening to the recording and that they would be able to edit and approve the transcript. I figured that recording the interviews with my computer would be experienced as less obtrusive than having a recorder in the middle of the table. This also enabled me to record the interviews conducted by phone, as I used a VoIP software<sup>9</sup> to make the calls. I was already using my computer to reference the interview guide, and I believe this measure helped reduce any potential inhibition. The use of a recorder was mentioned in the introduction letter, and I also secured verbal permission prior to the interviews.

Several challenges of conducting interviews presented themselves along the way. Continuously checking the interview guide broke up the flow in the conversation, however, this improved after a few interviews as I internalised the questions and got a bit more confident in my role as interviewer. It also proved hard to keep to the timetable, as breaking the informant off from lengthy digressions could at times seem blunt and damage the rapport. Another issue is related to diffuse or partial answers. Here I felt it was difficult to prompt for a clear answer more than once or twice.

In retrospect I saw that, as intended, the semi-structured approach allowed different topics to be illuminated with different emphasis across the cases. This, however, presented difficulties when I began considering comparison of my initial findings. The natural conversations I so strived to achieve also entailed unique contexts for the interpretation of the questions, so some of the answers might have been given under slightly different assumptions. In order to

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<sup>9</sup> VoIP stands for “Voice over Internet Protocol” and enables voice communication over the Internet. I used the popular software “Skype” in combination with “Piezo” to make and record my calls.

secure more comparable data, where all respondents would have the same conditions for responding, I sent out a follow-up survey questionnaire.

All of the interview guides are enclosed in Appendix A.

### **5.3.3 Step 2: E-mail survey questionnaire**

In order to improve the level of comparability of the cases I decided on a more stringent method for the follow-up data collection. A survey questionnaire is defined as a quantitative method, as the focus usually is on a broader set of respondents. However, with my limited number of samples, my findings are not statistically significant, and cannot be used to generalise about the correlation between my variables; motivation, behavioural additionality, and R&D experience (Punch, 2005). It would have been interesting to perform a larger separate survey, but my findings were nonetheless useful for collaborating some findings from the interviews, and enabled me to dig deeper into selected topics of interest.

The design of the survey resembles a strictly structured interview with pre-established questions and response options. I limited the questionnaire to 13 multiple-choice questions to ensure maximum participation. The survey was hosted on an encrypted online server and was provided by a trusted service provider. The estimated time it would take to answer the survey was 5 minutes, but most respondents spent between 7-9 minutes.

The questions evolved around the theoretical assumptions that defined the topics in the interviews, but on a more focused area. The same assumptions informed the answer options with the additional influence of initial findings from the interviews.

The first few questions were of a demographic nature and focused on the firms' experience with R&D and innovation. The next 8 questions dealt with the stated goal of the R&D project, motivation for applying for public support and the level of behavioural additionality. Most of these last questions used a Likert-type scale where the respondents were asked to rate various options from low to high. In order to mitigate forced answers and self-promoting ranking most questions had an answer option equivalent to "not relevant", or "unknown". In addition to this each question had an optional comments field where the informant could elaborate their answers or register concerns with the options offered (Punch, 2005).

The questionnaire asked for information from different points in time, and I was wary of potential pitfalls with this approach, both in the design of the survey and in the analysis. Informants can have different recollection and perception of past events, they can be influenced by the actual outcomes when answering contra factual questions and have a tendency to present themselves in a more flattering light.

My informants had already agreed to answer potential follow-up questions, but I still had to prompt several of them once or twice in order to get full participation. The prompting did not have any effect on the time spent on answering the survey. By means of respondent-unique access points to the survey I was able to tie interview- and survey data together. Though most of the survey results converge with findings from the interviews there were some intra firm inconsistencies that I kept in mind when analysing the data.

The survey is presented in Appendix B.

## **5.4 Reliability, validity and ethical concerns**

During the entire research project I have strived to remain critical and reflective of my own choices and actions, and how they might affect the validity and reliability of my research. Both validity and reliability are concepts that derive from quantitative research and evaluation, and has been adapted to qualitative approaches (Punch, 2005; Thagaard, 2009). However, the gist of the concepts remains unchanged.

Some of the measures I have taken and considerations I have made have already been mentioned above, but here I will present the concepts in relation to my attempts to strengthen them throughout the thesis. I will also describe some ethical considerations that have shaped my research as some of these choices might have affected the reliability.

### **5.4.1 Validity**

The point of considering and assessing validity is to ensure that the conclusions reached are logical and have been based on the analysis of appropriate data (Punch, 2005; Thagaard, 2009). As advised in the literature (Punch, 2005, pp. 29), I considered the validity across four

dimensions; the *validity of data* prescribed that I critically selected my cases as well as what data I collected so that it reflected the phenomenon I was studying; to ensure *overall validity* I have strived to make the logic of my research sound, and easy to follow; by following logical deductions from theory and empirical data, I have worked to make the study reflect the actual phenomenon, thereby improving the *internal validity*; and in order to improve the *external validity*, or transferability of analytical generalisations, I have tried to provide a clear and structured line of argument in the analysis.

In quantitative methods the external validity refers to the generalisability of the results, but this is neither the goal of, nor possible with, qualitative data. Instead, the consideration of external validity focus on whether the analytical observations made about the applied theory can be transferred from the studied cases to similar ones (Kvale, 2007; Thagaard, 2009).

By applying several methods of collecting data for my cases I have attempted to increase the validity of the empirical results. It enabled me to compare different sources of information and identify convergences in these, on the patterns of variation between cases. Yin (2009, pp. 114-15) calls this process triangulation, and argues that this is one of the advantages of case studies. A challenge associated with this, however, is that the sources of data must address the exact same phenomenon, and failure to ensure this might affect the reliability of the research (Ragin and Amoroso, 2011). I should mention that the firms have been represented by the same informants in both the interviews and surveys, but I believe that the different methods present different settings and conditions for the informant, and thus provide grounds for triangulation.

### **5.4.2 Reliability**

Reliability of the study focus on how consistent the research is over time, and refers to how replicable the study is. This is challenging for a qualitative study where people's opinions and perceptions form the basis of analysis, but I have none the less tried to describe the steps in my research by discussing my theoretical framework and the choices and processes for selecting, gathering and analysing my data (Kvale, 2007; Yin, 2009). These efforts to make my research transparent have hopefully strengthened the reliability of this thesis.

Furthermore, I have attempted to reduce the chance for errors and bias from both the informants and myself. Above, I have already identified several of the measures pertaining to the informants, but can add that the informants approved the transcripts of the interviews with few minor adjustments and clarifications. The interview and survey questions were designed to be neutral and when I first generated the survey questionnaire the Likert-type scaled answer options were randomly ordered.

I have considered the implications of my own predispositions and interpretation of data as well as the fact that the data gathered from the informants do not necessarily reflect the exact situation of the firm, but their individual perception of it. In my interaction with the informants I tried to show my genuine interest in their projects, while still maintaining some degree of formality. This was a trade-off between the positive effect of a good rapport and the drawbacks of not being utterly objective. By keeping this in mind while organising and analysing the transcripts I believe I managed to compensate a bit where this was evident.

One element that reduced the reliability of my thesis, somewhat, is the fact that I decided to anonymise the responses in order to maintain confidentiality. More on this in the following section.

### **5.4.3 Ethical considerations**

Punch (2005, pp. 276-77) argues that, especially for qualitative research, ethical considerations should be made as the researcher is involved with real people.

Since the phenomenon under study is of a sensitive nature involving firms' attitudes to tax deduction and use of public funding, I insisted on anonymising the individual respondents and "who said what". This was done to ensure the respondents that they could answer freely without fear of placing themselves or their firms in a bad light. Unfortunately this, together with the semi-structured interviews, makes it harder for others to recreate my exact research project (Ragin and Amoroso, 2011). I made sure all informants were well informed before consenting to participation, and I believe that the implications of my research will be just as beneficial for them as for myself and academia.

Moreover, I approached the firms as a university student and even though I used my NUPI affiliation to emphasise my academic intent and qualifications I do not believe I imposed any obligation to participate through my social status. One of the reasons I did not approach the SkatteFUNN secretariat and request that they act as an intermediary was exactly to avoid any power asymmetries.

When it comes to more obvious ethical practice, pointed out by Ragin & Amoroso (2011, pp. 81), I can attest to not having concealed any findings nor produced fictional data. In addition to this, I have strived to correctly refer to the work of those I have built my own arguments upon.

## **5.5 Process of analysis**

Finding the appropriate way of analysing took a lot of time as there are many approaches and no-one is “right”. Punch (2005, pp. 194-95) points this out, and argue that it is important to guide the reader through the choices made in order to show how the conclusions were reached.

The first step of my approach was to transcribe the interviews. Since this was done within a week of conducting the interviews the analysis did in fact begin long before I turned my full attention to it. Initial findings, not covered earlier in the thesis, prompted me to make follow-up inquiries and to expand the theoretical framework.

The data were not analysed following strict methods like discourse analysis, but consisted of a more pragmatic muddle of analytical techniques, dubbed “bricolage” by Kvale (2007, pp. 115). I began organising the individual case data by coding the findings in spreadsheets and was able to categorise several codes under the topics I investigated. Out of these I focused mainly on two (“motivation” and “behavioural additionality”) that have particular relevance for my research question.

Although the focus in the data gathering was to deep-dive into single units to better understand how the tax-credit was perceived in each case, the overarching research question was focused on what could explain the variation in response between the cases. By first

looking at each case isolated from the others I tried to make sure I would not miss any interesting findings. I added the survey data to the spreadsheet and by comparing my findings across cases I could identify differences and similarities. Some of these differences seemed contingent upon contextual influence I had controlled for, and in the last stage I investigated how existing literature could explain these findings (Baxter, 2010; Ragin and Amoroso, 2011).

## 6 Results

This chapter presents the results of my comparative case study analysis. I have structured the presentation in two main sections based on my two main dependant variables, and will begin by presenting how I found *motivation to apply* to vary between the R&D experienced and non-R&D experienced cases. The next section will address the variation in *behavioural additionality* benefits from the tax-incentive scheme. I will then discuss how my findings relate to extant theory on heterogeneity and how it complements the findings from the previous evaluation done by SSB some years ago.

### 6.1 Motivation to apply

To better understand what motivated the firms to apply I used a mix of direct and indirect questions, both open (in the interview) and specified (in the survey). Both in the interview and survey questionnaire the informants were asked to recall the motivation for applying for their first, as well as their latest, SkatteFUNN projects. In the interview setting these were also accompanied by questions pertaining to the necessity and expected relevance of the R&D project and what would happen if they didn't get support. In the survey they were asked to rate nine alternatives (presented in table 3) from “not motivating” to “highly motivating”. To make the distinction very clear, I first asked about the motivation, or targets, of the project in general, before asking about the motivation for applying to the tax-incentive.

I will begin by summarising some of the main patterns emerging from the survey. As indicated above, the survey results should not be interpreted as providing representative statistical evidence, since they refer to a limited sample of companies. It is however useful to report the average of some of the questions that I asked the firms in order to give an introductory overview of the main results. I will then discuss in further detail the findings of the personal interviews carried out with the same companies.

When looking at the average ratings of all the cases, “development of new products/services/processes” stands out from the seven alternatives as the most common *goal of the projects*. However, by looking at the variance across experience with R&D, the



aggregated average only correlates with the general trend in the cases where firms had prior experience with R&D. For the non-R&D experienced cases “exploration of new opportunities” had the highest rating, and a few significant differences between the groups could be identified.

When it comes to the *motivation for applying* for their first SkatteFUNN project the total average again correlates with the average from the R&D-experienced cases, by pointing to “reduction in the cost of the project” and “expansion the scale of the project” as the main motivators. By only looking at the average for the non-R&D experienced firms it is rather “completing the project faster” and “securing necessary funds to initiate the project” that share the highest rating.

Even though controlling for R&D experience provides more nuances, these indications are still based on average patterns in a non-representative survey dataset, hence they should be interpreted with caution. To test my first hypothesis I look at the in-depth knowledge I have gained of the various cases, and compare them in order to identify more specific patterns and regularities in firms’ response to the SkatteFUNN scheme.

Table 3. Motivation for applying to SkatteFUNN

Question #8	Alternatives	R&D experienced	Non-R&D experienced	Difference
What was the motivation for applying for SkatteFUNN support, for the first SkatteFUNN project?	Reduce the cost of the project	4,50	3,67	0,83
	Expand the scale of the project	3,93	3,83	0,10
	Conduct more technologically complex R&D	3,07	3,17	-0,10
	Reduce the inherent risk	3,43	3,67	-0,24
	Complete the project faster	3,21	4,00	-0,79
	Secure necessary funds to initiate the project	3,43	4,00	-0,57
	Increase internal support for the project	1,71	3,00	-1,29
	Gain access to counseling and support	1,93	2,50	-0,57
	Benefit from potential structural conditions and/or learning effects associated with administering the SkatteFUNN project.	2,00	2,83	-0,83

### 6.1.1 Experienced R&D performers

Throughout the interviews firms with prior R&D experience emphasised cost reduction as the major motivator for applying, something the results from the survey questionnaire support. Almost every one of these cases gave this motivation the highest rating, but the focus on cutting costs was explained in different ways. For many of the cases it was a

question of priority. In some cases projects that were deemed profitable would be initiated no matter what, whereas projects that were considered interesting but which had uncertain utility were more contingent on public support in order to be fully realised.

*“We apply for funding for some of our projects, but are only dependent on support for a few of these. We consider SkatteFUNN a type of financing that enables us to pursue projects with more uncertain market value, typically projects that mainly contribute to general competence building” (Firm in the MPG group).*

*“There is no doubt that SkatteFUNN makes us more able to pursue these types of pointed projects, that cannot be directly commercially exploited, but which have a clear relevance to our exploitation of technology” (Firm in the AKP group).*

In other cases the question of priority was not tied to the uncertainty of the project, but a short-term vs. long-term development trade-off. This was more prominent in the relatively young firms where the R&D efforts were focused on developing and improving products and services. Since these firms had to maintain operations to finance the further development of their products and services, only a limited effort could be invested in long-term development. In these cases the “cost reduction” seemed to be tied to a desire to expedite their R&D efforts.

*“When we started up we had to fight for every cent, and every order and while at the same time invest enough in the development of our technology to stay competitive ... To be honest, I don't know if we would have been here today if it were not for those funds” (Firm in the MPG group).*

*“For a firm like ours it is a dilemma to find the right balance between short-term and long-term development. If our focus is short-term, then we can improve our turnover by intensifying operations, and if we focus on long-term development we know we have to develop our product in order to win a larger market share. Without SkatteFUNN we would most likely have been forced to focus more on operation in order to stay afloat, and it would have taken us longer to grow” (Firm in the AKP group).*

Some of the firms maintained that they were purely motivated by the effect of the tax-deduction on the bottom line, and that they unconditionally would have conducted the R&D project without any limitations.

*“We are engaged in a lot of R&D and because of that SkatteFUNN has an obvious appeal. I think we can be cynical enough to say that we have used it solely to benefit economically from the tax-deduction”* (Firm in the SIS group).

This was justified by pointing out the extensive amount of investments they already had made in R&D, and that it would be “stupid not to apply” when the funds were available to all that met the SkatteFUNN criteria. Only a few of the experienced firms reported any other motivation for applying; one informant explained that they did not see the support as financial gain, but as a chance to do a better job; while another mentioned the goodwill it generated with top management, and that a SkatteFUNN approval could be used to build internal support for the project.

*“For the top management this type of support is always a plus. One is always cautious with innovation projects, because so many are money drains that do not lead to anything. So when you can point out that some of the money comes back as a tax deduction, support for initiating these types of projects increase”* (Firm in the AKP group).

Most of these projects would have been initiated regardless of the tax-incentive, but the support enabled them to finish the projects faster or to increase the scope of the project. This is also visible in the survey data where most of the firms that emphasise “reducing the cost of the project” also rate “expanding the scale” as a top motivator.

### **6.1.2 Non-experienced R&D performers**

Both the interview and survey data revealed that also among the non-R&D experienced cases, some were highly motivated by the idea of cutting R&D costs. However, the top rating had a greater variability than for the experienced firms, and was spread out across five additional alternatives; conduct a more complex R&D project; reduce the financial risk; complete the project faster; secure necessary funds to initiate the project; and increase the internal support.

Some of the firms explained that in order to divert resources to R&D activities, the projects had to be of a certain size and ambition. A few even felt that they had to justify not just the resources directly related to the R&D efforts, but also the administration cost of applying and managing the SkatteFUNN project, as they feared that if the projects were too small it would diminish the value of the support. The resulting scope and complexity of the R&D projects entailed an unprecedented risk for the firms, and cutting cost became a motivation for applying for support in order to reduce the firms' financial stake.

As with most of the R&D-experienced firms, the motivations for applying did not "stand alone". Firms replying that cutting cost or reducing the financial risk were main motivations for applying described situations in which they were unable to carry these burdens alone.

*"It was first and foremost to get the funding, because without SkatteFUNN we wouldn't have survived - We would have been bankrupt"* (Firm in the AKP group).

*"Limited resources and prioritisation were the main reasons we didn't start up the project sooner ... This changed when we saw that SkatteFUNN could give us the financial breathing room to hire a person that wouldn't have to be concerned with short-term revenue, but could focus on long-term development ... Our first R&D project wouldn't have been initiated without the fiscal incentive provided by SkatteFUNN"* (Firm in the MPG group).

*"I would say that the main motivation was the financial support. It made it possible for us to initiate the project, which we otherwise wouldn't have had resources to pursue"* (Firm in the SIS group).

Some of the firms explained that if possible they would annotate their internal project proposals "eligible for SkatteFUNN-support", and were motivated to apply for support because they believed it would be easier to convince top management to get behind an R&D project once SkatteFUNN had approved it.

*"I thought that presenting the SkatteFUNN-opportunity would be a nice way to pitch the project for the upper management, which had made it clear that they did not want R&D projects to run at the expense of daily operations, and that it would have to be something we could achieve on the side line"* (Firm in the SIS group).

The need for external resources is also reflected in the survey results, where firms that highlighted cutting cost or reducing risk as strong motivators also placed the same emphasis on securing necessary funds. For a few of the cases the project was fundamental for the establishment of the firm, but for most the R&D represented exploration of opportunities for improvement or branching out.

### **6.1.3 Hypothesis test: motivation**

Although cost reduction was a more pronounced and consistent motivation for the R&D experienced cases, both groups articulated the desire for reducing the cost of their R&D project. However, the context that influenced this desire can be seen to vary with their experience.

With the exception of the R&D experienced firms that reported that they would have completed the project within the same timeframe and with the same scope regardless of the tax-incentive, all the cases were faced with resource constraints to their projects.

In the experienced firms the R&D-departments fought other departments for resources, and different R&D projects competed for a share of the budget. The constraints experienced by these firms seem to emanate from project specific attributes affecting its relative priority negatively. In other words, it appears not to be a question of whether or not to continue with R&D but rather which projects the firms are willing to invest in.

In all these cases the projects would be initiated no matter what, but for most, the limited resources would force a reduction in the project scale or pace. Thus, it seems that the desire to cut project costs was in order to speed up the projects or increase their scale, relative to what would be possible with the available resources.

For the inexperienced firms, on the other hand, the resource constraints were not so much related to the content of the R&D but were instead tied to the challenge of diverting resources away from secure income generating activities in order to invest in R&D. In these cases the firms were motivated to apply in order to reduce the cost of the R&D project enough to justify resource displacement from operation activities. Most of the R&D projects would not

see the light of day unless they got an influx of funds, and as such they were much more dependent on the tax-deduction than the R&D experienced firms.

The various motives for applying appear to be in line with the first hypothesis. Since firms with prior R&D experience already have developed formal R&D capabilities, and usually come from sectors with highly codifiable knowledge and higher levels of technological opportunity, their motivations for applying differ from those of the non-R&D experienced firms, which usually are found in sectors where it is harder to capitalise on R&D, and lack formal R&D capabilities.

Although there are a few exceptions the motivations for applying to SkatteFUNN are clustered on either side of the explanatory variable; reducing the project cost and increasing the scale and pace of the project as main motivators for the R&D experienced firms; and securing necessary funds to initiate the project as the main motivator for the non-R&D experienced firms.

## **6.2 Behavioural additionality**

The results from my study of the changes in behaviour are based on the interviewees' perception and experience, and corroborated by the survey questionnaire. Separating the additional effects from the support and the R&D in general is not an easy task, but I made the explicit distinction when I phrased my questions, both in the interviews and in the survey. The informants answered questions on whether the SkatteFUNN support had led to any "extra" benefits beyond the financial, and were probed about changes to strategy and routines. In addition, they were asked to rate the degree to which the support had contributed to thirteen different behavioural additionality effects, depicted in table 4. They could grade these effects at five levels from "no degree" to "very high degree", as well as choosing a sixth option of "not relevant".

The total average from the survey questionnaire indicate that the strongest effects experienced were related to the expansion of the knowledge base and increased competence for those working on the project. Looking a bit closer, the average behavioural additionality reported by the experienced R&D performers strongly resembles the total average. On

average, the non-R&D experienced cases also rated increased competence as a top behavioural additionality, but tied with this effect was a stronger focus on R&D and a new innovation strategy. The latter was among the bottom rated for the experienced firms, separated by more than two scales. In fact, according to these averages, the non-R&D experienced firms reported stronger behavioural additionality for all of the effects.

Table 4. Behavioural additionality effects.

Question #12	Alternatives	R&D experienced	Non-R&D experienced	Difference
To what degree has the SkatteFUNN support contributed to the following effects?	New knowledge / latent R&D / future innovation	4,00	4,40	-0,40
	Improved competence for R&D personnel	4,00	4,60	-0,60
	Improved understanding of, or valuation of intangible assets (e.g. available knowledge, user experience)	2,57	4,40	-1,83
	Stronger R&D focus	3,50	4,60	-1,10
	Expanded network (improved linkages with institutions, competitors, suppliers or customers)	3,64	4,00	-0,36
	Stronger focus on market access and distribution forms	3,23	4,00	-0,77
	Internationalisation (increased access to international markets and networks)	2,93	3,80	-0,87
	Organisational change in general (e.g. establishing a dedicated R&D dep., inter-disciplinary project groups)	1,69	3,60	-1,91
	More pronounced innovation drive and management from the top-down.	2,85	3,60	-0,75
	Better integration of R&D efforts across departments and disciplines in the firm	2,54	3,60	-1,06
	New innovation strategy	2,50	4,60	-2,10
	Improved internal routines (e.g. Internal communication, reporting, project management)	3,23	4,20	-0,97
	More active search for public funding	2,64	3,00	-0,36

### 6.2.1 Experienced R&D performers

The extent to which the experienced firms benefitted from behavioural additionality was usually limited to effects that improved existing processes and helped maintain focus. However, some could not identify any persistent changes to their routines or strategies that could be attributed to SkatteFUNN.

*“In general I don’t feel it has given us anything “extra””* (Firm in the SIS group).

A few of these cases believed they would have completed the project in the same way without the tax-incentive, so the absence of behavioural additionality can in some cases be traced back to a lack of input additionality. Others believed that since they already had well developed strategies and R&D capabilities, little could be gained from the SkatteFUNN support.

*“I cannot say that any of our routines or strategies have been affected by the scheme, but I think that is because of our starting point. We were very research- and innovation focused, and the way SkatteFUNN is organised has only been in line with our established practice and mind-set”* (Firm in the AKP group).

Some of the same firms did, however, experience positive effects that contributed to the improvement of the particular R&D project.

*“Some times we are too eager to apply for a project, and the application process has gone over two rounds before being approved. The feedback we receive upon the initial rejection, either from Innovation Norway or SkatteFUNN, have been valuable to the improvement of the project, and I must say the structure and process around SkatteFUNN is commendable”* (Firm in the MPG group).

*“You can say that, when you design the SkatteFUNN application you have to describe and improve the processes and your documentation, which is beneficial since it challenges you to improve your project”* (Firm in the AKP group).

According to the SkatteFUNN representatives I interviewed, several firms find the application template so useful that they use it as a general R&D project template even for projects they have no intention of applying to SkatteFUNN for. There were also cases where firms apply for support to a wide array of projects only to use the feedback from Innovation Norway and the SkatteFUNN secretariat to select which projects to initiate.

Several firms answered that the rules and regulations of the program enabled them to build more knowledge and improve their competence, by providing structure and improving their project routines.



*“I would say that SkatteFUNN is providing some additional structure. You have to work out a lot of detail when you write the application, and you will try to structure the project in a similar way. These processes required by SkatteFUNN also make it easier for me to hand the projects over to other project managers, and provide instructions on what to report”. (Firm in the AKP group).*

*“Without SkatteFUNN we would probably lack some of the pressure along the way. The reporting helps maintain a beneficial project focus” (Firm in the AKP group).*

*“In a way, SkatteFUNN ensures that you treat the internal processes related to the project, as external – Something that can be very healthy” (Firm in the AKP group).*

In addition, some of the firms pointed out an image building effect, where SkatteFUNN support worked as a kind of “seal of approval” that was seen as conducive to increased expectation and involvement from management, and provided better conditions for recruiting competent personnel. Also worth mentioning is that one of the firms have adopted a more holistic approach to their R&D in an attempt to adapt to the design of SkatteFUNN and other R&D programs.

The effects experienced here were typically improvements of existing routines, and were related to the documentation requirements in the application and reporting stages, and to some extent the process of applying. The findings from the interviews are supported by the survey results, which also made it easier to compare the relative benefits experienced. When forced to rate different effects, only a few of the firms responded that an effect was irrelevant or that SkatteFUNN had not contributed at all. Most of the experienced firms reported a low or moderate influence on all effects, with higher ratings for effects pertaining to knowledge and competence building, improvement in R&D focus and processes, and improved linkages with users, suppliers, competitors, or external R&D institutions. That the latter effect was not mentioned in the interviews is peculiar because the deduction cap has been twice as high for projects that are done in cooperation with approved R&D institutions. The omission might indicate that my questions did not captured this dimension, and that the firms view this as more than, or something completely different from, an “extra” effect of the support. It should be mentioned that even though the scheme provides stronger incentives for collaboration efforts, the results from the SSB evaluation showed that the effect was limited.

### 6.2.2 Non-experienced R&D performers

In the interviews with the inexperienced firms the source of the additionality seemed to hinge on the rules and requirements, although some also referred to the novel experience with a more formal way of learning.

*“SkatteFUNN help us get into the right mind-set - In a way it is like a positive straitjacket, that force you to contemplate every stage of a long and complex process. We would never have had ambitions at this level, because we wouldn’t have had the possibility to pursue them without the funding” (Firm in the MPG group).*

*“The first project wasn’t all that successful, but based on the experiences we made, our following projects turned out really well ... The competence we acquired placed us in a stronger position for handling future R&D projects” (Firm in the MPG group).*

Since many of the cases would not have engaged in R&D without the support, effects related to the R&D experience in general can in these cases be ascribed to the SkatteFUNN program.

Several of the firms mentioned that the support helped them improve the way they conducted their R&D, both for the specific project and in the future, and that the program requirements forced them to collect more and better data.

*“It is clear that when you are forced to document the entire process of a SkatteFUNN supported R&D project, you are forced to reflect more thoroughly on certain aspects than without that structure. The alternative would likely have been a stronger reliance on serendipity, and we have probably improved our R&D processes and become more aware of the value of R&D as a result of our first project ... I honestly believe that we have learned more because of the awareness the SkatteFUNN requirements entail” (Firm in the MPG group).*

Part of the new appreciation of formal learning processes seems to be tied to an increased awareness of their knowledge bases, and accompanying appreciation of knowledge as an important asset.

*“It [SkatteFUNN] was a thorough introduction to that way of working. We also saw that in several areas our knowledge was limited at best”* (Firm in the MPG group).

*“You basically build a model for improving learning and knowledge absorption, and I believe you become more aware of your own knowledge, or lack thereof, and at the same time learn to appreciate those intangibles to a larger degree”* (Firm in the MPG group).

*“The acknowledgement that this type of deep knowledge attained by formal research projects is alpha and omega in product development can to a large degree be attributed to the imposed structure of the SkatteFUNN project”* (Firm in the MPG group).

In some cases, the tax-incentive also reduced risk aversion among the managers. Both the reduced cost and the positive results from the first project contributed to this.

*“I believe that the doors we opened with our R&D project, have led to a higher tolerance for risk and uncertainty, among the top-management”* (Firm in the MPG group).

One of the less frequently mentioned effects was that in addition to the effect of the fiscal support on the pace of their projects, the fact that they had an engagement with a public actor with deadlines and reports helped create a "we-need-to-finish" mind-set. One firm also mentioned that even though not all of the top- or department managers seemed aware of the R&D effort initially, more and more began to show an interest, and that a more positive attitude towards R&D was slowly spreading over the course of the project.

The interview data demonstrate that the main focus of the non-R&D experienced respondents have been on the development of new capabilities related to formal learning processes. Together with the thorough introduction to formal knowledge production the SkatteFUNN process represented, the increased appreciation of their extant knowledge and the rich and detailed knowledge R&D can produce were highlighted as particular strong effects.

This can also be seen in the survey data, but in addition this data revealed many more behavioural additionality effects than those gleaned from the interviews. When grading these thirteen effects the two lowest ratings (*no degree* and *little degree*) were only afforded three times among all the inexperience firms. An important finding was that all of the non-R&D

experienced firms continued to perform R&D after this initial SkatteFUNN project and, as I will discuss in section 6.3.1, their motivation for applying for SkatteFUNN support to these latest projects have changed along with their behaviour.

### **6.2.3 Hypothesis test: behavioural additionality**

The findings reveal that almost all of the cases experienced some behavioural additionality, but the different effects varied in strength across the explanatory variable of R&D experience.

The R&D experienced firms felt the strongest effect on competence development and knowledge production through improvements to the project or minor changes to existing routines. The effects attributed to SkatteFUNN were usually linked to the documentation requirement in the application and reporting stage. However, some of these cases did not experience any effect at all.

For the cases with no prior R&D experience the effects highlighted in the interviews were more fundamental, being associated with the formal process of R&D for the first time. Both the R&D experience in general and the requirements associated with the SkatteFUNN program contributed to an increased focus on, and appreciation of, the knowledge assets of the firm, and of R&D as a source of new knowledge. The processes prescribed by the SkatteFUNN requirements were a formative introduction to R&D routines for these inexperienced firms.

Although two different patterns appear, the theoretical arguments of both propositions seem to hold. The R&D experienced firms able to build upon their existing knowledge, routines and competence, did experience their strongest effects in these very areas. The strong knowledge and competence building effects might be a sign of an accumulation effect, but the changes in routines were mostly limited to the duration of the project, which might indicate a persistent path dependence or a limited development potential intrinsic in the SkatteFUNN requirements. The catch-up potential of the inexperienced firms, on the other hand, allowed them to embrace new routines and mind-sets introduced through the SkatteFUNN project, and they underwent larger changes from a broader set of effects.

Although the evidence from the interviews indicates the group with the strongest behavioural additionality, it is difficult to compare the relative strength of their experiences. However, the survey questionnaire data supports the hypothesis that the inexperienced firms benefitted from a stronger behavioural additionality by providing the relative degree to which each of the firms experienced the different effects. With only a few exceptions, the sum of the behavioural additionality effects for each of the non-R&D experienced firms was higher than the respective sums of the experienced firms. In addition, the average of each of the thirteen effects was rated higher by the non-experienced firms. This leads us to conclude that hypothesis 2b is supported by the data, and that under the conditions of the SkatteFUNN program the catch-up potential of inexperienced firms is larger than the cumulative advantage held by experienced firms.

## **6.3 Discussion**

### **6.3.1 Links between motivation (H1) and behavioural additionality (H2)**

The analysis in relation to the first hypothesis strongly indicates that firms' response to a tax-incentive varies across R&D experience, and that firms with previous R&D activity are more likely to apply for support in order to reduce the project cost, or to increase the scale of the project, while the inexperienced firms are more likely to be motivated to apply in order to secure necessary funds to initiate their R&D activity.

As demonstrated, the R&D experience has affected the innovation capabilities of the firms through behavioural changes. Since the needs and desires that shape the motivation to apply are dynamic, and are assumed to change together with the conditions affecting the firm, e.g. capabilities, we can expect motivation to have changed more in the cases that experienced the strongest behavioural additionality.

The data on motivation for applying *after* the initial SkatteFUNN project confirm this proposition. In the cases where the firms had no prior experience with R&D 86 % have changed their motivation after their first R&D project. In comparison only 38 % of the firms with previous R&D experience reported similar changes.

Drejer and Leiponen (2007) believed that the firm-level variation in capabilities was the main source of heterogeneity affecting innovation. If this variation in capabilities represents the strongest contextual influence on motivation, the motivation of the inexperienced firms should begin to resemble that of the experienced firms as they gain experience and develop their formal R&D capabilities.

For later projects, the previously inexperienced firms' motivation to apply began to resemble the experienced firms' motivation, with respect to expansion of the scale of the project, reduction of risk, increase in the pace of the project and acquisition of necessary funds. However, at the same time they became more motivated to apply in order to conduct more technologically complex R&D, build internal support, and to gain access to counselling and support. All of which, together with a weaker motivation for cutting project costs, increased the difference in motivation between the two groups.

These discrepancies in convergence after the R&D experience and resulting capability development indicate that either the variation in capabilities is not the only source of heterogeneity, or that other factors influence the potential scope of opportunity to develop capabilities. The requirements of the SkatteFUNN scheme might represent a limited external "nudge" for experienced firms to branch their capabilities or for inexperienced ones to develop capabilities. It is reasonable to assume that the SkatteFUNN experience has most to offer in terms of formal R&D capability development. That is, formal search and problem solving processes associated with the STI-mode of learning – an approach that usually produce highly codified know-what and know-why knowledge. Even though both groups now had some level of STI-mode capabilities, the *total* variation in capabilities could still have a strong affect on the groups' motivation.

### **6.3.2 Sectoral heterogeneity**

As noted above, the firms that I have interviewed have developed their competencies and routines in response to different experiences and their capabilities are thus path dependant. An indication that industry-level heterogeneity could be at play is the correlation of R&D experience with the sectoral group-identity for the cases. All but one of the inexperienced firms were found in PGS or SIS sectors, and only two PGS firms reported prior experience with R&D. This strong pattern suggests that sectoral conditions pertaining to technological

opportunities, complexity, risk, appropriability conditions and cumulativeness might have contributed to the development of widely different capability-sets, influencing firms' response to the tax-incentive.

The inter-sectoral heterogeneity literature emphasises that the competitive environments related to the maturity of a technology, as well as attributes of the knowledge bases relevant to different sectors, produce a systemic variation in mode of innovation (Castellacci, 2007; Malerba, 2005; Pavitt, 1984). Evidence of intra-sectoral variation has been used to criticise this view, and to argue that firm-level factors explain the observed variety (Drejer and Leiponen, 2007). However, the concepts of inter- and intra-sectoral heterogeneity are not necessarily mutually exclusive (Clausen, 2013; Peneder, 2010). According to the firm-level theory on dynamic capabilities (Teece and Pisano, 1994), firms strive to adapt their capabilities in order to exploit the opportunities offered by the environment they are situated in, in order to gain competitive advantages – an environment that to a large degree is defined by more or less dynamic and static attributes of the sector they are engaged in.

The limited convergence in motivation after the initial SkatteFUNN project, and the correlation between R&D experience and sectoral group-identity, lends support to the conclusions reached by Claussen (2013) and Peneder (2010) that the observed heterogeneity is caused by an interplay of firm- and industry-level influences. The opportunities and constraints provided by the sectoral context influence the way firms organise their innovative activities (Castellacci and Lie, 2014).

## 7 Conclusions

The objective of this thesis has been to extend our understanding of the patterns and effects of R&D policy by studying how and why firms' response to R&D tax-incentives varies depending on firms' characteristics and sectoral conditions. Following a presentation of the Norwegian tax-incentive scheme, SkatteFUNN, and the industrial context it is embedded in, I reviewed the theoretical foundations of innovation policy, and the recent evaluation literature. After criticising the extant evaluations' lack of attention to the heterogeneous behaviour of firms, and consequently the important dimensions of the effectiveness of the scheme, I discussed some theories that contribute to clarify the concept of heterogeneity and its importance when analysing firm behaviour and market dynamics. These theories on how properties of knowledge and learning lead to firm- and industry-level heterogeneity enabled me to develop my theoretical arguments and focus my attention on two of the dimensions that have largely been neglected in extant literature: the motivation to apply to fiscal incentives schemes; and the behavioural additionality effects experienced by the companies.

Arguing that "prior R&D experience" is a suitable explanatory variable to catch firms' variation in technological capabilities, mirroring the relevant firm- and industry-level conditions influencing heterogeneous firm behaviour, I formulated two hypotheses to further my investigation of the variation in firm response to SkatteFUNN. The first (H1) hypothesis is that R&D experienced firms are more likely to apply for the tax-incentive in order to reduce the costs of their projects or to expand their scale, while non-R&D experienced firms are more likely to apply in order to secure necessary funds to invest in R&D for the first time. This is expected because the two groups differ in terms of R&D capability and related sunk costs, and hence have different levels of opportunities to capitalise on R&D. The second hypothesis leads to two contrasting propositions. One (H2a) suggests that because experienced R&D performers already have developed formal R&D capabilities, and will be able to take advantage of the cumulative character of knowledge and learning to build upon prior success, they will likely experience the strongest behavioural additionality affects. By contrast, the alternative hypothesis (H2b) argues that because non-R&D experienced firms are likely to lack any formal R&D capabilities, and have a larger potential to catch-up and develop easy to imitate capabilities, they will arguably experience the strongest behavioural additionality effects.



In the empirical part of the thesis, I conducted a comparative case study of a selected sample of Norwegian firms. I conducted personal interviews and gathered e-mail survey data from 20 firms that had completed R&D projects with SkatteFUNN support in recent years. These were selected in a two-step process; (1) first I generated a sample of 150 firms from the total population of SkatteFUNN beneficiaries; (2) then I selected a representative sample of firms according to three selection criteria: (i) sectoral group, (ii) level of prior R&D experience, and (iii) firm size.

Based on the informants' experiences and explanations, I identified strong similarities and differences across the explanatory variable of R&D experience, and found empirical support for hypothesis 1 and hypothesis 2b. Firms that already had prior experience with R&D when they applied to SkatteFUNN were more motivated by cutting the cost, and increasing the scale and pace of their projects. On the other hand, the inexperienced firms, which described stronger financial constraints to their R&D ambitions, were more motivated by securing necessary funds to initiate their R&D projects. In line with hypothesis 2b, I found that the catch-up potential of the inexperienced firms was stronger than the advantage of cumulativeness held by the experienced R&D performers, and consequently that the behavioural additionality was strongest for the non-R&D experienced firms.

In my dataset, the firms' response to the tax-incentive varied systematically with R&D experience, because they were subject to different firm- and industry-level conditions, affecting their behaviour heterogeneously. The change in motivation observed after the firms gained R&D experience indicate that both variation in capabilities and sectoral conditions influence firms' response.

This study has provided qualitative support for the proposition that heterogeneous firm behaviour affects firms' response to R&D policies such as the SkatteFUNN tax-incentive, which implies that R&D policy makers cannot continue to assume that firms are homogeneous actors and need to design their schemes and carry out the relative evaluations with a due consideration to firm heterogeneity.

While the qualitative approach has provided a deep perspective on how the different firms experienced their R&D situation and the tax-incentive, the limited sample in my study makes it of course hard to generalise from patterns discovered in my findings. Although it is

important to interpret these results with the due caution and not generalise from them, it is at the same time important to conclude by discussing some possible general implications that the research presented here, if corroborated by future research, would have for the future design of innovation policies.

## **7.1 Is the SkatteFUNN programme effective?**

SkatteFUNN is a cap-limited volume-based tax-incentive that was designed to be a more neutral R&D incentive. It is considered to be a “catch-all” instrument, directed at firms from all sectors, and of all types and sizes. It can, however, be questioned if this is an optimal approach for reaching the objective of increased social welfare.

The DFØ evaluation of SkatteFUNN was mainly focused on the *formative* aspect of the policy, i.e., the effectiveness of the implementation and execution of the scheme (DFØ, 2006), whereas the SSB evaluation was mainly focused on the *summative* aspect, i.e., the impacts and results of the tax-incentive (Cappelen et al., 2008).

The findings from the SSB evaluation show that the additionality effects varies between sectors with high and low R&D propensity, with size, and with R&D experience. However, they made limited efforts to consider the *appropriateness of the means*, in other words, how the varying results influence the ability of the policy to mediate present failures, and to generate a net increase in social welfare.

This could be a result of a narrow interpretation of the mandate to focus on the attainment of the project goals; increasing private R&D investment; generating innovation; and stimulating knowledge based value creation in Norway.

### **7.1.1 Addressing Market and non-market Failures**

As firms’ needs and desires reflect their underlying conditions, the motivation to apply for a tax-incentive provides a good perspective on which failures might be present.

It seems likely that the inexperienced firms that were motivated by a need to secure necessary funds were suffering from financial market failure. Several of the firms mentioned that looking for financial sources outside the firm was out of the question since it would require a better top- and bottom line than they had. It was also considered too costly as it might entail giving up some of the control of the firm and “paying out of the nose” to regain control at a later stage. All of these firms, that would not have engaged in R&D without the support, can attribute their additionality to the SkatteFUNN support, but did not necessarily suffer from underinvestment caused by indivisibility or appropriability challenges of knowledge, associated with what is typically defined as knowledge market failure.

The experienced firms I talked to cannot be said to have suffered from this type of financial market failure, but several mentioned that part of the motivation for applying was to reduce the financial risk associated with R&D projects with uncertain profits. The support enabled them to increase the scale or pace of these low-priority projects, and as a result more R&D was performed per year, likely affecting the output of knowledge in a positive manner. However, this increase in R&D did not necessarily involve any additional R&D investments from the firms. Although none of the cases articulated concerns about the public character of the knowledge they sought to develop, there certainly were cases with underinvestment in R&D associated with uncertain returns of investment. In the cases where the firms would have completed the exact same R&D within the same timeframe without the tax-incentive it is difficult to argue for the existence of additionality effects, and consequently not any market failure correction either.

Behavioural additionality is a more complex concept, and it relates not only to the failure of markets, but also to systemic failures. In a study involving only treated firms it is difficult to say anything beyond the effect on the firms themselves, but it is not unrealistic to assume that in cases where the R&D has involved interaction with actors external to the firm, also firms that were not treated directly experienced behavioural additionality. The non-R&D experienced firms could be considered to have suffered under “capability or learning failures” where, in addition to the financial resource constraints, the limited experience with formal search and knowledge production might have constrained them from engaging in R&D sooner. None of the goals of the SkatteFUNN program are focused on system failures, but the introduction to formal methods of learning through R&D is in line with the goal of “stimulating knowledge based value creation in Norway”.

The aim of the public intervention attempt to correct the underinvestment in R&D is not just to improve the situation of the individual firm, but also to increase the social welfare.

### **7.1.2 Increasing Net Social Welfare**

As mentioned in chapter 2.1 and 2.2 the development of the Norwegian industry structure and support system has resulted in a specialisation pattern where a relatively small part of the industry relies on R&D as a driver for economic growth. The Norwegian firms constitute a diverse industry structure that based on distinctive conditions has different needs and motivations, and, as my findings indicate, firms' response to the tax-incentive differs accordingly.

The R&D experienced cases, that mainly came from the AKP and MPG sectoral groups that provide the rest of the economy with knowledge, were mainly motivated by cutting costs or increasing the scale of the project. The inexperienced firms came from the SIS and PGS groups that traditionally are knowledge recipients in the knowledge production value chain, and were rather motivated by initiating R&D. When the firms, with these characteristics, are motivated as such it carries implications for the aggregate output of the scheme.

The results from the SSB evaluation of SkatteFUNN reflect these motivations when they find that firms with little previous R&D experience drove the input additionality, and that the output additionality was strongest in R&D intensive sectors.

In their evaluation, SSB pointed out that the particular output generated by the scheme, process- and new-to-the-firm product innovation, was not expected to generate large external effects. However, they did not mention that the inexperienced R&D performers often come from sectors with fewer opportunities to capitalise on R&D, and thus would likely generate less output. Nor did they comment on how the distribution of effects limited any potential synergy effect between the additionalities. Instead of regarding the effects in relation to the groups of firms that experienced them, they used the average to conclude that the scheme mainly works as intended.

By applying a similar line of argument as Castellacci and Lie (2014), we see that SkatteFUNN can be considered inefficient in light of the overarching goal of increasing the social welfare.

Since the input additionality was found to be weaker in R&D intensive sectors the incremental effect on innovation output will consequently be limited. The stronger input additionality experienced in the low-R&D sectors should, following neo-classical assumptions, lead to a corresponding increase in output, but since these sectors are presented with fewer technological opportunities the input additionality had a limited effect on innovation output. Likely coloured by this, the R&D intensive sectors were found to have relatively stronger output additionality than the low-R&D sectors despite the limited stimulation of private investment among these firms.

In addition to the limited output generated by the scheme, the aggregate spillover effects of the tax-incentive can also be considered to be low. For the R&D intensive sectors the types of innovation the support generally stimulated have a limited externality effects. Whereas the output from the low-R&D sectors have a limited spillover potential because they usually are recipients, not producers of knowledge, and their products and services are seldom used as intermediaries in further value creation.

When all that is said, it is important to consider positive impacts of the tax-incentive on economic growth. As mentioned, the support is especially beneficial for SMEs, and SkatteFUNN sustains the innovative activities of many of these. This is beneficial for other complementary policy goals, such as increasing entrepreneurship and market competition. The positive impact on economic growth should also be seen in combination with other programs. Even though there still is far to go, the innovation policy instruments are increasingly designed to work together. Different programs from both the NFR and other actors, such as Innovation Norway, complement each other, and in several cases SkatteFUNN support is a requirement for approval from other programs (e.g. the IFU and OFU programs<sup>10</sup>). Another important objective towards increasing economic growth is the introduction, or education, SkatteFUNN represents for inexperienced R&D performers.

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<sup>10</sup> IFU is a program for industrial research and development contracts, and OFU represents the equivalent for public contracts. Both are administered by Innovation Norway.

Hopefully, they graduate from this “low-threshold” program, and escalate their R&D efforts with more advanced support programs.

## **7.2 Policy Implications**

The different capability-sets and sectoral contexts firms operate under generate different needs and motivations for applying to a tax-incentive and affect the possible effect of the support. The different responses to the SkatteFUNN program indicate that the homogeneous “catch-all” approach of the policy has a limited effect on reaching the social objective of increasing the social welfare.

This study has demonstrated the importance of considering heterogeneity when designing and evaluating R&D policy. As argued, in the case of SkatteFUNN, neglecting to acknowledge this can have large repercussions for the effectiveness and appropriateness of the program. One implication carried by this study is that policy makers should move away from the assumption that firms are homogeneous actors, and should re-evaluate current designs that are based on this. Furthermore, an explicit target of future evaluations should be to consider the ability of the policy to mitigate failures and increase the social welfare.

In order to increase the efficiency and impact on the social welfare, SkatteFUNN would not necessarily have to make very large adjustments. The scheme already differentiates between SMEs and large enterprises, as well as private and collaborative endeavours with approved R&D institutes. Without limiting its broad reach, the program could for instance be revised to target specific motivations, or levels of experience with R&D, apparently conducive to specific outcomes.

Inexperienced R&D performers, likely to suffer from financial market failure, seems to benefit from the volume-based scheme used today, but could benefit from increased follow-up in the commercialisation phase of their R&D. A continuation of today's design, coupled with counselling, would continue to help them establish R&D activities and develop STI capabilities and could also improve the “output-opportunity” realisation margin.

The approach to experienced R&D performers, on the other hand, should be adapted to incentivise a larger input and output additionality. Since these firms often are located in knowledge providing sectors with a lot of technological opportunities and strong spillover potential, a targeted policy would be beneficial for the overall production of knowledge. A minor adjustment could be to increase the deduction cap, and consequently the marginal rate of return, for firms that can demonstrate persistent R&D activity. To some extent, this is happening already as the caps on the scheme were raised both in 2009 and 2014. However, this was done for all firms equally, and the potential maximum benefit from the tax-incentive is still limited compared to the R&D budgets of many of our largest R&D performers. Another approach could be to introduce flexible incremental-based tax-incentives for these firms, ensuring that the support leads to increased private investment in R&D.

While supporting the recommendation of Castellacci and Lie (2014); that in order to design programs better suited to further the national technological frontier and increase social welfare, policy makers should consider sector specific conditions, I also acknowledge the interplay between the firm- and industry-level, and agree with Clausen's (2013) recommendation that even though they provide particular contexts, not even sectors should be considered to consist of homogeneous actors.

Controlling for heterogeneity at the industry- and firm-level might even represent a step towards a more holistic policy design and evaluation tradition. Innovation is seldom something that happens in the vacuum of a single firm, but through an interplay of firm-, industry-, and national-level influences. As Arnold (2004) argues: in a world where we think of innovation in a system perspective, we need to evaluate on a system-level as well.





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# Appendix A

## Appendix A1 – Interview guide *firms*

1. Drev dere med forskning og utvikling før dette prosjektet?

Kjerneaktiviteten (før og nå)?

Kunnskapsbase

2. Hva har vært de viktigste kildene til deres innovative aktivitet?

Intern eller ekstern FoU

Vertikalt eller horisontalt samarbeid (leverandør/ konkurrent)

Utstyr og materialer

Brukere

Offentlig forskning og universiteter.

Design og utvikling

Intern produktutviklingsavdeling.

2. Hadde dere noen tidligere erfaring med offentlige støtteordninger?

3. Hvordan ble prosjektet unnfanget, og hva var **motivasjonen for å gjennomføre det?**

Utvikling av ny teknologi

Videreutvikling av eksisterende teknologi

Utvikle teknisk kompetanse

Bedre teknologisk posisjon

Bygge nettverk

Løse spesifikt problem

Bedre omdømme

4. Hvorfor ble ikke dette prosjektet startet opp tidligere?

Knappe ressurser (kunnskap, finans, kapasitet)

Prioritet

5. Hvor viktig var SF-prosjektet for bedriftens hovedaktivitet?

**6. Hva var motivasjonen for å søke om SF-godkjenning?**

Sikre oppslutning om prosjektet

Sikre midler til å gjennomføre prosjektet

Å motta skattefradrag / kutte kostnader ved prosjektet.

Øke omfanget på prosjektet

Dele den iboende risikoen ved FoU.

Rent innovasjonsfokus

**7. Hva hadde skjedd hvis dere **ikke hadde fått godkjent** prosjektet?**

Gjennomført prosj. u. endringer, samme omfang og tidsskjema.

Gjennomført med samme omfang, men på et senere tidspunkt.

Gjennomført prosjektet, men i mer begrenset omfang.

Utsatt prosjektet på ubestemt tid

Henlagt prosjektet

Outsourcet prosjektet

**8. Hva var det viktigste bidraget fra SkatteFUNN-støtten?**

**9. Har SkatteFUNN prosjektet gitt dere **noe ekstra**, utover det økonomiske?**

Endring i bedriftens rutiner som resultat av prosjektet?

Hvor viktig var nettopp støtten for disse endringene?

**10. Fikk dere alle kostnadene godkjent?**

Har dere vært fristet til å føre ekstra timer og kostnader inn i prosjektregnskapet?

**11. Ført til økonomisk støtte siden? Fra hvem?**

## **Appendix A2 – Interview guide *SkatteFUNN***

1. Målsetning med ordningen, kun stedfestet i Str.mld.? Hvordan måles måloppnåelse?
2. Reaksjon på funn fra evalueringene? Endring i ordningen i etterkant? (f.eks. sjekklister, rutiner, uformelle krav, eksterne fagpersoner, forskrifter, etc.)?
3. Følelse av dagens situasjon?
4. Diskuter midlertidig funn fra mine intervjuer.
5. Brukerene, og bedriftene som driver med innovasjon i Norge som sådan, er jo ikke en homogen masse. Forskjellige kunnskapsbaser og evner, teknologiske regimer med varierende kilder til innovativ aktivitet, forskjellige teknologiske muligheter, approprieringsmuligheter, og grad av kumulativitet for kunnskapsbasen.
6. Vi vet jo at tilbøyeligheten til å drive med intern FoU varierer med sektortilhørighet. Hvordan oppleves denne fordelingen i søkermassen?
7. Dere følger jo ESA krav om klassifisering av Industriell Forskning vs. Eksperimentell Utvikling. Opplever dere en skjevhet i sektortilhørighet her?
8. Aktuelt å tillate mer innkjøp av maskineri og utstyr for visse sektorer?
9. To argumenter for denne typen støtte; Markedssvikt (risikofordeling og approprieringsvansker) og Finansmarkedssvikt (dyr ekstern kapital). Disse utfordringene gjør seg jo gjeldene i forskjellig grad for forskjellige bedrifter. (Store og små). Opplever SkatteFUNN, med sitt hovedfokus på SMB'er, at disse utfordringene er representert ulikt i forskjellige sektorer?
10. Opplever dere at noen variasjon i bedrifters motivasjon for å søke om støtte? Eller uttalte konsekvens dersom godkjenning ikke innvilges?

11. I følge årsrapportene deres er det mange tilbakevendende brukere, har dere utarbeidet noen statistikk over fordelingen her, etter bransjer / sektorer?

12. Kan jo være vel så viktig i det lange løp, som å få til et vellykket prosjekt – Hva er deres målsetning rundt endring i rutiner og adferd (behavioral additionality)?

13. I lys av utfordringer ved å måle endring i rutiner og adferd, hvordan får dere innblikk i denne effekten av SkatteFUNN?

14. Dere samarbeider jo med resten av virkemiddelapparatet. Opplever dere at mange begynner i SF og utvider sin FoU aktivitet etter det? Sektorer som utmerker seg?

## **Appendix A3 – Interview guide *NOFAS***

1. Rådgivning er jo et bredt begrep. Kan dere fortelle meg litt om omfanget av tjenestene dere tilbyr?

Direkte teknisk FoU-personell (med utplasserte spesialister)?

Utforming av prosjekt (m hvilket utgangspunkt)?

Praktisk info (rigid regelverk og krav, identifisere nytte, tungrodd prosess etc.)?

Kommunikasjon. m IN, SF, R & LE (Avklaringer, prosjektrapporten)?

Søknad?

Prosjektregnskap?

2. Hvis vi bare fokuserer på SkatteFUNN – Hvorfor benytter bedrifter deres tjenester? Hva er deres motivasjon?

Hvordan vil du beskrive deres typiske kunder?

Noen bransjer som utmerker seg? (High-tech / low-tech).

Nye for FoU?

3. Varierer typen rådgivning kundene ønsker?

Etter bransje?

Etter erfaring?

4. Variasjon i typen prosjekter fordelt på forskjellige bransjer?

Forskning eller Utvikling?

Mange som samarbeider med forskningsinstitusjoner?

5. Virker det som om bedriftene er åpne om egen motivasjon for å søke SF?

Hva er den vanligste motivasjonen?

Sikre oppslutning om prosjektet?

Sikre midler til å gjennomføre prosjektet?

Å motta skattefradrag / kutte kostnader?

Dele den iboende risikoen ved FoU?

Rent innovasjonsfokus?

Bransjer som utmerker seg?



6. Det er påvist gjennomsnittlig høyere prosjektkostnader i SF enn andre FoU prosjekter. Har dere noen ide om hva som kan forklare dette?

Kan det ha noe med erfaringsnivået på bedriftene?

Kan det handle om usikkerhet rundt hva som kan fradragsføres og under hvilke poster?

7. Er det mange prosjekter som må endres for å møte SF sine krav?

Årsak? Svake prosjekter, eller dårlig informerte bedrifter?

Eksempel?

8. SSB peker på positive adferdsaddisjonalitet og ca. 3/5 tilbakevendende bedrifter. Har dere mange "returning customers"?

Bransje?

Erfaring?

9. Opplever du at tilbakevendende kunder har utvidet sin FoU aktivitet etter sitt første SF-prosjekt? (For eksempel økt omfanget eller antall prosjekter, flere kilder til støtte, org.struktur, FoU-ansatte, strategi etc.)

Varierer dette mellom bransjer (high low)?

Endres da bedriftenes behov for rådgivning?

10. Har dere noen tanker rundt prosjektet, som jeg ikke har spurt deg om?

## Appendix B – Survey questionnaire

Hei,

Som nevnt i e-posten er denne undersøkelsen tenkt å supplere intervjuene jeg har gjennomført på tvers av bransjenorge.

Undersøkelsen består av 13 spørsmål med svaralternativer og det hele skal ikke ta mer enn 5 minutter.

Spørsmålene fokuserer på motivasjon for å drive med FoU og for å søke om SkatteFUNN-støtte, samt effekten av ordningen på selskapet, utover det rent økonomiske.

Tusen takk for at du tar deg tid til å dele din innsikt og erfaring!

**\*1. Drev dere med forskning og utvikling (FoU) før deres første SkatteFUNN-prosjekt?**

- ☐ Ja
- ☐ Ja, men uten å definere det som FoU
- ☐ Nei

Ca. hvor mange år? (valgfritt)

**\*2. Hvor mye erfaring med innovasjon hadde dere før deres første SkatteFUNN-prosjekt?**

- ☐ Ingen erfaring
- ☐ Litt erfaring
- ☐ Noe erfaring
- ☐ Mye erfaring
- ☐ Veldig mye erfaring

Kommentar (valgfritt)

**\*3. Hvor mange SkatteFUNN-prosjekter har dere hatt?**

- ☐ 1
- ☐ 2-4
- ☐ 5-7
- ☐ 8-9
- ☐ 9<

Kommentar (valgfritt)

**\*4. Ble prosjektet definert som "industriell forskning" eller "eksperimentell utvikling" av SkatteFUNN-sekretariatet?**

- ☐ Forskning
- ☐ Utvikling
- ☐ Både og
- ☐ Husker ikke / Vet ikke

**\*5. Hvor teknologisk komplisert har prosjektene vært?**

- ☐ Litt
- ☐ Nokså
- ☐ Ganske
- ☐ Veldig
- ☐ Varierende
- ☐ Husker ikke / vet ikke

Kommentar (valgfritt)

**\*6. Hva var målsetningen for å gå i gang med det første SkatteFUNN-prosjektet?**

	Ikke en målsetning	Litt viktig	Nokså viktig	Ganske viktig	Veldig viktig
Utforske nye muligheter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forbedre eksisterende produkter/tjenester/prosesser	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Løse spesifikk teknologisk utfordring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Utvikle nye produkter/tjenester/prosesser	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Beholde teknologisk lederposisjon	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forbedre selskapets markedsposisjon	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forbedre selskapets image/profil	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Annet (vennligst spesifiser)

**\*7. Hvor viktig er følgende kilder for nyskapning i selskapet?**

	Ikke viktig	Litt viktig	Nokså viktig	Ganske viktig	Veldig viktig
Intern FoU	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ekstern FoU	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Innkjøp av maskineri / instrumenter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Råvarer og leverandørsamarbeid	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Brukererfaring og kundesamarbeid	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Standarder og offentlige kravspesifikasjoner	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Seminarer, konferanser og andre bransjeforum	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Annet (vennligst spesifiser)

**\*8. Hva var motivasjonen for å søke om SkatteFUNN-midler på det første SkatteFUNN-prosjektet?**

	Ikke motiverende	Litt motiverende	Nokså motiverende	Ganske motiverende	Veldig motiverende
Senke kostnadene ved FoU	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Utvide omfanget av prosjektet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gjennomføre mer teknologisk komplekst FoU-prosjekt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Redusere risikoen ved FoU	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gjennomføre prosjektet raskere	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sikre nødvendige midler for å starte prosjektet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Øke oppslutningen om prosjektet internt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Få tilgang til rådgivning og støtteapparat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Godtgjøre seg av eventuelle strukturelle forhold og/eller læringseffekter av SkatteFUNN-administreringen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Kommentar (valgfritt)

**\*9. Vil du si at motivasjonen for å søke om SkatteFUNN-midler har endret seg noe ettersom selskapet har utviklet seg og fått erfaring med ordningen?**

- ☐ Ja
- ☐ Nei

**\*10. Siden motivasjonen har endret seg noe, hvordan ville du rangert motivasjonen for å søke om eventuelle SkatteFUNN-midler i dag, eller hva var det for det siste prosjektet deres?**

	Ikke motiverende	Litt motiverende	Nokså motiverende	Ganske motiverende	Veldig motiverende
Senke kostnadene ved FoU	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Utvide omfanget av prosjektet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gjennomføre mer teknologisk komplekst FoU-prosjekt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Redusere risikoen ved FoU	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gjennomføre prosjektet raskere	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sikre nødvendige midler for å starte prosjektet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Øke oppslutningen om prosjektet internt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Få tilgang til rådgivning og støtteapparat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Godtgjøre seg av eventuelle strukturelle forhold og/eller læringseffekter av SkatteFUNN-administreringen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Kommentar (valgfritt)

**\*11. Hvor sannsynlig er det at følgende ville skjedd dersom dere ikke fikk godkjent SkatteFUNN-søknaden?**

	Ikke sannsynlig	Lite sannsynlig	Nokså sannsynlig	Ganske sannsynlig	Veldig Sannsynlig
Prosjektet ville blitt gjennomført uansett	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prosjektet ville blitt gjennomført, men i mindre skala	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prosjektet ville blitt gjennomført, men ville tatt lengre tid	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prosjektet ville blitt utsatt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prosjektet ville blitt forkastet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Hvorfor? (valgfritt)

**\* 12. I hvilken grad har SkatteFUNN-støtten bidratt til følgende effekter?**

	Ikke relevant	Ingen grad	Liten grad	Noen grad	Stor grad	Veldig stor grad
Ny kunnskap / latent FoU / fremtidig innovasjon	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kompetanseheving blant FoU-personellet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bedre forståelse for, eller verdsettelse av, immaterielle verdier i selskapet (f.eks. kunnskapsbase, brukserfaring)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sterkere fokus på FoU	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nye FoU prosjekter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Utvidet nettverk (økt kommunikasjon og samarbeid med institusjoner, konkurrenter, leverandører eller kunder)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sterkere fokus på markedstilgang og distribusjonsformer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Internasjonalisering (økt tilgang til internasjonale markeder og nettverk)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Organisasjonsendring generelt (f.eks. opprettet egen FoU avd., tverrfaglige prosjektgrupper, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tydligere innovasjonsdriv og ledelse i bedriften	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bedre integrering av FoU aktivitet på tvers av avdelinger og fagområder i bedriften.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ny innovasjonsstrategi	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Forbedret interne rutiner (f.eks. internkommunikasjon, rapportering, prosjektstyring)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mer aktivt søk etter offentlige subsidier	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Kommentar (valgfritt)

**\* 13. Har erfaringen SkatteFUNN har gitt dere med virkemiddelapparatet i noen grad påvirket dere til å søke støtte fra andre ordninger?**

- ☐ Ja
- ☐ Nei
- ☐ Har ikke hatt flere prosjekter

Spesifiser gjerne hvilke programmer

## **Appendix C – Sectoral grouping**

Castellacci's (2008) taxonomy covers the traditional manufacturing and service sectors, but excludes typical public sectors, like "water collection, treatment and supply" and "education". The following list of sectoral groups and corresponding sectors is based on the referenced 2008 paper.

### **Advanced knowledge providers (AKP):**

Computer and related activities; research and development; other business activities; machinery and equipment; medical, precision and optical instruments.

### **Mass production goods (MPG):**

Chemicals; office machinery and computers; electrical machinery and apparatus; radio, TV and communication equipment; rubber and plastic products; other non-metallic mineral products; basic metals; fabricated metal products; motor vehicles; other transport equipment.

### **Supporting infrastructure services (SIS):**

Post and telecommunications; financial intermediation; insurance and pension funding; activities auxiliary to financial intermediation; wholesale trade and commission trade; land, water and air transport; supporting and auxiliary transport activities.

### **Personal goods and services (PGS):**

Food and beverages; textiles; wearing; leather; wood and related; pulp and paper; printing and publishing; furniture; recycling; sales, maintenance and repair of motor vehicles; retail trade and repair of personal and household goods; hotels and restaurants.

Because of the central position of natural resource exploitation in the Norwegian economy, I chose to present the "agriculture, forestry and fishing" and "mining and quarrying" sectors in addition to the four groups of the taxonomy.



