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SkatteFUNN and Corporate Groups

How changes in the SkatteFUNN scheme affects group structure and firms' operational expenses

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Abstract

In this thesis, we have chosen to study the Norwegian R&D tax incentive; SkatteFUNN. The aim of the thesis was to see whether corporate groups optimizes from the scheme by making structural changes with changes in the SkatteFUNN scheme. In addition, we have looked at the number of groups who receives SkatteFUNN, and how much they receive.

We have a panel data provided by the Norwegian Tax Administration (Skatteetaten), containing accounting data and data on SkatteFUNN costs from 2005 to 2016. We found a change in the structure of the groups every time there was a change in the SkatteFUNN scheme. For example, one of our regressions implies a small decrease in the number of firms in groups after a change in the SkatteFUNN scheme in 2014. The coefficient for the treatment variable after 2014 was -0.069 and was significant at a one percent level. This suggest that the increase in threshold changed the structure of the groups marginally.

We also looked at corporate groups and how their SkatteFUNN costs increased over time. Particularly, we looked at groups that reported R&D costs above the purchased R&D threshold for one firm. We noticed a significant decrease in the number of groups exceeding threshold from 2013 to 2014. However, the groups exceeding threshold both in 2013 and 2014 had an increase in SkatteFUNN costs of 48 percent.

Because of the large increase in R&D costs between 2013 and 2014, we wanted to see whether the overall level of costs changed for SkatteFUNN reporting firms. Using propensity score matching and a regression analysis, we found a statistically significant increase in operational expenses of approximately 9.7 percent after 2014 for firms receiving SkatteFUNN.

Our findings indicate that the structure of the groups changes with a change in the SkatteFUNN scheme. The government should therefore consider group composition when they decide on a change in the scheme. Groups reported approximately 50 percent of all SkatteFUNN costs between 2006 and 2015, and a change in the scheme would affect them particularly. Generally, when the threshold increases, so does the investments in R&D.

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1. Introduction

On January 25th, 2011, former U.S. President Barack Obama said

> *Cutting the deficit by gutting our investments in innovation and education is like lightening an overloaded airplane by removing its engine. It may feel like you're flying high at first, but it won't take long before you feel the impact*.
>
> -Barack Obama, 25 January 2011 (Sanger, 2011).

To build on Obama's speech, we can think of a country's economy as the airplane. In order for the airplane to fly, it depends on its engines. In order for the engines to carry the plane properly over its lifetime, it needs maintenance, and sometimes it has to be replaced. In addition, in order for the airline to survive in a competitive market, it has to find ways to stay ahead of the competition, for example by finding a viable way to reduce the price of tickets or to differentiate their products and services from their competitors. To gain a competitive advantage, the airline will have to engage in R&D; otherwise, they will have difficulties keeping up with competition.

1.1 Innovation: an everlasting component in our society

Humans have been innovating since we started doing business with each other. Ever since, people have improved their products and services to increase their revenue streams; from the grocer discovering that polishing their potatoes increased the sales, to Apple improving the camera on their iPhones. Innovation increases the cash circulation and contributes to economic growth.

Innovations usually come as a response of emerging demands and in the years to come the western world will experience a decrease in the working-age population. We will thus experience an increased fiscal pressure because a smaller workforce has to support an ageing population. In addition, the demand for different products and services are expected to change as the age of the population increases (OECD, 2015, p. 42).

Despite innovation being important for economic growth, firms do not invest in enough R&D and innovation to sustain the economic growth. In our opinion, the most prevalent and distortive reasons for the underinvestment in R&D are market failures, spillovers and the characteristics of innovation, which we will elaborate in chapter 3.

Because of spillovers and market failures, governments have to stimulate investments in R&D in the private market, in which SkatteFUNN is an example. By stimulating R&D using public funds, governments intend to incentivize a level of R&D in the private market that maintains or increases the economic growth (OECD, 2015).

1.2 R&D goals in Norway and abroad

In 2017, the R&D investments in Norway was at 2.110 percent of GDP, which is below the 2.368 percent average for the OECD countries (OECD, 2019). The goal from the «Europe 2020» strategy is to invest 3 percent of GDP in R&D by 2020 (The European Commission, 2010, pp. 8-9). In order for the EU to reach their 3 percent target, they depend on the Member States to reform their national R&D systems in a way that support and enhances investments in R&D. In particular, the Commission supports tax incentives and other financial instruments to boost the private investments in R&D (The European Commission, 2010, p. 11).

In OECD countries, promoting private R&D through tax incentives have become a major tool, and as of 2017, 30 out of 35 OECD countries provided tax reliefs for R&D expenditures (OECD, 2018, p. 5).

Norway has not reached the goal from the Lisbon agenda to invest 3 percent of GDP in R&D. We are also far behind our neighbor, Sweden, who had a total R&D spending of 3.26 percent of GDP in 2015. In Norway, the same number was 1.93 percent (The World Bank, 2019).

The Norwegian government has implemented three major schemes to incentivize investments in R&D and innovation. These three are SkatteFUNN, funding from Innovation Norway and the Research Council of Norway (RCN). The support from RCN and Innovation Norway are of a selective nature. Innovation Norway grants are given based on professional assessments and guidelines (Statistics Norway, 2008, pp. 32, 35).

The SkatteFUNN scheme is a tax incentive implemented in 2002 in order to incentivize private R&D investments. The scheme was originally meant for SMEs, but in 2003, large firms were included. Compared to other similar schemes, SkatteFUNN has a relatively easy application process, and a higher percentage of accepted applications. SkatteFUNN has a low threshold for applying and is not exclusively meant for difficult and exhausting projects (Klevstrand, 2017). The Research Council of Norway reported that the budgeted tax credits from SkatteFUNN has increased by 158 percent between 2013 and 2017 (The Research Council of Norway, 2013d).

Samfunnsøkonomisk Analyse AS published the latest SkatteFUNN-report in 2018. The Ministry of Finance reported in the government budget for 2015 that they wanted an external evaluation of the SkatteFUNN scheme to investigate whether the scheme was an efficient use of the public resources (Ministry of Finance, 2015). Samfunnsøkonomisk Analyse addressed the impact of SkatteFUNN on R&D investment, innovation, productivity and the potential for misuse (Benedictow, et al., 2018).

They found that SkatteFUNN increased investments in R&D, especially small projects. The positive effects of SkatteFUNN was regarded as larger than the costs of misuse and other distortive effects, and thus, they recommended that the scheme should be continued (Benedictow, et al., 2018, pp. vii-viii).

1.3 Research question

We wanted to write a thesis that was relevant for the tax authorities and had a benefit to society. After a conversation with a representative from the Norwegian Tax Administration, we got an insight into a number of topics that would be interesting for us to look into. The Tax Administration expressed their interest in misuse of the SkatteFUNN scheme. However, Samfunnsøkonomisk Analyse researched two types of misuse. We have thus chosen to put our focus elsewhere.

We got the impression that corporate groups might be problematic because they can restructure to optimize from the scheme. Our own research in newspapers also indicated that this might be an issue. In December 2017, Dagens Næringsliv published an article that highlighted the

fact that large firms got millions in support for their projects (Klevstrand, 2017). The article claimed that an increased level of the SkatteFUNN tax credits were given to large firms, and to projects that were not checked for quality (Klevstrand, 2017). Large firms and corporate groups carry a large portion of the R&D projects, and thus receive a larger piece of the SkatteFUNN tax credits, which may indicate that groups are problematic.

In our research, we will focus on the change in number of firms per group receiving SkatteFUNN to see if the structure changes with a change in the scheme.

We came up with the following research question:

"*Do corporate groups restructure to optimize from the SkatteFUNN scheme?"*

By "restructure" we mean that the number of firms in groups increases or decreases with a change in SkatteFUNN. To answer our question, we will investigate how corporate groups are structured and whether there is a tendency that corporate groups exceed the purchased threshold. When looking at the structure of the groups, we will calculate how many firms per group receives SkatteFUNN and perform a regression analysis to see if there is a change in number of firms in groups when the scheme changes. We will summarize the total SkatteFUNN costs per group to see whether any groups exceed the purchased R&D threshold.

We know from the Samfunnsøkonomisk Analyse report that the R&D costs has increased rapidly the last couple of years, and the increase has been particularly large after 2013 (Benedictow, et al., 2018, p. 9). Because SkatteFUNN is a small scheme, we wanted to see whether the rapid increase in SkatteFUNN costs is reflected in the operational expenses for SkatteFUNN receivers.

We came up with the following sub-question:

"*Do operational expenses change with a change in the SkatteFUNN scheme*?"

The thought is that if the operational expenses increases rapidly for the SkatteFUNN receiving firms after the 2014 change in threshold and hourly cost cap, then the R&D costs constitute such a large amount of the operational expenses that it implies the operational expenses do not consist of other types of expenses.

In May 2019, the government published a consultative paper on the SkatteFUNN scheme, where they suggested several different changes to the scheme. We will discuss some of the implications these changes may have based on our results.

1.4 Outline

The rest of the thesis is structured as follows: chapter two introduces SkatteFUNN in detail; chapter three gives important theoretical concepts through former research and hypotheses. Chapter four presents the methodology used in this thesis, chapter five gives the presentation of the results and chapter six presents the discussion, conclusion and suggestions for further research.

2. SkatteFUNN

SkatteFUNN is a tax deduction scheme for Norwegian firms' R&D expenses. The scheme was established in 2002, and the goal is to motivate firms to increase their investments in R&D (The Research Council of Norway, 2013a). The tax credit for small and medium sized enterprises (SME) is 20 percent of the project costs, and for large firms the tax credit is 18 percent.

When SkatteFUNN was implemented in 2002 only SMEs were eligible for the tax credit. In 2003, the government decided to include large firms. They implemented an 18 percent tax credit and argued it would keep the aid intensity for large firms from becoming too high according to EU law (Statsbudsjettet, 2003). The scheme has become more popular over the years, and in 2018, they reached a new record of more than 4500 applications (The Research Council of Norway, 2013c).

The SkatteFUNN scheme apply to all firms that are liable to pay corporate tax in Norway. The scheme is neutral in application and rights based, i.e. there are no restrictions regarding the firm size, business model or industry. For the firms to be eligible for SkatteFUNN, they have to meet a set of requirements adhered by The Research Council of Norway (The Research Council of Norway, 2013a). Foreign firms are also eligible to apply for SkatteFUNN. The prerequisite is that the project is in connection with the tax liable operations in Norway (Hambro, 2012, p. 217).

There have been several changes in the scheme over the years, and today the maximum project cost per year is 25 million NOK for intramural R&D and 50 million NOK for purchased R&D. The purchased R&D has to be conducted by an approved R&D institution in order to be eligible for the tax credit. In cases where the project cost is 25 million NOK, the tax deduction is 5 million for SMEs and 4.5 million for large firms. If the project cost is 50 million NOK, the tax deduction is 10 million for SMEs and 9 million for large firms. If the tax credit exceeds the amount the company have to pay in tax, the residual is paid in cash to the firms (The Research Council of Norway, 2013a). The higher threshold for purchased R&D is based on the assumption that the R&D conducted by a research institution will have a wider spread (i.e. knowledge spillover), and is therefore more valuable to society (Hambro, 2012, p. 236).

Year	Budgeted R&D costs	Budgeted tax deduction	Number of projects
2002	4.5 billion	0.6 billion	N/A
2003	9.0 billion	1.3 billion	N/A
2004	9.7 billion	1.3 billion	N/A
2005	9.2 billion	1.1 billion	N/A
2006	8.6 billion	1.4 billion	4055
2007	8.5 billion	1.4 billion	3735
2008	8.3 billion	1.4 billion	3527
2009	9.3 billion	1.5 billion	3560
2010	10.1 billion	1.7 billion	3579
2011	10.9 billion	1.8 billion	3577
2012	12.1 billion	1.9 billion	3811
2013	13.1 billion	2.2 billion	3975
2014	16.2 billion	2.7 billion	4821
2015	20 billion	3.5 billion	5819
2016	27 billion	4.8 billion	6925
2017	32 billion	5.6 billion	N/A
2018	32 billion	5.7 billion	7440
Sources: Statistics Norway (2007), The Research Council of Norway (2008), (2009), (2010), (2011), (2012), (2013d), (2014), (2015), (2016), (2017) & (2019)			

Table 1: Budgeted SkatteFUNN costs

In column 2 of the table above, you find the budgeted R&D costs the government has reported in the State budget each year. In column 3, you can see the budgeted tax deduction for the SkatteFUNN scheme, and in column 4, you can see the number of active SkatteFUNN projects per year. In 2008, there were 3527 active projects, which is the lowest observation. The table

shows that after 2009, the scheme has grown. It seems to become more popular, considering both the budgeted tax deductions, and number of active projects.

SkatteFUNN entails administration costs for both the applying firms and the government. The Samfunnsøkonomisk Analyse report found that all firms receiving SkatteFUNN in 2015 had administration costs of 93 million NOK in total, excluding cost of consultants. About a third of the responders in a survey says they have used consultants in the application process, which increased the administration costs. The Research Council of Norway spent NOK 17 million on the administration of the SkatteFUNN scheme in 2015 (Benedictow, et al., 2018, p. 17).

2.1 Background for the SkatteFUNN scheme

Until the 80's, the main focus on R&D in Norway was centered around the educational institutions. NTH (later NTNU) was built up as a technological center in Norway. Investments in the private sector were neglected. In 1980, a public selection lead by the bank manager of Den Norske Creditbank, Lars Thulin (Tvedt, 2014) suggested that the government should implement additional incentives for R&D investments in the private sector. Small changes were made to the existing incentives, but none had major effects on R&D investments in private sector (Ministry of Trade, Industry and Fisheries, 2000). In 1995, Chairman of Norsk Hydro AS, Torvild Aakvaag, lead a public selection that described many of the same concerns as Thulin. They focused even more on the concern regarding the reduced long-term income from the petroleum sector. Issues regarding the non-existing venture capital culture in Norway was noted. Mechanisms and schemes that could help with these issues were proposed. The most important consequences of these two reports was a tax deduction scheme that reduced the private firms total tax burden, and a state-owned fund which focused on seed funding (Ministry of Trade, Industry and Fisheries, 2000).

In 1999, a public selection led by Professor Arild Hervik was assembled to analyze measures to increase private R&D investments in Norway (Ministry of Trade, Industry and Fisheries, 2000). The Hervik selection came up with the scheme that later became SkatteFUNN.

2.2 Definition of an R&D-project

The definition of an R&D-project is anchored in the Regulation for Completion and Implementation of the Tax Act §16-40 (lovdata.no, 1999). The definition is based on the definition from the OECD's Frascati-manual. An R&D-project is understood as a defined and targeted project where the aim is to obtain new knowledge or new skills that is assumed to be of use for the organization in developing new or improved products, services or production processes (lovdata.no, 1999). Activities part of the daily operations are not included in the definition (lovdata.no, 1999). A project is a one-time task that has a clear goal, start and finish, and differs from the routine work of the firm. The project has to create new knowledge or new capabilities (Hambro, 2012, pp. 179-180).

2.3 Definition of SMEs

Generally, firms eligible for a 20 percent tax deduction are firms with less than 250 employees, and has an income not exceeding €50 million or a yearly balance sheet total that does not exceed €43 million, cf. §16-40-5(1) (lovdata.no, 1999). When identifying the number of employees, a firm has, the calculations are built on its financial statement. If the organization engages in partnerships or joint ventures, then these are to be included when calculating the total number of employees plus all financial amounts (§16-40-5(2)) (lovdata.no, 1999).

An additional requirement is that the firm has to be independent (Hambro, 2012, p. 239). The principle of independency is upheld when a firm who fall outside the ESA definition of SMEs owns less than 25 percent of the capital (Statsbudsjettet, 2003). Independent in this case means that the affiliates and partner firms have to be identified. If such firms are identified, and the combined financial amounts of the group exceeds the definition of an SME, none of the firms in the group will be regarded as SMEs. They will thus be eligible for the 18 percent deduction (Hambro, 2012, pp. 239-241).

2.4 Costs incorporated in SkatteFUNN

A firm can incorporate several types of costs in the SkatteFUNN-project. In general, all costs that incurs because of the project in excess of the firm's daily operations, are eligible. If the firm has to buy new equipment in order to implement the project, the costs of the new equipment can be incorporated (Hambro, 2012, pp. 222-223). However, if the equipment has a residual value after the project is finished, the firm cannot register the full purchase price as costs in relation to the SkatteFUNN-project (Hambro, 2012, pp. 227-229).

The maximum hourly wage is 600 NOK, and the maximum number of hours allowed is 1850 per employee per year. Costs for personnel outside the firms are to be fully incorporated in the SkatteFUNN-foundation. This also applies for people employed in a group-related firm (Brumoen, 2017).

2.5 The Application Process

The Research Council of Norway approves the applications for SkatteFUNN. The organizations have to fill out an online application-form that includes all relevant information the RCN needs to evaluate the project. Applications the RCN receives before September 1st are to be evaluated before year-end. Costs related to the project that occurs before the approval of the application may be deductible as long as they have occurred the year of application. The projects are approved for a three-year period. If the project lasts longer than three years, the firm has to apply for SkatteFUNN again (Hambro, 2012, pp. 251-252).

All organizations that apply for deductions in accordance with the Tax Act §16-40, has to keep a separate project account for the R&D project, which has to include both the actual costs of the project and the budgeted costs (lovdata.no, 1999). If the life span of the project is more than one year, the firms will have to submit a yearly report in addition to the final report at the end of the project. Both are due March 1. The firms have to attach an auditor certified, electronic form for all project expenses in connection to the tax return (The Research Council of Norway, 2013b). The RCN is eligible to withdraw the project approval if the project does not satisfy the requirements (§16-40-10) (lovdata.no, 1999).

A number of elements has to be included in an application for SkatteFUNN. In Hambro's (2012) book, Hambro provides information on what the application looked like in 2012. The electronic application form asked for information about the project title, the project sector, the main aim of the project, what period the project is supposed to run, and a work schedule. In addition, the applicant has to provide a description of the new knowledge or skills the project is to provide, or to provide a description of the new or improved good, service or production process. They also have to provide a description of how the project will be of use to the firm, and a number of other elements have to be included. For example, they have to include whether the firm has used a consultant to fill out the SkatteFUNN application (Hambro, 2012, pp. 295-305).

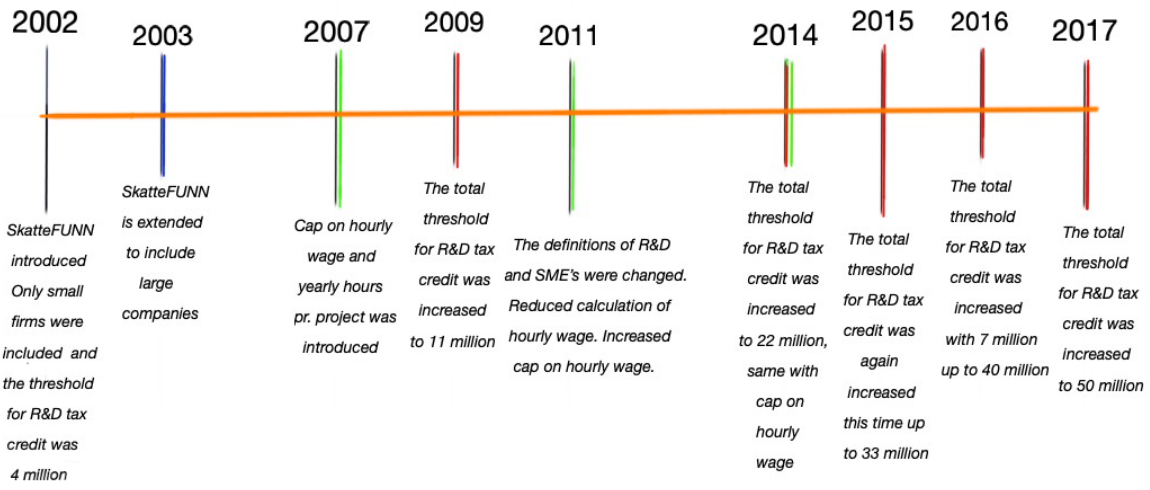
The project will be approved if it meets the definition of R&D. What constitutes R&D is not decided by how the R&D is conducted, but rather the nature of the project (Hambro, 2012, p. 177). According to Hambro (2012), the most frequently used reason for rejecting an application is that they are not clear enough on what type of knowledge or skills the project is to provide (Hambro, 2012, p. 178). Only projects that are useful for the organization are to be approved. Useful means that the firm can use their R&D results in future production of goods or services or in their general turnover (Hambro, 2012, p. 194).

2.6 Rationale for the cost cap of SkatteFUNN

Many countries have schemes targeting SMEs; Norway included (European Commission, 2017, p. 5). The rationale behind the differentiation between SMEs and large firms is that small firms experience financing constraints more often than large firms. In addition, studies have found the effectiveness of R&D tax incentives to be higher for SMEs than large firms, and might thus be a cause for different subsidization rates (European Commission, 2017, p. 3). In addition, the aid intensity has to comply with the State Aid rules of EU law. Some researchers recommends that the tax incentives should not be based on the firm size, because the preferential treatment of SMEs may discourage firms to grow (European Commission, 2017, p. 11).

The SkatteFUNN cost cap, or threshold, have changed several times after its introduction in 2002, see figure 1. In the beginning, the threshold was at four million for intramural R&D

and eight million for purchased R&D. The threshold changed in 2009 to 5.5 million NOK for intramural R&D and 11 million NOK for purchased R&D. In 2014 and 2015, the thresholds were changed to eight million and then 15 million for intramural R&D and 22 million and then 33 million for purchased R&D. The threshold was again changed in 2016 to 20 and 40 million, and in 2017 to 25 and 50 million (Benedictow, et al., 2018, pp. 7-8).



Source: Samfunnsøkonomisk Analyse (2018, p. 8)

Figure 1: Main Changes in SkatteFUNN

Prior to the change in 2009 from four to 5.5 million for intramural R&D and from eight to 11 million for purchased R&D, Statistics Norway released a report where they recommended that the threshold for intramural R&D should be changed to five million NOK because of the increases in costs and salaries between 2002 and 2009. The Ministry of Finance argued that the four million NOK threshold should be kept because many of the SkatteFUNN receiving firms had lower R&D costs than the threshold. However, the threshold was changed to 5.5 million NOK in 2009 because they wanted additional projects to be invested in, and hoped the projects would be completed faster (Ministry of Finance, 2009a; Ministry of Finance, 2009b). In addition, the change was made to offset the expected decreases in R&D during the financial crisis (Benedictow, et al., 2018, p. 8).

When the threshold increased again in 2014, the rationale was that the increase in threshold would hopefully incentivize increased cooperation between firms and research institutions to contribute to the completion of more economically profitable projects (Ministry of Finance, 2014). In 2015, they increased the threshold to incentivize larger R&D projects (Ministry of Finance, 2015). When the threshold increased in 2016, it was explained as a step in the government's efforts to increase private investments in R&D (Ministry of Finance, 2016). In 2017, they hoped again that if the threshold increased, larger projects would be conducted and the projects would be completed at a faster pace (Ministry of Finance, 2017).

In 2007, the Government introduced the cost cap on the hourly wage, which was a result of a report from the Norwegian Government Agency for Financial Management. The cost cap introduced was an hourly wage of 500 NOK and maximum 1850 hours per employee a year (Ministry of Finance, 2007). The cost cap of 500 NOK per hour was arguably too small, which is why the cap was changed to 600 NOK per hour in 2014 (Benedictow, et al., 2018, p. 8).

The literature gives the rationale for an 18 and 20 percent tax credit. Guellec and van Pottelsberghe (2000) found that the relationship between government support and private spending on R&D has an inverted U-curve, where the highest effect of government support was at a subsidization rate between 4-19 percent. Their study looked at 17 OECD countries. The elasticity was negative at a level above 20 percent (Guellec & van Pottelsberghe, 2000, p. 13). The figures are mainly illustrative: not only will they vary between different countries because of politics and economic conditions; they will also vary across time. In addition, several studies have shown that the effectiveness of the scheme increases with a stable policy (Guellec & van Pottelsberghe, 2000, p. 14). Other factors that affects the effectiveness of the tax credits are predictability, refundability, and if there is a time lag between the R&D investments and the reception of the tax credit (European Commission, 2017, p. 4). In countries where the level of funding is either too low or too high, the private R&D investments would be lower than in countries offering an intermediate level of funding (Guellec & van Pottelsberghe, 2000, p. 17).

The Regulation to the Tax Act states that when the received aid of the project exceeds the maximum allowable aid, a reduction in the tax credit has to be made (lovdata.no, 1999). If a Norwegian firm receives funding from either Innovation Norway, the Research Council of Norway, and/or other agencies providing aid in addition to SkatteFUNN, the firms' auditor has to make sure that the sum of the aid is less than the maximum allowable amount in EU

law. If the firm receives funding from several agencies and the aid exceeds the limit, then the SkatteFUNN amount granted to the firm has to be reduced in order for the firm to stay within the limits of EU law.

2.7 Bang for the Buck

In order to assess whether the SkatteFUNN-scheme has been successful, Samfunnsøkonomisk Analyse AS measured what they called "bang for the buck" (BFTB). This is a measure that tells us how much more has been invested in R&D per NOK invested by the state in SkatteFUNN (Benedictow, et al., 2018, p. 54).

In order to measure the BFTB, the report uses two different approaches. The first approach is assessing the firms' reaction to changes in the price index for R&D investments. If a firm spend all the tax deduction from R&D schemes on investments, the input additionality is equal to one. If they spend more than the tax deduction on investments, the input additionality will be larger than one. If the project would have been invested in either way, the input additionality is zero. A project that would not have been undertaken without the tax incentive has a BFTB of five (1/0.20) if the firm is an SME and 5.56 (1/0.18) if the firm is large. According to Samfunnsøkonomisk Analyse, a BFTB of one is considered acceptable. Their research found that SkatteFUNN has a BFTB of 1.01, which means that for each NOK given in tax credit, one additional NOK is spent on private R&D. However, this number must be interpreted with caution, because the calculation is built on relatively large firms (Benedictow, et al., 2018, p. 54).

In the other approach, the beneficiaries of the tax scheme are compared to a control group not participating in the scheme. In this case, the coefficient of the tax scheme can be used to interpret the input additionality. Using the matching approach, they found a BFTB of 2.07 (Benedictow, et al., 2018, p. 68)

They also calculated the BFTB of SMEs vs large firms, where they provided this table:

	SMES	LARGE FIRMS
POLICY REGIME		
2002-2003	2.104	1.865
2004-2006	2.560	2.603
2007-2008	2.205	2.344
2009-2010	1.869	1.849
2011-2013	1.401	1.899
2014-2015	1.554	1.710

Source: Samfunnsøkonomisk Analyse *(2018, p. 69)*
Table 2: "Bang for the buck" by size of firm

From table 2, we see that the BFTB was higher for SMEs than large firms when the scheme was implemented, but changed over the years to have a higher BFTB for large firms (Benedictow, et al., 2018, p. 69).

Samfunnsøkonomisk Analyse conducted a survey where they found that most of the SkatteFUNN projects would have been conducted independent of the SkatteFUNN scheme, giving the scheme a low BFTB. Without the scheme, however, the projects would be performed in a lower scale or with a delay. They also found that the SkatteFUNN support allowed firms to take higher risks with the projects and increased the ambition levels (Benedictow, et al., 2018, pp. 40-41).

In 2008, Statistics Norway released a report on SkatteFUNN. To measure input additionality, they limited their sample to firms that had reported positive R&D-investments before SkatteFUNN was introduced, i.e. the sample only included “R&D-firms” (Statistics Norway, 2008, p. 19). Based on their estimates from their regressions, they found an input additionality between 1.3 and 2.9, where their best guess is an input additionality of 2. Their empirical results show that the SkatteFUNN scheme has increased the private R&D investments (Statistics Norway, 2008, p. 24).

Not only will the BFTB be affected by the effectiveness of the R&D tax incentive scheme, it will also be affected by what type of tax incentive it is. For example, by nature, incremental tax incentives has a BFTB>1 (Mohnen, Vankan, & Verspagen, 2017).

2.7.1 BFTB in Australia, the Netherlands and Québec, Canada

Holt, Skali and Tomson (2016) studied the new Australian tax incentive scheme and calculated the BFTB. The results from their propensity score matching analysis show that firms receiving R&D tax incentives spent 50 percent more on R&D than firms that did not (Holt, Skali, & Thomson, 2016, p. 14). They estimated the additionality to be 0.8. Their difference-in-difference analysis gave an additionality of the new scheme of 1.9, which is higher than the BFTB of 0.8 they found in their propensity score matching (Holt, Skali, & Thomson, 2016, pp. 20-21).

For the BFTB in the Netherlands, Lokshin and Mohnen (2007) found a BFTB of 0.9, using a fictive scenario without the tax incentive program. The calculated BFTB was a weighted sum of individual rates of R&D and the costs the government had because of the tax incentive program (WSBO). In line with the results from Samfunnsøkonomisk Analyse, they found the effect to be largest for the smallest firms, which had a BFTB of 6.4 the first year, and after a few years the BFTB declined to 1.87. For large firms the BFTB the first year was 1.02 while a few years later it was down to 0.37 (Lokshin & Mohnen, 2007; Benedictow, et al., 2018, p.70).

Baghana and Mohnen (2009) analyzed the R&D tax incentive in Québec, Canada, using data from 1997 to 2003. They found the BFTB for both large and small firms, by dividing R&D arising from the tax incentive by the total cost of the government for the support of the scheme. The results show that for small firms, the BFTB starts at above six and slowly drops but is always higher than one, even after 20 years. Large firms' BFTB, however, starts at three and drops below one after only seven years (Baghana & Mohnen, 2009, pp. 101-102).

2.8 SkatteFUNN on public consultation

In May 2019, the Department of Finance submitted a proposal for changes in the SkatteFUNN scheme based on the recommendations from the 2018 report from Samfunnsøkonomisk Analyse AS (Ministry of Finance, 2019).

First, they want to increase hourly cap on wages from 600 NOK to 650 NOK per hour. At the same time, they suggest reducing the R&D threshold from 50 to 25 million, i.e. to remove the additional 25 million firms can invest in SkatteFUNN by purchasing R&D. In addition, the tax deduction is set at 19 percent instead of 18 and 20 percent. They argue for the 19 percent deduction rate because some large firms will exceed the maximum allowed aid intensity according to the EEA Agreement if the tax deduction rate is at 20 percent (Ministry of Finance, 2019). In addition, a mutual deduction rate will also reduce the administration costs of the scheme.

The new hourly wage cap of 650 should also include the wages for employees from related parties, limiting corporate groups' opportunity to optimize from the scheme. The projects bought from abroad are suggested to only extend to the EU (Ministry of Finance, 2019).

They have also tried to address some of the issues with SkatteFUNN and are planning to implement some changes that will make it harder for firms to misuse the scheme. They want the person responsible for the SkatteFUNN project to sign time sheets in addition to submitting a project account from the subcontractor (Ministry of Finance, 2019).

The new changes are assumed to have no impact on the level of SkatteFUNN support given by the government, and they want to implement the changes in 2020 (Ministry of Finance, 2019).

The consultation deadline is set to 2nd of August 2019 (Ministry of Finance, 2019).

3. Theoretical Concepts – Investing in Knowledge

We could not find any relevant articles or theories for what we have chosen to research. Particularly, we missed research on R&D tax incentives and groups. We believe groups to be different from individual firms because they can avoid financing constraints. Because of the lack of literature, we have chosen to look into why we have R&D tax incentives to begin with. We will look into the financing constraints and market imperfections that makes it difficult for firms to invest in R&D. In spite of the market failures, it is important that firms invest in R&D to secure future income and growth. Thus, in order to increase the investments in innovation and R&D, the government has decided to implement schemes like SkatteFUNN, along with several other measures. We have included literature on large firms and R&D, and we assume that large firms and groups might have similar financing constraints.

3.1 Investing in R&D and Innovation

Brownyn H. Hall defines research and development as the activities that conducts innovation and improvement of products and processes. R&D has been considered an indicator for innovation worldwide for ages (Hall, 2006). Investments in R&D and innovation is considered a driver of sustainable economic growth and competitiveness. Underinvestment in R&D can be detrimental not only for firms, but for society. Underinvestment can cause lower competitiveness and decreased economic performance (Czarnitzki & Hottenrott, 2010, p. 2).

In the beginning of a R&D-project, the knowledge base of the employees are particularly important for the firm. This causes firms to smooth out their R&D spending over time, so they do not have to lay off knowledge workers during recessions, and thus the R&D spending are treated as if they have high adjustment costs. This has two implications for firms: the rate of return on R&D investments is high to cover the adjustment costs, and it is difficult to measure the impact of changes in the costs of capital (Hall, 2010, pp. 2-3) (Hall & Lerner, 2010, p. 612).

In line with any other investment, investments in R&D need financial resources. What separates investments in R&D from other types of investments is the fact that investments in innovation and R&D are highly uncertain. Usually, firms research something never researched before. It is hard to get investments for an uncertain project, and therefore the projects require more capital from the firms themselves (Czarnitzki & Hottenrott, 2010, p. 5).

In addition to being difficult to finance, R&D projects are also highly firm specific. This makes the projects hard to implement in other firms until completion, when the project can be implemented in other firms. In addition, these investments involve high information asymmetries between the investor and the researchers, along with a number of other market imperfections (Czarnitzki & Hottenrott, 2010, p. 5).

3.1.1 Information asymmetries

The problem with asymmetric information is the fact that the inventor of a product/service has a much better understanding and knowledge of whether the product/service will be successful compared to the potential investor. Because R&D is intangible, it is more difficult for investors to distinguish the good from bad projects (Hall & Lerner, 2010, p. 614). The more information for the investor, the better investment decision, but the more information released the worse it is for the innovator to keep competitors away.

Reducing the information asymmetries by giving out more information about the project is not a good way to get funding for the project, because the more information that is available, the easier it is for competitors to imitate the project (Hall & Lerner, 2010, p. 614).

3.1.2 Capital structure

Capital structure can also constitute a reason why it is harder for some firms than others to get external financing in order to pay for investments in intangible assets. Debtholders usually require collateral when they provide loans to firms. Because R&D projects are intangible, it is harder for firms to get external funding for their projects. When applying for external financing, the companies are required to have a stable cash flow, which makes getting a loan for a R&D project harder, especially for SMEs (Hall & Lerner, 2010, p. 617).

3.1.3 Knowledge spillovers from R&D investments

When investing in R&D, the R&D has a potential not only to generate benefits for the firm conducting the R&D, but also for third parties that do not compensate the innovator for their

gain in knowledge. This is called knowledge spillovers (Czarnitzki & Hottenrott, 2010, p. 3). Due to the non-rivalrous characteristics of knowledge, the knowledge acquired from innovations might spillover to competitors both directly and indirectly. The downside is that the firm do not get the full competitive advantage of its investment in R&D (Scotchmer, 2004, p. 269). Private firms will thus not invest in R&D at a level that is socially optimal when they have to bear all costs of the research while competitors and the society as a whole can benefit from their research.

Knowing that most of the R&D is situated in the larger firms, some of the knowledge from the R&D centers might be spilt over to smaller entities. A study by Acs, Audretsch and Feldman (1994) found that large firms tend to be more concerned with the knowledge created in their own research centers than what smaller firms are (Acs, Audretsch, & Feldman, 1994, p. 340). This entails that large firms tend to be less likely to invest in projects with high knowledge spillovers. In cases where the potential for knowledge spillover is high, a government-supported R&D incentive is a good measure (Feldman & Kelley, 2006, p. 1509).

3.2 Public R&D policies

One of the benefits with R&D is that it can have an impact on several users at the same time, which is why it is socially beneficial to carry out the projects. In order to increase total R&D spending, private R&D investments are incentivized through publicly financed schemes. These schemes are justified because countries will usually not reach the socially optimal level of R&D investments without them. Government R&D subsidies might also incentivize other external investors to invest in a project. When the government with their standards and reputation accepts a risky project, it signals that the project has monetary value. Especially if the government scheme is associated with commercial potential, the external investors will consider their accepted projects as less risky compared to other high-risk R&D investments (Feldman & Kelley, 2006).

3.2.1 Different forms of incentives

There are several ways a government can incentivize investments in innovation and R&D. For example, the government can grant direct subsidies or tax incentives, in which Norway has

both. Innovation Norway and the Research Council of Norway grants direct subsidies. In addition, Norwegian firms can receive grants from other countries as well, as long as the grants are provided according to EU law. The direct incentives are selective, and not all firms performing R&D get the grants. When it comes to tax incentives, there are different ways of granting the subsidy: tax credits or tax allowances. What firms prefer depends on their tax position. In many cases, large firms would be indifferent to receiving a tax credit or a tax allowance because they are usually normally tax liable. Small firms, however, have the potential of benefitting more of tax allowances than tax credits, because tax allowances reduce their taxable income. Tax credits arguably has a higher effect on the decision-making regarding R&D, because they are directly applied to the R&D budget. Tax credits are thus more visible to the firms conducting R&D, in addition to being more likely to encourage or incentivize higher R&D investments (OECD, n.d, p. 28).

Most OECD countries use either incremental tax incentives or volume-based incentives. Volume-based incentives are the most common. One of the biggest disadvantages with a volume-based incentive is that this form of incentive subsidizes projects that would have been invested in either way. However, volume-based incentives tend to be easier for both governments and firms. Because they will receive higher tax credits, firms conducting a high level of R&D will prefer the volume-based incentives (OECD, n.d, pp. 16, 28).

While incremental incentives are more complex and harder to handle, it is however, more likely that incremental schemes target new projects in addition to projects that would not have been invested in without the incentive. By the nature of the design of incremental incentives, they have a BFTB>1 (Mohnen, Vankan, & Verspagen, 2017). Thus, the incremental incentives may have a higher value for society (OECD, n.d, p. 28).

SkatteFUNN is a volume-based incentive. In addition to the advantages of tax credits mentioned above, there are several other advantages of investing in R&D. Taxes are one of them.

3.2.2 Taxes

In most OECD countries, R&D is expensed when they occur instead of capitalized and depreciated (Hall & Lerner, 2010, p. 613). Because the costs are expensed, the effective tax

rate is lower for R&D assets. The depreciation of R&D assets is less than the depreciation allowed for tax purposes, and the required rate of return is lower. Some countries offer tax credits or subsidies to R&D, that can reduce the after-tax cost of capital even more (Hall & Lerner, 2010, p. 618).

3.3 Firm size and innovation

Schumpeter's view on firm size and innovation was that large firms had an advantage in capital-intensive industries due to entry barriers, while small firms on the other hand were the most innovative in less capital-intensive sectors (Schumpeter, 1950). Schumpeter's view is supported by Acs and Audretsch (1987), who found when studying U.S. firms, that large firms tend to be most innovative in capital- and advertising-intensive industries. Small firms tend to be most innovative in highly innovative industries as well as industries with a high proportion of large firms. The results in Acs and Audretsch's report gave an average innovation rate among small firms about 43 percent higher than large firms. However, the difference between small and large firms vary between industries (Acs & Audretsch, 1987, pp. 567-569).

Research from Québec and Japan shows that large firms are benefitting the most from the tax credit scheme (Baghana & Mohnen, 2009, pp. 96-97; Koga, 2003, p. 645). In a report from Québec, they discovered that a greater part of the applications for the scheme are from SME's, but still the majority of the tax credit are given to large firms. In addition, when looking specifically at tax credits for purchased R&D, large firms tend to get the largest share compared to SME's. (Baghana & Mohnen, 2009, p. 96).

Baghana and Mohnen states that smaller firms are more sensitive to changes in the scheme due to the difficulties of financing R&D (Baghana & Mohnen, 2009, p. 93). In addition, Koga explains that large firms invest more in R&D; they have employed researchers and research centers. The research centers makes large firms able to conduct R&D regardless of changes in the market, and thus enable them to utilize the tax credit scheme (Koga, 2003, p. 646). This is in line with what Shefer and Frenkel (2003) found: groups are more likely to invest in R&D than individual firms (Shefer & Frenkel, 2003). However, large firms need to be included in order for the SMEs to grow into large firms, and to make sure the innovation rate is stable enough to secure economic growth.

3.4 Corporate Groups

Legally speaking, a parent firm owns the majority of the shares in at least one other firm. A group consists of at least two firms and one consolidated entity. The goal of the two firms combined is usually to maximize the result of the two firms. The consolidated entity does not have any direct income because it does not engage or compete in the product market. It is the two business units who compete in the product market, and thus bring the income of the group (Lien & Jakobsen, 2015, p. 18).

The parent firm is assumed to have control over the subsidiary when it owns a substantial part of a firm that directly or indirectly gives more than 50 percent of the shares or votes in a firm (Langli, 2010, pp. 559-560). Control is the decisive factor for whether or not a firm is to be incorporated in the consolidated financial statement. Control can also be gained through agreements (Langli, 2010, pp. 560-561).

One advantage of groups is that the group can have different entities with different management styles in the same sector. One subsidiary might have an innovative culture, where they try different structures and projects that, if successful, can be implemented in the rest of the group. In addition, the diversification that a subsidiary can bring means that the parent firm do not need to change how they operate, or to change their culture in order to achieve their innovative goal (O'Reilly & Tushman, 2016, pp. 185-187).

There are several reasons for why a firm would want to acquire another. Berk and DeMarzo (2017) gives several: economies of scale and scope, vertical integration, expertise, monopoly gains, efficiency gains, tax savings and operating losses, diversification, earnings growth and managerial motives (Berk & DeMarzo, 2017, pp. 998-1004).

Large firms enjoy economics of scale, where they because of their size and production in high volume, enjoy discounts because of the sheer volume they order. The large firms can also enjoy economics of scope from combining the distribution and marketing of related products. Vertical integration occurs when two firms in the same industry merge. These firms make products required at different stages in a production cycle. Firms that engage in vertical integration usually do so because they believe they can enhance the production cycle or

product itself. The expertise of the employees in a firm can be reason for acquiring it, usually because it is hard to find the qualified personnel in the labor market (Berk & DeMarzo, 2017, p. 999)

A company may be acquired because the purchase reduces competition. The acquirer may also believe that they can run the organization better and more efficient than the present management. Another reason for acquiring a firm is to offset operating losses; a loss in one division can be offset by profits in another. A firm may want to acquire another because of the advantages of diversification; risk reduction, liquidity reasons, debt capacity and borrowing costs. By conducting a merger, the earnings per share of the merged firm may exceed the earnings per share of the premerger firm, usually because of synergies. Managers might have their own reasons to merge, usually conflicts of interest or overconfidence. Managers would rather manage a large unprofitable firm than a small profitable one. In addition, overconfident managers believe that they have the skills and ability to manage the merged firm, when they really do not. Rather than create value, they destroy value (Berk & DeMarzo, 2017, pp. 1000-1004).

Small firms have a particular advantage of being a part of a group; the parent firm can help with the funding of projects that a small firm alone will have problems financing. In addition, the parent firm can contribute with their knowledge and expertise in such projects.

3.5 Hypotheses

Because of the financing constraints faced by small firms when investing in R&D, we believe that the majority of SkatteFUNN receivers are relatively large firms.

Based on what we found about innovation and firm size, we expect to find that large firms are conducting more intramural R&D than SMEs, because large firms tend to keep their innovation in-house.

The threshold for SkatteFUNN has been increased to include larger firms and larger projects. Therefore, we believe that relatively speaking, firms will report higher R&D costs after an increase in threshold.

When considering corporate groups, we believe that the minority of firms in a group actually report R&D costs, because investments in innovation and R&D are rare.

As for whether firms establish subsidiaries to receive more SkatteFUNN, we believe that this might be a problem. We know that those who see the opportunity to optimize from the scheme probably will do so. Thus, we expect to find some change in the group structure when the threshold increases.

4. Methodology

4.1 Data

In our study, we have used data provided by the Norwegian Tax Administration (Skatteetaten). We got access to three different datasets through NoCeT (Norwegian Center for Taxation). The first dataset includes information about SkatteFUNN-receivers from 2005 to 2016, including project costs for firms in the "SME" and "Large firm" category. It also includes information about cost of unpaid work. The second and third dataset contain accounting data from Norwegian firms in the period from 2006 to 2015. This data is mainly collected from RF-1167 (Income Statement 2) and RF-1123 (Controlled transactions and accounts outstanding) and are self-reported once a year by the firms. The dataset also includes information about the parent firm, retrieved from the Register of Shareholders (Aksjonærregisteret). Based on numbers provided by Statistics Norway, our datasets include information about 50 to 60 percent of the firms in Norway (Statistics Norway, 2019).

The datasets provide an extensive amount of information, and we needed variables from all datasets. The datasets were sorted by year and organizational number, and in cases where we needed information for several years, we had to merge the datasets. For a section of the analysis, it was necessary to gather the relevant information from 2006 to 2015 in one panel to see the changes over the years clearly.

The datasets contain consistent information on organizational numbers, which makes us able to connect the three different datasets over the years. The data is anonymous and presents fictional organizational numbers. We will thus not be able to conduct a case study or any interviews of employees in firms with interesting accounting data.

4.1.1 Reliability and validity

Numerous elements can affect the reliability and validity of the research. Our data is retrieved by the Norwegian Tax Administration, which in general is assumed to be a reliable source. Several conditions can weaken the reliability of the data and the method used in our thesis.

The data is self-reported to the tax authorities by the firms, and there is no way of knowing if the firms have presented the correct numbers in their financial statement.

From a methodological point of view, there are several problems that can reduce the reliability. First, changes in definitions of for example R&D and SMEs, or changes in threshold may have an impact. For the SkatteFUNN scheme, the definition of R&D and SMEs were changed in 2011. Second, we had to make an assumption about the variable for parent firm, see section 4.1.2, that may provide us with different results than others.

In general, we would say that our dataset is reliable because of its source. As we understand it, the data is the official accounting data that the tax administration work with and should therefore produce the same results repeatedly.

Our dataset contains the entire population of firms receiving SkatteFUNN in Norway. Thus, our results will be applicable to all firms operating in Norway. However, we do not believe our results can easily be generalized to suit other countries because different countries have different tax incentive schemes, although it may give indications of what is going on in other countries with a similar scheme.

4.1.2 Variable for Parent Firm

The datasets provided several variables for the parent firm. We looked at the difference in number of observations to understand which variable we should use in our analysis. One variable contains information from the Register of Shareholders, which is the official register for ownership of shares in Norway. This number is collected from RF-1086 (Shareholder Register Statement) and reported once a year by the firms. The RF-1086 gives information of who owns shares and how many shares they own (Altinn, 2018). The other variable is retrieved from the RF-1028 (income tax form), where the firms report the organizational number of the firm they consider as their parent.

We decided to use the variable from the Register of Shareholders, because it is more extensive, and we consider it to be more accurate due to the more specific definition (who is the owner and how many shares do they own vs. who is your parent firm?, if you have one). The

definition of a parent firm ("toppselskap") is somewhat unclear. If the definition is a firm that owns 50.1 percent or more of the shares in another firm, then we might have lost some observations when the parent firm owns less than 50.1 percent of the shares (because of a fragmented ownership structure). If the definition of the parent firm is the firm with the control of the subsidiary, we are confident we have caught all observations.

The problem with the variable for parent firm provided in the Registry of Shareholders was that there were some observations where the organizational number and the parent firm was the same. In order to get around this problem, we recoded the variable, so all observations had a parent firm, i.e. where the cells were empty, we used the organizational number as the parent firm. Then, we could make a variable counting how many times each parent firm was observed per year, and then remove the observations from our dataset where the parent firm was observed only once. Obviously, a parent firm only reported once have no subsidiaries. This was, however, only a problem in our analysis of corporate groups. All firms are still included in the regression analysis on operational expenses.

4.1.3 Data cleaning

In the process of cleaning and sorting our data, we started with the accounting data, and merged it with the SkatteFUNN data. Then we could see which firm received SkatteFUNN and who, if they had one, was their parent firm.

We decided to remove all variables we found irrelevant to the research question and hypotheses. Therefore, we decided to remove all the variables in the datasets that had no observations or did not contain any information at all. We removed all the observations with missing data in columns that we wanted to use. We decided to remove cells with a "." because it did not provide any information.

We decided to include all observations with the value "0", because we assume that the firms have reported a zero because they simply have nothing other than "0" to report. This will implicate all calculations we have done with means and medians. In some cases, we decided to remove the observations with a zero in order to get the most accurate results.

We have chosen to keep all firms that has reported zero employees in our analysis. Norway have many small firms, and it is reasonable to believe that many of these firms do not have any employees. In Norway, if you own a firm, you can choose not to be employed by the firm. If this is the case, the owner get compensation through dividends, but they do not obtain any social rights, as they would on a normal salary (Altinn, 2018). According to Statistics Norway, approximately 65 percent of all firms in Norway has zero employees, and many of them are full-fledged firms (Statistics Norway, 2019). Leaving these firms out of our analysis will thus entail losing a substantial amount of observations.

To investigate if there is a change in the structure of the groups, we decided to create variables and use descriptive statistics to answer the research question. When it comes to operational expenses, we decided to use propensity score matching by trying to replicate the method used by Samfunnsøkonomisk Analyse. In order to measure the change in operational expenses, we decided to go for a simple linear regression.

4.2 Constructed variables

Here, we will present the most important constructed variables for our analysis. In order to make sense of our data and to understand what we were dealing with, we created different variables in order to count how many times the same parent firm has been reported in a year, and how much they have received.

4.2.1 Duplicates variable

We wanted to create a variable that, in a useful matter, told us how many firms that were part of a group in our dataset. We therefore created a variable using the duplicates function in Stata (statistical software), where we counted the number of duplicates per parent firm. This variable is important because when we knew how many firms there were in a group, it was easier to determine whether the group had organized to optimize from the SkatteFUNN scheme. We used this variable to remove the observations with no duplicates only for our analysis on corporate groups.

4.2.2 Total R&D costs per corporate group

We collapsed the sum of R&D costs for the different groups to get around the fact that we only had R&D per firm and not per group. Using the new collapsed variable, we could count how much each group reported in R&D costs per year. Then, we could identify the groups that reported R&D costs above the purchased threshold.

Using the collapsed variable, we were able to remove all observations where the group in total did not exceed the purchased R&D threshold. Then, we could count how many groups exceeded the threshold each year and by how much. The amount in which the groups have exceeded the threshold, is the amount the government could have saved if the threshold was per group instead of per firm.

4.2.3 Treatment variable

We have constructed two different treatment variables, or dummies. The first dummy equals one if the firm is in a group where at least one firm receives SkatteFUNN, and zero if the firm is in a group where no one receives SkatteFUNN. This variable was used in regressions with corporate groups.

The second dummy was used in our regression on operational expenses. We constructed a dummy for the treatment group that equals one for the SkatteFUNN receiving firms and zero for the control group. This was constructed to distinguish between the treatment and control group.

4.2.4 Event variable

In our analysis, we have conducted several different regressions on the 2014 change in the SkatteFUNN scheme. We constructed an event dummy, which was one for 2014 and 2015, and zero for 2012 and 2013. This variable indicates the time of the change in SkatteFUNN threshold.

4.2.5 Treatment*event variable

We also constructed a variable for the interaction effect (treatment x event). This variable was one for all observations that were in the treatment group after the event and zero for all observations in the treatment group before the event. In addition, it is also zero for all observations in the control group. This variable indicated when there was a change in the SkatteFUNN threshold and enabled us to measure the effect of the event on the treatment group.

4.3 Number of firms in groups

We wanted to look at corporate groups to see if they reorganized to capture the value of SkatteFUNN. We thus chose to exclude all firms who did not report any parent firm. In order for the research to be as extensive as possible, we chose not to exclude any firms from our analysis as long as they reported parent firm and had useful accounting data.

It was important that we looked at the structure of the groups in order to see whether it changed when the SkatteFUNN threshold changed. Ingrid Nergaard Fjeldstad from Skatteetaten told us that this might be a problem in relation to corporate groups; if the structure of the group changes when the threshold changes, it could be that corporate groups tries to optimize from the scheme.

Then, we made a figure that depicts the number of firms in corporate groups receiving SkatteFUNN and a control group in order to compare their development over time. To see if there was a significant increase or decrease in the number of firms in groups receiving SkatteFUNN in 2014, we ran a regression. A significant increase in the number of firms in groups after the 2014 change may imply that groups organized to capture the value of the scheme. We used three dummy variables in the regression; the treatment dummy which was zero for groups not receiving SkatteFUNN and one for those who did, an event dummy and the treatment*event dummy. The regression equation looks like this:

$$log(y_{it}) = \beta_0 + \beta_1 Treatment_{it} + \beta_2 Event_{it} + \beta_3 Treat * event_{it} + \epsilon_{it}$$

The dependent variable is the log of the number of firms in groups. This variable count how many firms have reported the same parent firm, independent of whether they receive SkatteFUNN or not. The treatment group consists of groups receiving SkatteFUNN, and the control group consists of corporate groups that do not receive SkatteFUNN. We were not able to control for other factors that might affect the number of firms in groups because we did not include any control variables.

In addition, when the treatment group is not random, as in our case, an econometric problem occurs. When both the treatment and control group are random, we can compare them directly because they are likely to be similar to each other. When the treatment group is not random, a direct comparison between the two groups may give misleading results. This problem occurs because the treatment and control group may be fundamentally different from each other, which bias our results because we believe we have measured the effect of a change in SkatteFUNN when we really have not. Using propensity score matching would enable us to select a control group that is similar to our treatment group and reduce the bias (Rosenbaum & Rubin, 1983). However, we will not use propensity score matching in relation to corporate groups.

We chose not to use a matching procedure when defining our control group, because our focus was on SkatteFUNN reporting groups and how their group structure changed from 2006 to 2015. The purpose was to see whether there were changes in the group structure along with changes in the scheme. We believe that we are able to observe the changes without a matching control group. In addition, we controlled for being part of a corporate group, which indirectly gives us a control group of a certain size and that avoids financial constraints.

Knowing that firms who invest in R&D are usually large, might weaken our results when we have not matched the groups receiving SkatteFUNN to groups not receiving SkatteFUNN that are similar in size and structure.

4.4 Groups and SkatteFUNN costs

Corporate groups are in a good position using todays SkatteFUNN-rules, because SkatteFUNN is granted per organizational number. This enables groups to optimize from the scheme and divide the R&D activities on each subsidiary in order to get the maximum tax deduction per subsidiary. They can even have an approved research institution in their group in which all other subsidiaries can purchase R&D activities. Thus, the group can divide the SkatteFUNN grants between the subsidiaries in addition to buying R&D up to the purchased threshold for every subsidiary. If the groups do not want to purchase R&D, they can reorganize in such a way that they divide SkatteFUNN projects to each subsidiary so none of them exceeds the intramural threshold.

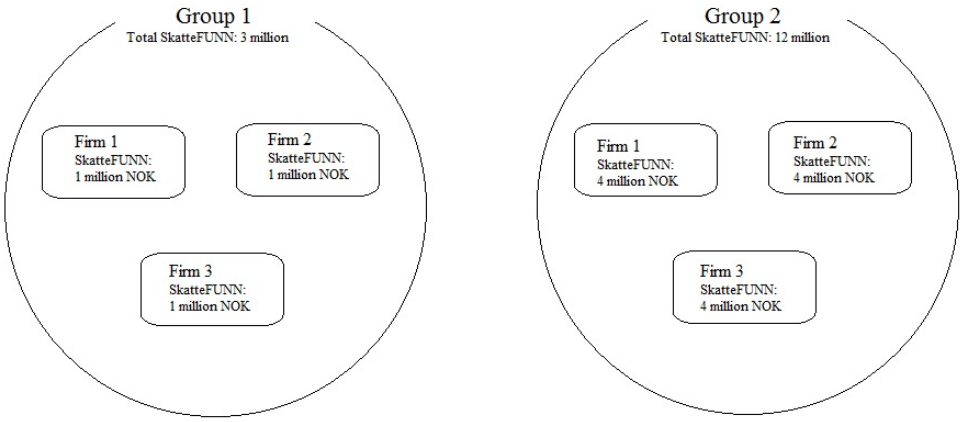


Figure 2: Illustration of group under or at purchased R&D threshold in 2006

Our idea is simple: we will calculate how much each group report in SkatteFUNN costs in total. This should enable us to pick the groups that exceeds the purchased threshold for one firm. Imagine the figure of the two groups above are groups in 2006. In 2006, the intramural threshold was at four million NOK and the purchased threshold was at eight million. Group 1 has three firms, each reporting one million in SkatteFUNN costs, which gives a total of three million NOK. Group 1 obviously have not organized to optimize from the scheme; they are under the purchased threshold for one firm.

Group 2 on the other hand, has the maximum intramural threshold for each firm, and exceeds the purchased threshold for one firm. This group has relatively high SkatteFUNN costs but would still be able to conduct intramural R&D only, a situation we believe it is easy to cheat

on the reported R&D costs. If we were to pick one of the two groups we believe to be reorganizing to optimize from the scheme, it would be Group 2 because of their high SkatteFUNN costs.

By calculating the total costs reported per group, we were able to identify how much the groups received in total of the tax credits given by SkatteFUNN. If the share going to groups is large, it is important that no groups take advantage of the scheme, because it will have a huge impact on the total costs the government has in relation to the SkatteFUNN scheme. We picked the groups we believed to be optimizing from the scheme by imagining that the purchased threshold for one firm was the maximum amount for the group in total. We looked at the corporate group as one unit, and considered all groups receiving more than the threshold for one firm as potential candidates for reorganizing to optimizing from the scheme.

4.5 Change in reported R&D costs from 2013 to 2014

To check if there were any changes in the reported R&D costs in corporate groups from 2013 to 2014, we did a regression analysis using the change in R&D costs as the dependent variable. The only corporate groups present in this regression are the 12 groups observed above the purchased threshold both in 2013 and 2014. We used the event variable and then ran the regression. The regression equation looked like this:

$$y = \beta_0 + \beta_1 Event_{it} + \epsilon_{it}$$

We have used a very simple regression in order to measure the increase we saw in the reported R&D costs for these particular firms. β_0 is the constant, β_1 is a measure of the effect the event has on R&D costs, and ϵ is the error term.

In order to double check whether the results from the regression was correct, we also made a variable for the change in the R&D costs using the natural logarithm. Then, we calculated the average change in R&D costs from year to year and got the same results as we did from the regression.

4.6 Propensity score matching

When we looked at the total R&D costs per year, we observed a large increase in R&D costs after 2013, which made us curious whether the increase had an impact on operational expenses. In addition, we wanted to look at the 2014 change in threshold because Samfunnsøkonomisk Analyse AS looked at the 2009 change in threshold, and Statistics Norway looked at the implementation of the scheme in 2002 (Benedictow, et al., 2018) (Statistics Norway, 2008).

4.6.1 Control group

We wanted to calculate the impact of the 2014 change in SkatteFUNN on the costs of the SkatteFUNN receiving firms. In order to get the best effect when conducting statistical analyses, the treatment group has to be selected randomly. However, SkatteFUNN receiving firms are not random. To get around this problem, we used a propensity score matching procedure. The method is used to pick the control group for our treatment group. The observations in our control group will be the ones that matches the best with the observations in our treatment group (Baltar, de Sousa, & Westphal, 2014, pp. 671-672). We hope that the only difference between the treatment and the control group is that the treatment group is a recipient of SkatteFUNN. We used the method to match one firm from the treatment group with one firm from the datasets containing accounting data, using the propensity score (Neicu, Teirlinck, & Kelchtermans, 2014). The method is based on the idea that the treatment and control group have an equal probability of participating in the program (Benedictow, et al., 2018, p. 60). Formally, the propensity score looks like this:

$$p(x) = prob(D = 1|x) = E(D|x)$$

where D denotes the dummy variable that is one for the treatment group and zero for the control group, and x denotes the different variables used in the matching (Caliendo & Kopeinig, 2008, p. 48).

We chose to use a propensity score matching procedure because we wanted to replicate the study by Samfunnsøkonomisk Analyse. Looking at other studies, we saw that using propensity score matching is quite common when measuring the effects of an R&D tax incentive. Both

Nilsen, Raknerud & Iancu (2018), Holt, Skali & Thomson (2016), Statistics Norway (2016) and Neicu, Teirlinck & Kelchtermans (2014) have all used propensity score matching in their studies. The same econometric problem occurs here as with the regression on the number of firms in groups: when the treatment group is not random, it may be that the treatment and control group are fundamentally different from each other, and we will thus not be able to measure the actual effect of an event. The matching approach is used to avoid the bias that occurs when the firms receiving tax incentives are not random.

Because we do not have data before the implementation of SkatteFUNN, we were not able to do the matching before the SkatteFUNN scheme was implemented even though that is recommended in Blundell and Costa Dias' report on approaches to evaluation in empirical microeconomics (Blundell & Dias, 2009).

We wanted to see how much the operational expenses changed for our treatment group when the threshold increased by 100 percent. We chose to conduct the matching in 2011 to include 2012 in our regression. When we included 2012 in the regression, we got a clearer picture of the common trend that needed to be present in a difference-in-difference analysis. We did not have access to data after 2015, and therefore no opportunity to find the long-term effects of the 2014 change in threshold.

We chose the relatively short period from 2012 to 2015 because we wanted to avoid unnecessary bias to our results. We wanted to avoid macroeconomic shocks such as a financial crisis, or any other changes in the SkatteFUNN scheme. Although we have a new change in threshold in 2015, we chose to include 2015 in our analysis. However, we regressed with and without 2015 in our data to see whether the results were significantly different from each other.

We decided to remove observations of firms that received SkatteFUNN after 2011. Having firms in the control group that later receives SkatteFUNN will bias our results, because the control group will be influenced by changes in the SkatteFUNN threshold. We deleted all firms reporting the year of 1000 as year of establishment, because we believe them to be wrongly reported. We also deleted all firms with missing data on the variables we chose to use in the matching. We removed observations of firms that were not present in all 4 years of our analysis. We did not remove the firms from our control group that received SkatteFUNN in 2011, but no longer report SkatteFUNN costs after. The number of observations we ended up with was between 12 722 and 16 326, depending on the type of regression.

4.6.2 Matching variables

We decided to match on firm size (i.e. total assets and number of employees), liquidity (defined as$\frac{Current\ Assets}{Current\ Liabilities}$), year of establishment, and operational expenses. Due to capacity restrictions in our statistical software, we made dummies for employees and year of establishment to ease the matching process. Because the purpose of our analysis was to see whether the change in threshold affected operating expenses, we believed these variables together indicated whether the matched firms really were a match that would enable us to measure the effect of the change in threshold.

We chose to use liquidity as an independent variable in our matching because we considered the firms with a high liquidity as more likely to invest in R&D than firms with a low liquidity.

Total assets were also a useful independent variable, because we wanted to compare firms that were equal in size. Number of employees was also a good indicator of firm size, because an SME often have fewer than 250 employees, which made us able to distinguish between firms based on their size.

We also included two dummy variables for when the firms were established. One dummy had the value of one if the firms were established before 1980, and one dummy variable that equaled one if the firms were established after 2000. We chose 1980 because we considered firms established before 1980 to be relatively old. We were comparing these old firms because they are probably bound by tradition, but still need to innovate in order to stay in business. The lifespan of firms has been reduced drastically the last couple of decades, and firms depend on innovations to keep a sustainable growth and to survive. According to Innosight, the average life span of firms have been reduced from 33 years in 1964 to 25 years in 2016, and it is expected to be reduced even further (Anthony, Viguerie, Schwartz, & Van Landeghem, 2018), which is another reason for us choosing 1980 as a threshold for the age of the firms. We chose to match on establishment after 2000, because firms established after 2000 are relatively young compared to the rest of the dataset. In addition, they may be more service-oriented and have a higher innovation rate.

The last variable that we included was a variable called “nace-kode”. The “nace-kode” is the industry code that shows the firms’ main activity (Brønnøysundregistrene, 2019). We included

the industry code in order to compare the firms in the treatment group to a firm in the same industry.

From the matching, we got the following coefficients:

Variables	Coefficient	z	P>z
Constant	-0.878	-11.55	0.000
Total assets	7.89e-12	1.34	0.182
Liquidity	-5.89e-09	-0.11	0.916
Operational expense	-5.44e-12	-0.81	0.415
Firm size	-1.095	-14.73	0.000
Established before 1980	-0.107	-2.71	0.007
Established between 2000-2015	-0.10	-5.81	0.000
Industry code	-4-26e-06	-12.25	0.000

Table 3: Matching variables

It was hard to get the matched firm to be similar to the treated firm. Obviously, no firm is an exact copy of each other. As we can see from the table of the matching variables; total assets, liquidity and operational expenses were not significant. See appendix 3 for t-tests.

When we matched firms, we decided to match one firm in the control group for each firm in the treatment group. This entails that in cases where one firm in the control group is the best match for two of the firms in the treatment group, we picked the second-best match for one of the two firms in the treatment group.

4.7 Regression Analysis on operational expenses

In order to run our econometric analysis on operational expenses after the change in threshold, we chose the following relevant variables.

4.7.1 Dependent variable

We chose operational expenses as our dependent variable, because the operational expense is likely to increase when firms invest in R&D. To evaluate the change in operational expenses we used the logarithm of the expenses. The Samfunnsøkonomisk Analyse report used R&D costs as their dependent variable (Benedictow, et al., 2018). Because it is compulsory following the Norwegian Accounting Standards to record the R&D costs in the balance sheet, we could not use the value for R&D listed in the balance sheet as our dependent variable.

4.7.2 Explanatory variables

To evaluate whether the change in threshold affected operational expenses, we used our constructed variables treatment, event and treat*event. The treatment variable was included to explain the effect of being a SkatteFUNN receiving firm. We included the event variable to evaluate the effect of the change in threshold in 2014. The interaction term was included to recognize the change in operational expenses for the treatment group after the event.

4.7.3 Control variables

We did not include any control variables in our regression, because they were already included in the matching. In an optimal matching, all relevant control variables should be accounted for.

4.7.4 Econometric Model

The purpose of our econometric analysis was to study whether there was a causal relationship between an increase in threshold in SkatteFUNN and the change in R&D investments. In order to accomplish this, we used a regression analysis making us able to measure the impact of the change in threshold on the treatment group. We used cluster-robust standard errors and fixed effects in our regressions in order to avoid issues with heteroscedasticity and autocorrelation.

To measure the impact of a change in threshold we used the following model:

$$logy_{it} = \alpha + \beta_1 \chi_i + \beta_2 \mathrm{M}_t + \beta_3 \chi_i \times \mathrm{M}_t + \lambda_i + \eta_t + \varepsilon_{it}$$

Where $log\gamma_{it}$ was the change to our dependent variable operational expense for firm i at time t. α was the constant, χ_i was the treatment dummy, and M_t was the event dummy. λ_i was the firm fixed effects and η_t was the time fixed effects, while ε_{it} was the error term. χ_i was one if firm i received SkatteFUNN in 2011 and zero if firm i was in the matching group. M_t was zero before the event in 2014 and one in the year of the event and after. $\chi_i \times \mathrm{M}_t$ was the interaction effect and equaled one for the treated observations after the event, and zero otherwise.

The firm and time fixed effects were included to control for unobservable effects that might affect the results. The λ_i was the firm fixed effect, which controlled for differences between the firms. The η_t was the time fixed effect and controlled for differences across time.

To measure the effect of the treatment variable and the event variable we conducted a simple linear regression:

$$logy_{it} = \alpha + \beta_1 \chi_i + \beta_2 \mathrm{M}_t + \beta_3 \chi_i \times \mathrm{M}_t + \varepsilon_{it}$$

Where the variables had the same interpretation as in the previous equation. The difference is that this model does not include fixed effects.

4.7.5 Difference-in-difference analysis and regression with leads and lags

In order to check the robustness of our analysis, we wanted to perform a difference-in-difference (DiD) analysis and a regression with leads and lags. When performing the DiD analysis, the results were not statistically significant, and we could not rely on the results.

We performed a regression with leads and lags, but the lag was omitted because of collinearity. Ideally, in a regression with leads and lags you should have three periods before the change and three periods after. We only had two before and one after the change.

Then, because of the insignificant results from the DiD analysis and the omitted lag in the regression with leads and lags, we chose not to include them in the results.

5. Analysis

In this section, we will present our results. First, we will present descriptive statistics, where we show how many observations we have per year, and other relevant information used in the analysis. Then, we will present our results about groups and SkatteFUNN. In the end, we will present our results from the regression analysis on the operational expenses for firms in general.

5.1 Descriptive Statistics

Table 4 below, lists the number of observations we had in the different datasets between 2006 and 2015.

Years 2006-2015	NUF	Profit Shifting
Mean	257354,1	257393,6
Standard Error	9704,74	9727,55
Median	252139	252138,5
Standard Deviation	30689,07	30761,23
Sample Variance	941819030	946253068
Kurtosis	-0,76	-0,74
Skewness	0,22320467	0,231182984
Range	96703	97103
Minimum	210591	210591
Maximum	307294	307694
Sum	2573541	2573936
Count	10	10

Table 4: Descriptive Statistics NUF and profit shifting dataset

In the NUF-dataset, we had a total number of observations at 2 573 541 when we excluded 2005 and 2016. The smallest observation was at 210 591 and the maximum was at 307 294, which gives a range of 96 703. The range was relatively small because the number of organizations per year do not fluctuate as much as costs. In addition, there was a steady increase in the number of observations from year to year. The same goes for the profit shifting documents, where we had a total number of observations at 2 573 936. The range was 97 103, where the largest observation was at 307 694 and the smallest at 210 591. The profit shifting dataset and the NUF dataset had approximately the same observations but presented different accounting data.

The dataset containing information about SkatteFUNN receivers had 33 855 observations from 2005 to 2016, see figure 3. When we removed 2005 and 2016, we were left with 26 593 observations. The year with fewest observations was 2009, while 2016 had the highest. The number of observations was 2275 and 4197, respectively. The range was 1373. Using the observations from the different datasets, we were able to establish that only one percent of all firms in our dataset received SkatteFUNN.

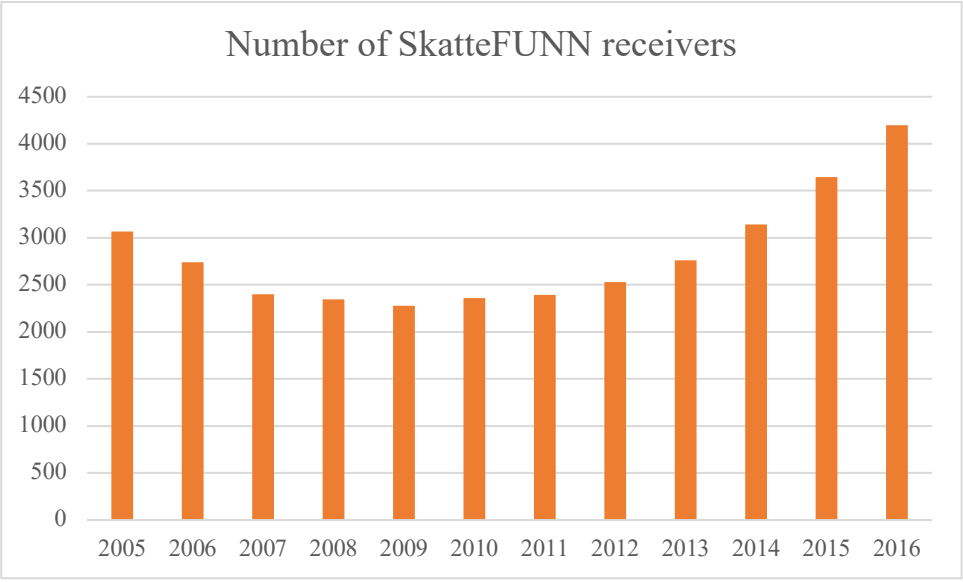


Figure 3: Total R&D observations per year

About the reported R&D costs, the median observation was 2 183 975, while the mean was 2 911 292. The largest observation was at 33 million NOK while the smallest observation was one NOK. In the figure below, we can see the total amount of R&D costs reported each year. The total R&D costs reported stayed relatively stable from 2006 to 2013. After 2013, the R&D

costs increased rapidly. In figure 4, we observed a trend that the SkatteFUNN costs increased every year after 2007. After 2013, the increase was much steeper, suggesting that an event occurred.

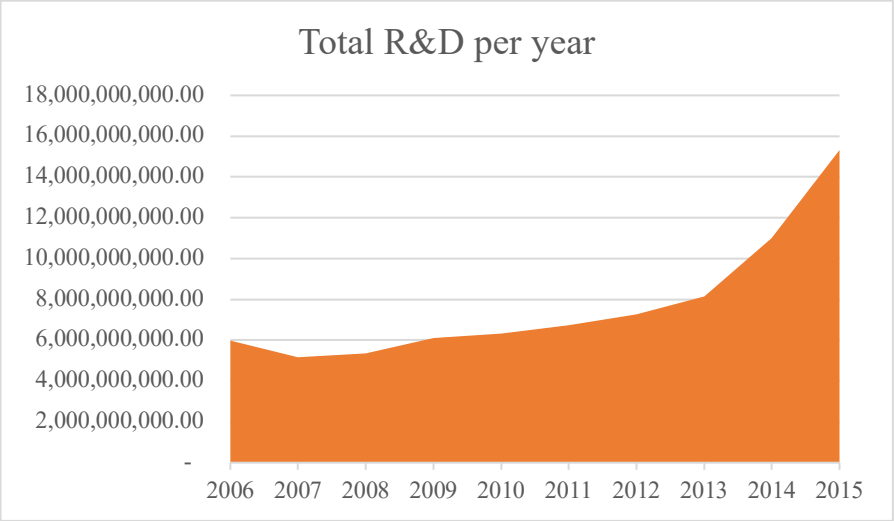


Figure 4: Total R&D costs per year

Figure 5 below, shows the difference in R&D costs from one year to the next. The difference in percentage change decreased from 2009 to 2010 before it increased again. We saw that after the government increased the threshold for R&D costs, the difference between years increased. The R&D costs increased a lot between 2013 and 2014, which can be explained by the 100 percent increase in threshold. When the threshold increased again in 2015, the impact of this change seems to be smaller than the change in 2014.

Figure 5: D.log total R&D

The total number of observations in the R&D dataset for large firms were 4480 from 2006 to 2015. The average SkatteFUNN cost reported over these years was 3.94 MNOK. The smallest observation was one NOK while the largest observation was at 33 million NOK, see table 5 below. The skewness of the observations was 1.97, which means that the dataset is positively skewed. This implies that a curve for the normal distribution of this dataset would have a distribution leaning towards the left and not at the center, i.e. the majority of the observations on R&D costs had a low value. The kurtosis for a normal distribution says something about the tails of the dataset. A high kurtosis indicates that the data has heavy outliers. For the observations at an 18 percent level, the kurtosis was 9.61. The kurtosis implies a heavily tailed distribution, meaning that the distribution is longer, and the tails are thicker.

	Large firms	SMEs
Number of observations	4480	22 113
Mean	3.94 million NOK	2.7 million NOK
Smallest	1 NOK	709 NOK
Largest	33 million NOK	33 million NOK
25th percentile	1.3 million NOK	0.89 million NOK
75th percentile	5.5 million NOK	4 million NOK

Table 5: Descriptive Statistics SkatteFUNN receiving large firms and SMEs 2006-2015

For SMEs, the number of observations were 22 113 over the course of 10 years. The mean of 2.7 MNOK was significantly smaller for SMEs than for large firms. The smallest observation was at 709 NOK, and the largest was 33 MNOK. The skewness at 2.02 was higher for the SMEs than the large firms. The kurtosis was 11.85, also indicating that the distribution was wider for the SMEs than for the large firms. The 99th percentiles presented in appendix 4 support the numbers. Interestingly, the 75th percentile was 11 MNOK, meaning the last 25 percent of the dataset had a wide range, i.e. 22 MNOK. However, the large outliers may be a result of the increase in threshold for purchased R&D, which increased from 11 MNOK to 33 MNOK from 2013 to 2015.

The table below provides the yearly average R&D costs. As we can see, the difference between the R&D costs reported by SMEs vs large firms in 2006 was approximately 0.7 million NOK, while the difference increased to approximately 3.2 million in 2015.

Year	SMEs	Large firms
2006	2 million NOK	2.7 million NOK
2007	2 million NOK	2.67 million NOK
2008	2.2 million NOK	2.7 million NOK
2009	2.5 million NOK	3.4 million NOK
2010	2.5 million NOK	3.5 million NOK
2011	2 .7 million NOK	3.5 million NOK
2012	2.7 million NOK	3.6 million NOK
2013	2.8 million NOK	3.75 million NOK
2014	3.2 million NOK	5 million NOK
2015	3.7 million NOK	6.8 million NOK

Table 6: Mean R&D costs large firms and SMEs

5.1.1 Form of business organization

Although our analysis does not separate between the different forms of business organizations, we believed that it was relevant to know what types of firms we had in our datasets. As to be expected, "AS" is the most popular, i.e. a limited corporation. The observations ranges from 197 277 in 2006 to 289 558 in 2015. There were 7442 NUF's (Norwegian Registered Foreign Company) in 2006, while there were 11 337 in 2015, which suggest that there was an increase in the number of Norwegian branches of foreign firms in Norway. See appendix 1 for a complete table on the observations of business organizations.

5.1.2 Number of employees

The firms that received SkatteFUNN had an average of 72.78 employees (this includes firms with zero employees). Firms that did not receive SkatteFUNN had an average of 10.66 employees. If we excluded all firms with zero employees, SkatteFUNN receiving firms had

an average of 82.62 employees and firms who did not receive SkatteFUNN had an average of 27.18 employees. Although SkatteFUNN was meant for small firms, on average the SkatteFUNN receiving firms were large. Not necessarily defined as a large firm, but compared to small firms not reporting SkatteFUNN, SkatteFUNN receiving firms were large. The results made sense because of the financing constraints small firms experienced and thus their lack of participation in R&D. The increase of almost 20 employees per firm for the firms not reporting SkatteFUNN suggests that the share of firms with zero employees is larger for firms not receiving SkatteFUNN than for SkatteFUNN receiving firms, relatively speaking.

5.2 Number of firms in groups

Figure 6 below shows the average number of firms in groups per year. The red line is the treatment group, i.e. the SkatteFUNN receiving groups, and the blue line is the control group.

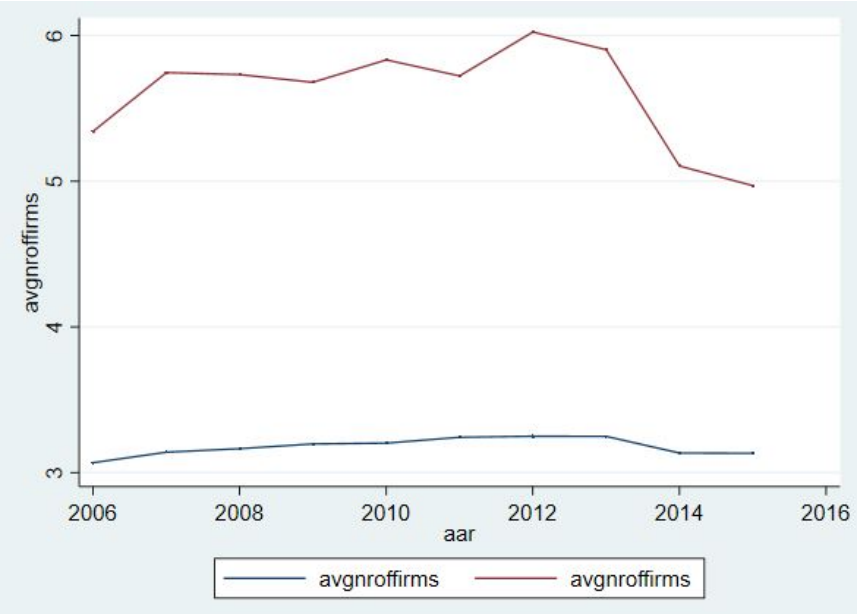


Figure 6: Average number of firms per group

What we saw was that the average number of firms per group was much higher for the treatment group than the control group, which proves that the treatment group, on average, have more firms per group than the control group.

There were changes in the SkatteFUNN scheme in 2007, 2009, 2011, 2014 and 2015. In 2007, the hourly cost cap of 500 NOK was introduced in addition to maximum 1850 hours per

employee on SkatteFUNN projects. From figure 6, we saw an increase in number of firms per group in 2007 compared to 2006. In 2009, there was a slight decrease in the number of firms per group receiving SkatteFUNN. We also saw a decrease in the number of firms with the change in definition of R&D and SMEs in 2011. Compared to the control group, the change in number of firms per group was higher for the treatment group in both 2009 and 2011.

From 2013 to 2014, we observed that the number of firms per group decreased quite rapidly for the treatment group while there was a moderate decrease in the control group. This suggest that the increase in threshold may have had an impact on the structure of the groups. From 2014 to 2015, there was a small decrease in the number of firms for the treatment group, while the control group seemed to have stabilized. We also saw changes in the group structure during years with no change in the SkatteFUNN scheme. However, the changes are arguably higher in years with a change in SkatteFUNN, which suggests the changes had an impact on the group structure.

In the next table, we have conducted regressions with the total number of firms in groups as the dependent variable. While we expected an increase in the number of firms in groups after the threshold changed in 2014, we saw a tendency for a decrease instead.

Dependent variable: log Number of Firms in groups	**Regression**	**Regression using xtreg**
Treatment (Std. Err)	0.340*** (0.010)	0.127*** (0.006)
Event (Std. Err)	-0.018*** (0.003)	-0.011*** (0.001)
Treatevent (Std. Err)	-0.069*** (0.013)	-0.044*** (0.005)
Constant (Std. Err)	1.003*** (0.002)	1.009*** (0.001)
Number of observations	114 450	114 450
R-squared	0.0188	0.0184
Fixed effects	No	Yes

*****Significant at a 1% level**

Table 7: Regressions with number of firms in groups

As we saw from table 7, being in the treatment group had a positive effect on the number of firms in the group. However, the event in 2014 had a negative impact on the number of firms.

When using log on one side of the regression equation, we measure the percentage change over the period. The interaction effect also had a negative impact on the number of firms in the group. We saw that after the event, the number of firms in groups changed by -6.9 percent, or -4.4 percent when accounting for fixed effects. All coefficients were statistically significant at a one percent level.

Figure 7 depicts the common trend for the number of firms in groups. The red line is the treatment group and the blue line is the control group.

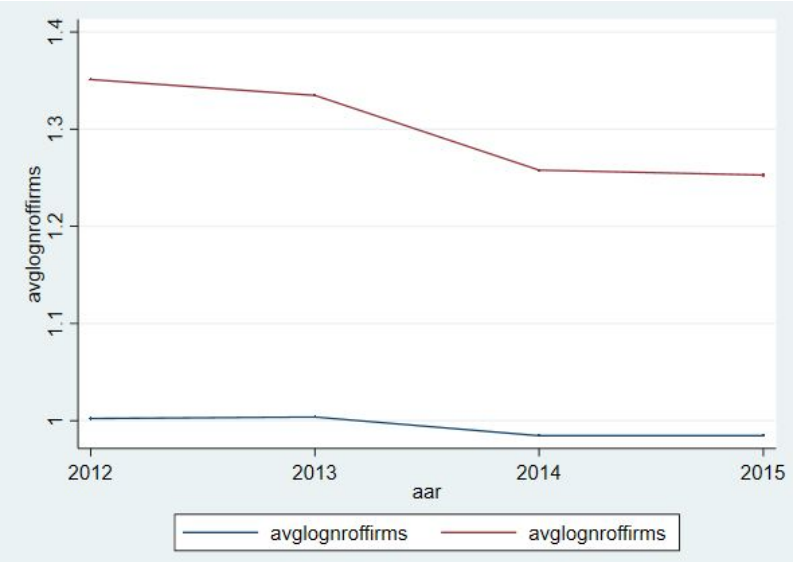


Figure 7: Common trend number of firms in groups

We saw that there was already a small decrease in the number of firms per group from 2012-2013 for the SkatteFUNN reporting groups. However, largest decrease was in the average number of firms between 2013 and 2014. Here, we also saw a decrease for the control group, which suggests that there were external effects that affected the number of firms in groups other than an increase in threshold.

5.3 Total R&D costs of corporate groups

Using the collapsed variable for total R&D costs per group, we saw that substantial amounts of the SkatteFUNN costs were reported by firms in groups. The total R&D costs for all firms

was around 77.4 billion NOK. Of those, firms in groups reported approximately 48 billion NOK, which constitutes around 60 percent of the total R&D costs, see appendix 5.

In table 8 below, we see that the number of groups where two or more firms have reported having SkatteFUNN costs ranges from 165 to 290. The highest observation of 290 groups was in 2015, while the lowest observation was in 2009.

Number of groups with x firms (SkatteFUNN and Parent company)										
x firms	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
2 firms	146	134	128	110	118	127	145	154	178	209
3 firms	34	31	35	36	26	34	38	43	43	49
4 firms	13	10	8	8	13	6	11	10	11	22
5 firms	8	4	5	4	4	4	6	2	4	3
6 firms	4	4	3	3	2	2	5	4	3	3
7 firms	2	0	0	1	2	3	2	4	1	1
8 firms	1	1	2	1	3	2	0	1	0	1
9 firms	0	0	0	2	0	1	1	0	0	1
10 firms	0	2	1	0	0	0	0	0	0	0
11 firms	1	0	0	0	0	0	0	0	1	1
Sum groups	209	186	182	165	168	179	208	218	241	290

Table 8: Total number of groups with x firms

The majority of groups, approximately 75 percent, had only two firms. The remaining 25-30 percent of all groups who reported SkatteFUNN costs had three or more firms. There were a couple of interesting observations in the table above. As we saw, in 2006, 2014 and 2015 one group had 11 subsidiaries that reported SkatteFUNN costs. Considering the number of firms engaging in R&D, the number of subsidiaries from the same group was rather high. Generally, it was interesting to see that this many groups had several firms that report SkatteFUNN costs, which was why it we were interested to see how the groups divided the R&D costs between them.

We collected the firms in groups that reported SkatteFUNN costs. On average, around 25 percent of all firms in groups had SkatteFUNN costs, which was in line with Statistics Norway, who found that 26 percent of all firms conduct R&D (2018). Depending on the year, we found that the share of firms in a group that report SkatteFUNN costs varies from 23 percent to 27 percent.

Year	Number of firms with and without SkatteFUNN costs where the group consists of two or more firms	Number of firms with SkatteFUNN costs where the group consists of two or more firms	Ratio
2006	2254	543	0.24
2007	2006	473	0.24
2008	1704	462	0.27
2009	1876	431	0.23
2010	1801	436	0.24
2011	1785	458	0.26
2012	2235	531	0.24
2013	2421	547	0.23
2014	2270	585	0.26
2015	2797	721	0.26
Sum	21 149	5187	0.25

Table 9: Number of firms in SkatteFUNN receiving groups vs. firms receiving SkatteFUNN in groups

We have summarized the number of firms that was part of a group receiving SkatteFUNN, both with and without individual SkatteFUNN projects. From table 9, we saw that in 2006, there were 2254 firms in a group that reported SkatteFUNN costs. Only 543 of these firms actually reported SkatteFUNN costs. This entails that 24 percent of the firms in groups in 2006 had SkatteFUNN costs. We saw that the majority of firms did not report SkatteFUNN costs. Approximately 73-77 percent of all firms in a group did not report SkatteFUNN costs.

In addition, the table showed that the number of firms in groups decreased from 2006 to 2009, which was in line with earlier findings. After 2009, there was a large increase in number of subsidiaries that reported SkatteFUNN costs, which suggests additional firms invested in SkatteFUNN-projects.

Figure 8 shows the same thing. Here, the blue line is the number of firms in groups regardless of whether they receive SkatteFUNN or not, and the orange line is the number of firms in groups that received SkatteFUNN. The figure also makes it clear that approximately 25 percent of all firms in groups received SkatteFUNN.

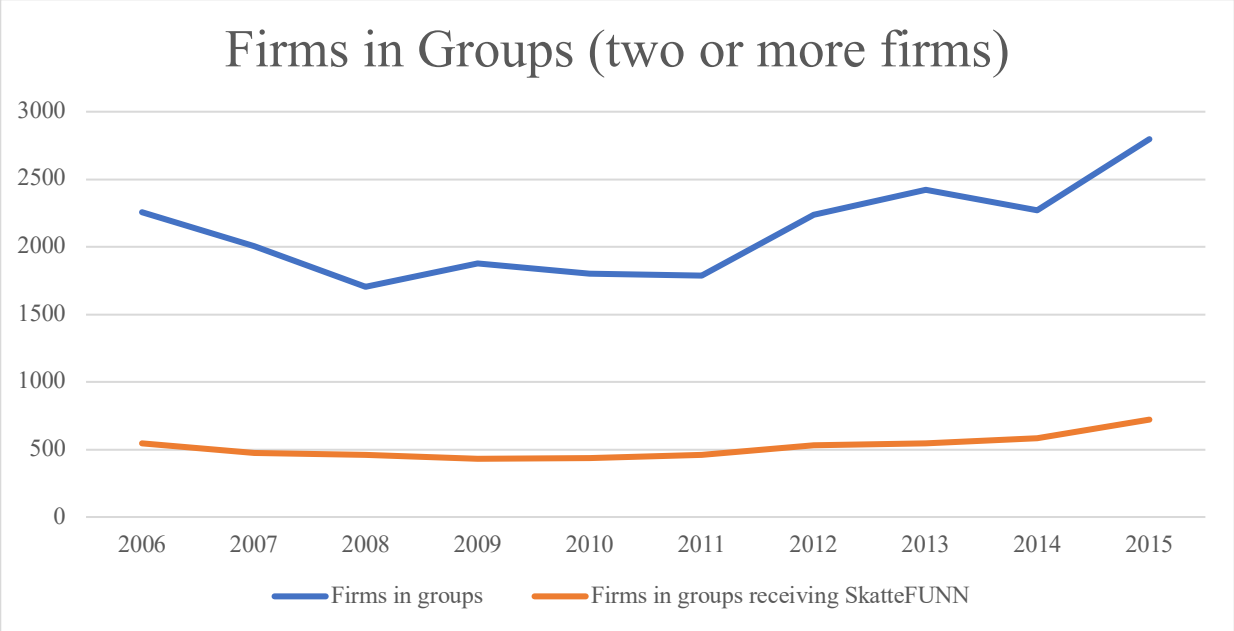


Figure 8: Firms in Groups

We then looked at the groups' total R&D costs, see appendix 5 for yearly R&D. When we removed all observations where a group did not exceed the purchased threshold, we were left with a few observations per year. See table 10 below.

Year	Number of groups above purchase threshold for one firm	Percentage of groups exceeding threshold for purchased R&D	Average number of firms in groups exceeding threshold	Groups above intramural threshold for one firm	Exceeding purchased threshold, but not necessarily intramural threshold
2006	55	26.32 %	2.48	21	61 %
2007	48	25.81 %	2.42	24	50 %
2008	38	20.88 %	2.27	15	60 %
2009	34	20.61 %	2.38	8	76 %
2010	37	22.02 %	2.27	11	70 %
2011	40	21.62 %	2.35	17	58 %
2012	41	19.71 %	2.20	10	76 %
2013	60	27.52 %	2.32	19	68 %
2014	17	7.05 %	2.83	6	65 %
2015	18	6.21 %	2.00	3	83 %
Average	38.8	19.77 %	2.352	13.4	66.7 %

Table 10: Groups exceeding purchased R&D threshold

There were on average, 38.8 groups per year that exceeded the purchased threshold. We saw that 55 groups exceeded the purchased threshold in 2006, and the number went up and down

before ending at 18 firms in 2015. As a reminder, the threshold between 2006 and 2008 was eight million, between 2009 and 2013 it was 11 million NOK, in 2014 it was 22 million and in 2015 it was 33 million. The share of groups that exceeded the threshold was fairly high between 2006 and 2013, where the share was between 20 and 28 percent of all groups actually exceeded the threshold. After 2013, the share went down to 6-7 percent.

When we looked at the number of firms in the groups that exceeded the threshold, we observed that on average, the groups had two or three firms that reported SkatteFUNN costs. In order for the groups to exceed threshold, the separate firms had to report relatively high R&D costs per firm.

In Column 6, we placed the percentage of groups who in total exceeded the purchased threshold, which because of the number of SkatteFUNN receiving firms in the group, might not individually have exceeded the intramural threshold. We believed that of all the groups in our dataset, the groups that combined exceeded the purchased threshold, but where each individual firm on average, did not exceed the intramural threshold, were the groups that might have restructured to optimize from the scheme. Our impression was that it would be harder for firms to report higher R&D costs than the actual R&D costs for their projects if they purchased all or some R&D (because of a third party involved). We assumed the groups who had a sufficient number of subsidiaries distributed their R&D costs so that each individual subsidiary did not exceed the intramural threshold. In our case, 66.7 percent of all groups were able to optimize from the scheme using this method, see column 6 in table 10 for details.

In the following figure, we present the yearly R&D costs over the purchased R&D threshold. The total R&D costs above threshold was below 300 million each year, but fluctuated a little.

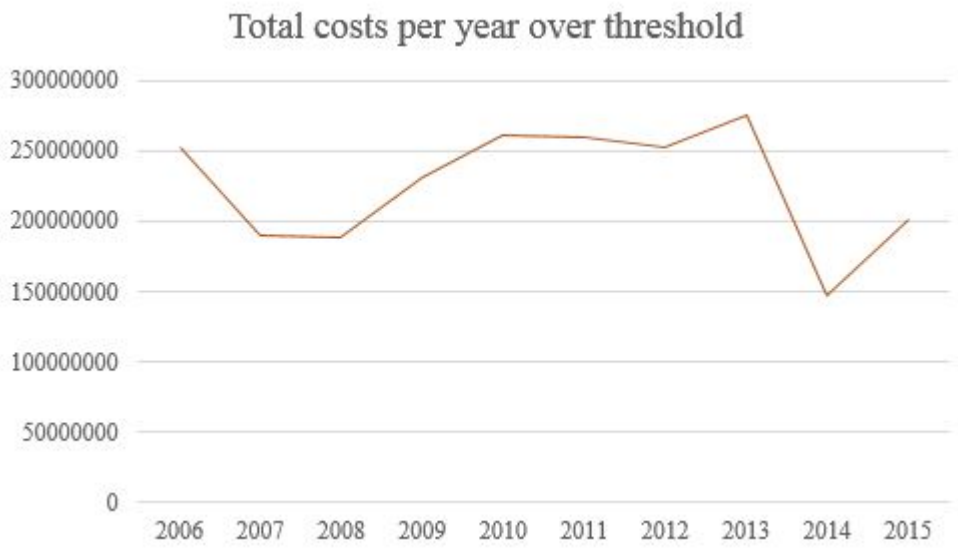


Figure 9: Total R&D costs per year exceeding purchased R&D threshold

When adding up the R&D costs that were above the purchased R&D threshold, we saw that the costs only constituted 2.26 billion, or 2.9 percent of the 77.4 billion NOK reported in R&D. The large drop in R&D costs over threshold between 2013 and 2014 made us curious: did the R&D costs decrease when the threshold increased, or was it simply a large increase in threshold?

5.3.1 The 2013-2014 change

The observations of groups above threshold decreased from 60 observations to 17 between 2013 and 2014. Twelve of these groups were observed above threshold both years. The level of SkatteFUNN costs of these 12 groups increased significantly between 2013 and 2014. This indicates that these groups had high R&D costs in 2013 and were prepared to report higher R&D costs once the threshold increased. Our regression showed that the R&D costs changed by 48.05 percent from 2013 to 2014 for those twelve groups. The results were statistically significant at a five percent level.

Dependent: log(total R&D)	Regression
Event **(SE)**	0.4804722*** (0.13511919)
Number of observations	24
R-squared	0.3647
Fixed effects	No

*** Significant at 1% level

Table 11: Regression with number of firms per group

In order to double-check our calculated increase, we made a variable for the change in total R&D for the 12 groups from 2013 to 2014. The variable also showed that the increase in costs from 2013 to 2014 was on average 48.05 percent.

5.4 Regression analysis on operational expenses

When the total R&D costs increased as much as they did after 2013, we were curious to see whether the change in R&D costs affected the operational expenses.

Table 12 below, Column 1 shows the results from the multiple regression with clustered standard errors and fixed effects from 2012 to 2015. It shows that the average operational expenses for the SkatteFUNN firms rose by 9.7 percent after the event. The result was significant at a 1% level. When we checked the shorter period from 2012 to 2014 (column 3), we observed that the expenses rose with 6.8 percent. The reason for the difference might be the new change in SkatteFUNN threshold in 2015, or that firms needed time to adjust to the new threshold. However, other factors apart from R&D that we were not able to control for might also have had an impact. The variables for treatment and event were omitted due to collinearity with the fixed effects.

	2012-2015		2012-2014	
Dependent variable: Log operational expense	**(1) Regression w/ Fixed effects**	**(2) Reg w/o fixed effects**	**(3) Regression w/ Fixed effects**	**(4) Reg w/o fixed effects**
Treatment (SE)	omitted	1.613309*** (0.0773141)	omitted	1.619212*** (0.0758274)
Event (SE)	omitted	-0.1313302*** (0.0248172)	omitted	-0.0929634*** (0.0267453)
Treat*event (SE)	0.0968775*** (0.0271632)	0.1356687*** (0.0317779)	0.0683093*** (0.025836)	0.080038** (0.0333065)
Constant (SE)	15.73434*** (0.0068717)	14.95682*** (0.062203)	15.73533*** (15.73533)	14.92497*** (0.0608902)
observations	16290	16326	12639	12722
R-squared	0.9558	0.0937	0.9669	0.0928
Time fixed effects	Yes	No	Yes	No
Firm fixed effects	Yes	No	Yes	No
treat*event	Yes	Yes	Yes	Yes
Standard errors	Cluster	Cluster	Cluster	Cluster
**** Significant at a 5% level ***Significant at a 1% level**				

Table 12:The effect of treatment and event on R&D expenses

We did also conduct simple linear regressions without fixed effects to get a better understanding of the difference between the treatment variable and the event variable. The results were shown in column 2 and 4 in the table above. The results showed that from 2012 to 2015, the firms in the treatment group had an average operational expense that was higher than the operational expenses for the control group. It also showed that the operational expenses, on average, decreased for both the treatment and control group after the event.

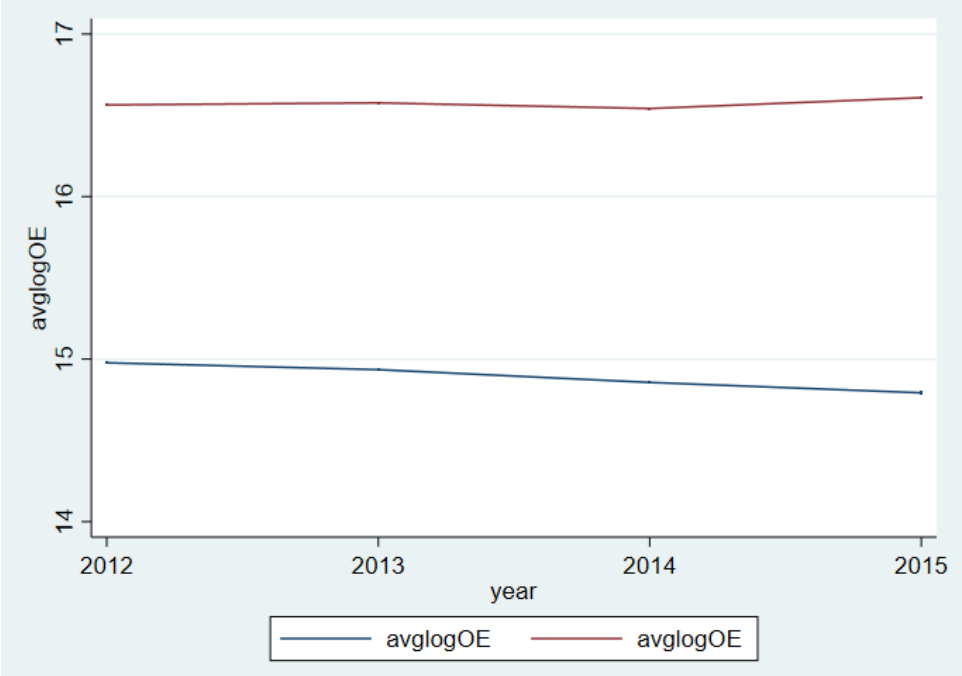


Figure 10: Common trend – red line= treatment group | blue line = control group

Figure 10 showed the average log of operational expenses for the treatment and control group between 2012 and 2015. From the graph, we saw that the treatment group had somewhat higher operational expenses than the control group. The lines also depicted a common trend between the two groups until the event in 2014. On average, we saw that the two groups to some degree followed a common trend. However, the two lines were not parallel because the control groups' operational expenses decreased faster than the treatment groups', and therefore breached the common trend assumption. For the treatment group, we saw a small increase in the operational expenses after the event.

After 2014, the operational expenses for the treatment group increased and the control group decreased. Combined, it seemed like the operational expenses decreased more than it increased, giving a small but negative average operational expense in total. That was not too far from the regression stating negative 13 percent on average.

6. Discussion and Conclusion

In this chapter, we will discuss our main findings. We will also discuss our results in terms of theoretical concepts, and what implications our findings may have. We will, based on our results, conclude, and we will provide some suggestions for further research.

6.1 General Discussion

6.1.1 Reported SkatteFUNN costs

In our dataset, we saw that the total SkatteFUNN recipients per year decreased from 2006 to 2009 and then increased, and the total R&D costs per year increased between 2007 and 2015. From 2006 to 2009, there were fewer approved SkatteFUNN applications, but the size of the projects increased. The number of observations was significantly higher for SMEs than for large firms, 22 113 observations vs. 4480, which was in line with the findings of Baghana & Mohnen (2009) in Québec. However, there are many SMEs in Norway compared to large firms, which in itself will make SkatteFUNN more popular for SMEs than large firms, simply because the number of SMEs is higher. Guellec and van Pottelsberghe (2000) found that the more stable and predictable R&D tax incentive, the more firms will take part in the incentive. Many firms will not invest in a long-term R&D project when they depend on the R&D incentive to go through with it, especially if they believe the scheme will be terminated next year. SkatteFUNN is no different, and it seems that when firms realized the scheme was permanent, firms invested in new and larger SkatteFUNN projects.

The average reported R&D cost for large firms in our dataset was 3.9 million NOK, and for SMEs the average cost was 2.7 million NOK. As expected, large firms had higher R&D costs than SMEs. We know that the largest observations on both SMEs and large firms are 33 million. The average R&D costs told us that the majority of the observations had low R&D costs, but the outliers pulled up the average. For SMEs, the observations with high R&D costs could be interpreted as outliers. We called the observations with the highest R&D costs outliers because they consisted of the one percent largest observations. We knew from appendix 4 that the 99^{th} percentile is around 15 million for SMEs. This entails that the last percent of observations has a range between 15 and 33 million.

There were several possible reasons why the R&D level is low; the firms may smooth out their R&D spending to avoid laying off R&D workers (Hall, 2010; Hall & Lerner, 2010). In addition, knowledge spillovers may also reduce the motivation for investing in R&D. One of the advantages of SkatteFUNN is that it is easy to obtain for all firms researching or developing a new or improved product or service. Because of the low-scale projects, we do not believe knowledge spillovers to be a substantial problem.

6.1.2 Number of firms in groups

In our analysis, we saw that every time there was a change in the SkatteFUNN scheme, i.e. 2007, 2009, 2011, 2014 and 2015, the number of firms in groups receiving SkatteFUNN changed. In general, we saw that every time there was a positive change in the scheme for the SkatteFUNN receivers, the number of firms in groups decreased. In 2007, a restriction was introduced, and the number of firms in groups increased. This indicates that with a more liberal scheme, the groups no longer saw the need to establish subsidiaries to optimize from the scheme because they already have the optimal number of firms in the group. When the scheme was restricted, the groups adapted by establishing new firms. Thus, it seems that groups reorganize to capture the value of SkatteFUNN.

Figure 6 showed the average number of firms per group both for our treatment and control group. The control group had an average of 3 to 3.5 firms per group while the treatment group had an average between 5 and 6 firms per group. Although the results might raise some questions, it can be perfectly reasonable as to why this is the case. Some groups may simply have highly innovative subsidiaries compared to others. A lot depends on what kind of market in which the firms are doing business. On the other hand, the consequence of not matching the treatment group to a similar control group may have impacted our results; the control group's average number of firms is much lower because they might have completely different structures.

The number of firms in the control group decreased in 2014, which may weaken our results. The decrease in the control groups tells us that something else might have happened in 2014 that we have not controlled for. The danger is that we believed the steep decrease in number of firms per group in 2014 was caused by the change in threshold and hourly cost cap, while

something else was going on that affected the firms. For example, some firms may have been impacted by the reduction in the oil price around this time, which may have led to bankruptcy or liquidation of the firms. In addition, our treatment and control group may be affected by completely different events because they may be fundamentally different from each other.

In the theoretical concepts chapter, we found that large firms usually invest in R&D, and our results indicates that the theory may be transferable to groups as well. The difference in number of firms between our treatment and control group is quite substantial, and our analysis showed that, on average, large groups invest in SkatteFUNN projects, especially in terms of number of subsidiaries.

Our regression analysis on the number of firms in groups indicated that groups reorganized to capture their desired value of SkatteFUNN. We got a negative coefficient of -0.069, which was statistically significant at one percent level. This implies that the number of firms in groups have decreased after the change. A reason may be that the groups no longer believed having many subsidiaries was necessary when they could concentrate the SkatteFUNN projects to fewer firms.

We believe that of all the groups in our dataset, the groups that exceeded the purchased threshold combined, but where each individual firm did not necessarily exceed the intramural threshold, were the groups that might have restructured to optimize from the scheme. In our dataset, 66.7 percent of all groups were in this position. These 66.7 percent have R&D costs above the purchased threshold for one firm, and thus have relatively high R&D costs. The danger is that these groups reorganizes to avoid investing in purchased R&D. To illustrate with an example: we had one group with three firms. Each firm invested three million in SkatteFUNN in 2006. The purchased threshold was at the time eight million, and the total investment of the group was nine million, which was over the purchased threshold. However, per firm the investments were still under the intramural threshold of four million. We believe that it is harder for groups to cheat when they have purchased R&D. When they have an independent third party involved who can confirm or deny the numbers the firm presents in their financial statement, we believe it would be better to look at the intramural threshold in which the firms can actually cheat.

There are a few things we have to keep in mind: when the threshold increases, it might not be necessary for the firms in groups to establish additional subsidiaries because they can simply increase the R&D spending of the already existing firms. In addition, an increase in the threshold will reduce the problem of groups exceeding the R&D threshold in itself. In our opinion, it is not a good solution to increase the threshold in order to reduce the number of groups exceeding the threshold. It might temporarily make the numbers look better, but as the new threshold stabilizes at a new level of R&D investments, eventually the problem will present itself again.

6.1.3 Corporate groups investing in R&D

Table 8 depicted the number of firms per group who received SkatteFUNN the different years. Because R&D is a relatively rare activity in Norway, we found it strange that as much as 11 firms in the same group invest in SkatteFUNN projects. In fact, we got suspicious when we discovered that more than two firms in the same group invested in SkatteFUNN projects, and thus, one of the main reasons why we decided to look at groups in the first place.

In our analysis, we found that on average, 25 percent of the corporate groups receiving SkatteFUNN consisted of two or more firms that all report SkatteFUNN costs. Although the ratio was rather high considering that only one percent of the firms in our dataset reported SkatteFUNN costs, there are several reasons as for why the ratio was high. First, the firms in the groups may supply different types of products and services. Second, the R&D projects are highly firm specific, and the R&D project is only relevant to their specific situation.

In the theoretical concepts, we noted that there are numerous advantages of purchasing another firm and being a part of a group. First, groups have an internal capital market where one can easily access an employee with the correct expertise to conduct R&D, providing the group have the relevant expertise (Berk & DeMarzo, 2017, p. 999). Through the internal capital market, firms can also easily obtain loans provided by another subsidiary or the parent firm because they may not require a high return or collateral. The 75 percent of firms in groups who do not invest in SkatteFUNN, are in a better position to provide loans to the firms that report SkatteFUNN costs, which may explain why firms in groups invest more often in SkatteFUNN than other independent firms.

We were curious about the sum of SkatteFUNN given to corporate groups, because the total R&D costs increased every year and we wondered if groups received a big part of the granted tax deductions. To investigate, we looked into the actual sum the different groups reported as costs relating to their SkatteFUNN projects. We found that the total SkatteFUNN costs reported by corporate groups amounted to approximately 60 percent of all SkatteFUNN costs from 2006 to 2015.

In accordance with the Samfunnsøkonomisk Analyse report, we expected firms that invested in R&D close to the threshold would benefit the most from an increase in the threshold. In addition, they have an incentive to increase their investments in R&D because it will increase their granted subsidies (Benedictow, et al., 2018, pp. 43-44). As we know from the theoretical concepts chapter, because of the characteristics of R&D investments, it is harder for firms to invest in R&D than other physical assets. Thus, when the threshold increased by 100 percent from 2013 to 2014, it is reasonable that some of the groups exceeding threshold in 2013 would not exceed the threshold in 2014. Not all groups would be able to scale up their R&D investments proportionally to the increase in threshold, and not every group had the need to invest more in SkatteFUNN either.

The purchased R&D threshold increased from 11 million NOK in 2013 to 22 million in 2014 and further to 33 million in 2015, which might explain the dramatic drop in groups with R&D costs above threshold. When the threshold was held constant between 2009 and 2013 and the total R&D costs increased, it was reasonable that the number of groups with R&D costs that exceeded the threshold also increased over the years. When the threshold doubled in 2014, we expected the number of groups above threshold to decrease. The reported R&D costs must have increased at a much higher rate than earlier years if the same number of groups were to exceed the new threshold. The groups we expected to find over the purchased R&D threshold both in 2013 and in 2014, were the groups waiting for an increase in threshold.

In table 9 we observed that the number of groups reporting SkatteFUNN costs increased yearly after 2009. The increase from 2014 to 2015 was particularly large, where the number of groups increased by 49 observations from 241 to 290 groups. We discovered that on, average, 20 percent of the groups from 2006 to 2015 exceeded the purchased R&D threshold. In table 10,

we observed that the number of groups exceeding threshold decreased dramatically from 60 in 2013 to 17 in 2015. We could also see the drop by looking at figure 9.

When we looked deeper into the groups exceeding the purchased threshold in both 2013 and 2014, we found something interesting. 12 groups exceeded the threshold both years. What we found was that, on average, the 12 groups reported an additional 10 million NOK in SkatteFUNN in 2014 compared to what they reported in 2013. Our regression on R&D costs for the groups above threshold showed an increase of 48 percent for the sample from 2013 to 2014. This indicates that some of the groups were able to turn around and invest an increased amount in R&D when the threshold changed. However, the level of innovation may not have increased although there was an increase in threshold. The SkatteFUNN-investing firms in a group could have other R&D projects in which they did not receive SkatteFUNN before the change in threshold. When the threshold changed, they may simply have applied for funding for existing projects.

If the purchased threshold were to be the applicable threshold for the groups in total, the government would have saved 2.9 percent of all the SkatteFUNN costs they have approved. Looking at the big picture, this was a small amount of money, which suggests that the groups exceeding threshold did not constitute a big problem. In addition, because the groups invested more in R&D than individual firms, it would be a good thing if they exceeded the threshold – they would keep up the investments in R&D and innovation. If the government were to put a cost cap on the groups, they should first investigate what consequences this would have for the overall level of innovation. Introducing a cost cap for the groups is not only discriminatory; it might have unwanted effects. When the firms in groups are no longer allowed to report SkatteFUNN costs at the same level as individual firms, the groups may lose their incentives to invest in SkatteFUNN projects and may thus decide to reduce their level of investments in R&D.

On average, the SkatteFUNN costs per firm were relatively low. Then why would the groups wait until the increase in threshold to increase their reported SkatteFUNN costs, when they had the option to buy R&D from a research institution? We know from the theoretical concepts that large firms tend to keep their R&D in-house to reduce the chance of knowledge spillovers (Koga, 2003). When the threshold increased for both intramural and purchased R&D, the groups would be able to increase their intramural R&D without establishing new subsidiaries

or invest in purchased R&D, because with a higher threshold, each subsidiary have a greater capacity for their in-house SkatteFUNN projects.

We found that the groups exceeding the purchased threshold were of a relatively small size (not considering the size of the firms themselves). The groups consisted on average of two to three firms, and these firms had high individual R&D costs. It could be that these groups have organized to capture the value of SkatteFUNN, because they had such high R&D costs per firm in the group. On the other hand, they might just be firms that had a naturally high level of R&D. Our results are the opposite of what we expected to find; we believed that the groups consisting of many firms would be the ones with the highest R&D costs.

All in all, we found that there are many corporate groups in our dataset, and 25 percent of firms in groups report SkatteFUNN costs. The groups report around 60 percent of all reported SkatteFUNN costs. However, the costs reported by the individual firms in groups are low. 20 percent of all groups exceeded the purchased threshold for one firm, which constitutes only 2.9 percent of the reported SkatteFUNN costs in total. It might be a good idea to look at the corporate groups' costs again at a time in the future where the level of reported SkatteFUNN costs has increased substantially. In conclusion, it does not look like the corporate groups reorganize to maximize their R&D costs to fit the allowed threshold. If they did, the SkatteFUNN costs should have been much higher per firm in groups.

6.1.4 The change in Operational Expenses from 2013 to 2014

We wanted to perform a regression on the 2014 change in threshold because we saw a significant increase in the R&D costs. The change was so rapid that we were curious to see if it had an impact on the operational expenses for the firms with SkatteFUNN projects. If the change in operational expenses was substantial, then it might indicate that the firms receiving SkatteFUNN were inactive: i.e. they did not participate in any activities other than R&D. If the change in operational expenses was small compared to the change in SkatteFUNN costs, the firms reporting SkatteFUNN costs should be participating in the product market. In addition, Samfunnsøkonomisk Analyse AS already researched the 2009 change in threshold and Statistics Norway researched the implementation of the scheme, which made the change in 2014 a natural choice.

The matching procedure made us able to pick the control group that was as similar as possible to our treatment group. The change in operational expenses should in theory only change for our treatment group when we ran the regression, because both the treatment and control group should have caught all other changes.

When we tested for the common trend assumption for operational expenses, we saw that our treatment and control group more or less followed the same trend. However, after the increase in threshold, our treatment groups' operational expenses increased, while the control groups decreased. The slight difference between the treatment and control group weakens our regression results. The decrease in operational expenses may be caused by a macroeconomic shock. For example, there was a decrease in oil prices around this time, which could affect many Norwegian firms. If the firms were affected by a change in the oil price and sold less products because of it, then it seemed the R&D costs had a relatively big impact on the operational expenses for our treatment group, assuming it was the only difference between the two groups. Even though there may be a decrease in oil prices affecting the firms, we assume that the reason for the increase in operational expenses for the SkatteFUNN reporting firms are increased investments in SkatteFUNN.

The results from the regressions indicated that the operational expenses for firms receiving SkatteFUNN increased after the threshold and the hourly cost cap changed. Our regression gave an increase in operational expenses at 9.7 percent, which was statistically significant at one percent level. When we included 2015 in the regression, we assumed that we would measure a "long-term" effect of the 2014 change, but our results also include the effect of the 2015 change in threshold. We were thus not be able to measure the effect of the 2014 change exclusively, which originally was our intention.

The change in operational expenses between 2013 and 2014 was at 6.8 percent, which is approximately three percent lower than the change we observed if we included 2015 in the regression. There are several possible explanations for the significant difference when including 2015 in the regression. First, the threshold increased by an additional 11 million NOK from 2014 to 2015, and second, the firms might need time to adjust to the change because there is a gradual increase in the R&D spending.

We were concerned that if the operational expenses changed rapidly after 2014, the SkatteFUNN reporting firms were relatively inactive, i.e. their sole purpose was to conduct R&D. When the change in operational expenses was relatively small, we believe that this was not the case, and SkatteFUNN receiving firms were engaging in other activities as well, which had an impact on the operational expenses.

The regression between 2012 to 2015 showed an increase in operational expenses of approximately 9.7 percent. However, by looking at the common trend figure, an increase in operational expenses of almost 10 percent seems unlikely. From our t-tests of the matching variable, we saw that the matching variables were to some degree different from each other, a difference that might cause the control group to be affected by something other than the treatment group. This may explain why the operational expenses increased for our treatment group and decreased for our control group from 2014 to 2015.

6.1.5 SkatteFUNN scheme on public consultation

The new, suggested threshold for SkatteFUNN of 25 million does not differentiate between intramural and purchased R&D. If the differentiation between intramural and purchased R&D is removed, there will no longer exist incentives for firms to purchase R&D from a research institution, which again will reduce the knowledge spillovers, and thus reduce the scheme's benefits to society. The government argues for the decrease in threshold because it only affects around 50 firms. The affected firms are encouraged to apply for additional funding either through Innovation Norway or the Research Council of Norway (Ministry of Finance, 2019). In our dataset, we found that the 99th percentile for large firms in 2015 was 22.5 million, suggesting that there are few firms that has R&D costs above 25 million. Although we have no observations above 33 million, we expect that the R&D investments have increased, such that some firms exceed 33 million in R&D investments in 2019.

We found that when the SkatteFUNN threshold increased, the number of firms in groups decreased. This indicates that when the scheme becomes more liberal, the need for multiple subsidiaries investing in SkatteFUNN decreases. It is reasonable to believe that when the threshold decreases, the number of firms in groups will again increase because the groups will have to adjust the number of firms receiving SkatteFUNN to keep their level of tax deductions.

Our claim is supported by the 2007 change in the scheme. In 2007, the maximum hourly wage on R&D workers was introduced, and the number of firms in groups increased.

In terms of group structure, we fear that a decrease in threshold will open up for the groups to restructure to optimize from the scheme, especially considering the structure has changed with every change in the scheme so far. On the other hand, when looking at the overall R&D investments in Norway and considering that the 99th percentile for R&D costs in 2015 was 1.5 million for SMEs and 2.25 million for large firms, it is unreasonable that the threshold should be at 50 million NOK.

6.2 Concluding remarks

The SkatteFUNN scheme has become more popular over the years, and between 2006 and 2015, the total SkatteFUNN costs reported by firms was 77.4 billion NOK. The number of SkatteFUNN receivers has increased every year since 2009, and the SkatteFUNN costs has increased every year from 2007.

There was a substantial increase in the SkatteFUNN costs after the threshold increased. With the change in threshold, we also observed a change in the structure of the groups. The Tax Administration were concerned that groups would restructure to optimize from the scheme. Our results show a tendency that the structure of the groups changes with alterations in the SkatteFUNN scheme.

We now know that groups are an important user of the SkatteFUNN scheme because they invest in many of the approved SkatteFUNN projects, and they account for around 60 percent of the total reported SkatteFUNN costs between 2006 and 2015. We observed a decrease in the number of firms per group each time the SkatteFUNN scheme was changed (increased), and we observed an increase in number of firms per group when the hourly wage cap was introduced in 2007, suggesting that groups restructure to optimize from the scheme.

Our analyses indicated that the costs of corporate groups were influenced by the changes in the SkatteFUNN scheme. After the 2014 change, there were fewer corporate groups that exceeded the purchased R&D threshold than before the change, even when the number of groups reporting SkatteFUNN costs increased. 60 groups were observed above threshold in

2013, while only 17 were observed above threshold in 2014. Of these, 12 groups were observed above threshold both years. They had an average increase in SkatteFUNN costs at 48.05 percent from 2013 to 2014.

The regression analysis indicated that the operational expenses increased for the SkatteFUNN receiving firms when the threshold increased. The operational expense had a small, but statistically significant increase for the treatment group compared to the control group. If the SkatteFUNN costs are incorporated in operational expenses, the large increase in R&D costs only had a marginal impact on the operational expenses. This indicates that the scheme is so small that we need several additional measures to increase the total investments in R&D in Norway.

In this thesis, we have looked at the composition of groups to see whether it changed with a change in the SkatteFUNN scheme. We found that the structure of the corporate groups changes with changes in the SkatteFUNN scheme. We also found that the total R&D costs increased almost every year in our dataset. The number of firms in groups also increased throughout this period. However, we found that with the increase in threshold in 2014, the number of groups above threshold decreased dramatically. For the 12 groups above threshold in both 2013 and 2014, we found an increase in R&D costs of 48 percent.

Because the increase in R&D costs was so high, both for the 12 groups mentioned above, and because there was an increase in the R&D costs in general, we looked at the operational expenses to see whether the increase was large enough to affect the overall costs. We found an increase in operational expenses for our treatment group of almost 10 percent, which suggests the increase in R&D costs was large enough to be reflected in operational expenses. In addition, because the increase in operational expenses was relatively small, it suggests that the SkatteFUNN receiving firms has operational expenses affected by more than just the R&D costs and are thus active in the production of products and/or services.

We see that the group composition changes with changes in the SkatteFUNN scheme. Our results suggest that groups attempt to optimize from the scheme, and we see that restricting the scheme in terms of hourly wage caps and threshold is not the way to go. We believe that if the government decreases the threshold from 50 to 25 million in 2020, the number of firms in groups receiving SkatteFUNN will increase because the group has to distribute their total

R&D costs to an increased number of firms to keep the same level of investments in SkatteFUNN. Our results indicate that the group structure changes with a change in the scheme and being close to the old threshold seems to be irrelevant, the structure changes either way.

Innovation has become more prevalent the last couple of years, and we believe it will also be important in the future. With volume-based incentives, the level of tax credits given to the firm will depend on how much the firm invests in R&D. If countries implement a maximum cost cap, as they have done with SkatteFUNN, at some point the firms will no longer invest in R&D because they no longer have any incentives to increase their R&D investments. To get around this problem, corporate groups can divide the R&D costs on multiple subsidiaries to avoid exceeding the cost cap. We believe these results to be transferable to any volume-based incentive, not only the SkatteFUNN scheme. Thus, our results may be applicable to all countries with volume-based R&D tax incentives, because anyone who wants to optimize from the scheme will try to optimize from the scheme.

Corporate groups account for more than half of the SkatteFUNN costs, and if the government were to implement a different threshold for corporate groups in particular, they have to make sure that groups taking advantage of the scheme is an actual problem. Implementing a threshold for groups would punish firms for being a part of a group, which might have distortive effects both for the level of innovation and for the number of groups in Norway.

We believe that because the SkatteFUNN scheme is rights based and should apply to all firms, the government should not change the SkatteFUNN scheme to implement stricter or more lenient rules for groups in particular. Rather, they can create a new form of incentive for groups, where they incentivize the groups to conduct R&D themselves and purchase from research institutions, which is especially important now when the incentives for purchasing R&D might be removed from the scheme.

6.3 Suggestions for further research

Because of a short time-frame and the lack of important data, we did not have the opportunity to research the bang for the buck for the 2014 change in threshold. We did not have the opportunity to apply for access to the additional relevant data. We recommend further research

into the bang for the buck for each change in threshold, because at some point, we expect the effect of an increased threshold to decrease or be non-existing. It is important to research this in order for the scheme to be as efficient as possible. In addition, the BFTB for groups should be calculated. Because 60 percent of all reported SkatteFUNN costs are reported by corporate groups, we should investigate whether groups invests in projects with a higher value for society.

We also recommend a deeper look into corporate groups and SkatteFUNN. We believe the best period to look at is before and after the implementation of the scheme in 2002(2003), to see whether the structure of the group changes after the implementation of SkatteFUNN. If there is a change in structure, it might indicate that the groups are trying to optimize from the scheme.

Next, we would also recommend that someone research what is the optimal threshold. We could not find any literature supporting the threshold of four and eight million NOK in 2006, and not for today's thresholds of 25 and 50 million. We understand that the threshold has been increased to stimulate higher private investments in R&D, but we do not understand why the government has chosen that particular threshold.

The average R&D expenses are far away from any of the maximum R&D thresholds per year. This indicates that there are only a few observations that are close to the thresholds. We recommend to research why the R&D costs increased as much as they did when the threshold increased in 2014. Samfunnsøkonomisk Analyse AS implied that the firms that are most likely to invest more in SkatteFUNN when the threshold increased are the firms that are close to the old threshold. Appendix 4 shows that there are few firms close to the maximum threshold per year. Then why did the R&D costs increase as much as they did after the 2014 change? Why does the investments in R&D increase that much when few invests at threshold before the change? Why did an increase in threshold from 11 to 22 million incentivize firms for example to increase their R&D investments from four to 10 million NOK?

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Appendix 1

Forms of business organizations in our dataset

	AS	ASA	DA	ENK	ANS	NUF	Other
2006	197 277	513	5	158	6	7 442	5 190
2007	209 213	485	3	71	6	10 469	5 112
2008	217 593	420	3	86	5	13 604	5 852
2009	220 613	368	3	87	5	16 961	5 309
2010	223 623	344	3	239	4	20 024	5 294
2011	228 681	320	3	227	4	20 178	5 334
2012	244 177	280	4	202	3	18 467	5 563
2013	260 155	257	4	179	2	14 344	6 810
2014	275 391	236	4	133	2	12 374	6 522
2015	289 558	228	3	103	2	11 337	6 463

Types of business organizations:

AS - Privatly held corporation, corporation

ASA - Publicly held corporation

DA - Apportioned liability

ENK - Sole proprietorship

ANS - General partnership

NUF - Norwegian branch of a foreign company

Appendix 2

Subsidiaries with and without SkatteFUNN costs

Year	Number of subsidiaries with and without SkatteFUNN costs	Number of subsidiaries with SkatteFUNN costs	Subsidiaries not engaging in SkatteFUNN projects	Share of groups with SkatteFUNN costs
2006	6347	1522	4825	0.24
2007	6280	1380	4900	0.22
2008	6036	1333	4703	0.22
2009	5861	1298	4563	0.22
2010	6300	1348	4952	0.22
2011	6238	1369	4869	0.22
2012	7079	1498	5581	0.21
2013	7479	1596	5883	0.22
2014	7810	1874	5936	0.24
2015	8692	2180	6512	0.25

Appendix 3

T-tests propensity scores matching variables

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	2,349	4.59e+08	2.20e+08	1.06e+10	2.89e+07	8.90e+08
1	2,349	2.25e+08	4.53e+07	2.19e+09	1.36e+08	3.14e+08
combined	4,698	3.42e+08	1.12e+08	7.68e+09	1.22e+08	5.62e+08
diff		2.34e+08	2.24e+08		-2.05e+08	6.74e+08

diff = mean(0) - mean(1) t = 1.0459
Ho: diff = 0 degrees of freedom = 4696

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.8522 Pr(|T| > |t|) = 0.2957 Pr(T > t) = 0.1478

t-test treatment and total assets

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	2,349	2.72e+08	1.98e+08	9.57e+09	-1.15e+08	6.59e+08
1	2,349	1.50e+08	2.12e+07	1.03e+09	1.08e+08	1.92e+08
combined	4,698	2.11e+08	9.93e+07	6.81e+09	1.63e+07	4.06e+08
diff		1.22e+08	1.99e+08		-2.68e+08	5.11e+08

diff = mean(0) - mean(1) t = 0.6130
Ho: diff = 0 degrees of freedom = 4696

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.7301 Pr(|T| > |t|) = 0.5399 Pr(T > t) = 0.2699

t-test treatment and operational expenses

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	2,349	162.882	532.0472	25786.46	-880.4492	1206.213
1	2,349	2.608129	.1922707	9.318685	2.231091	2.985167
combined	4,698	82.74507	265.9979	18232.02	-438.7356	604.2257
diff		160.2739	532.0473		-882.7885	1203.336

diff = mean(0) - mean(1) t = 0.3012
Ho: diff = 0 degrees of freedom = 4696

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.6184 Pr(|T| > |t|) = 0.7632 Pr(T > t) = 0.3816

t-test treatment and liquidity

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	2,349	.9727544	.0033597	.162833	.9661661	.9793427
1	2,349	.9727544	.0033597	.162833	.9661661	.9793427
combined	4,698	.9727544	.0023754	.1628157	.9680974	.9774113
diff		0	.0047513		-.0093149	.0093149

diff = mean(0) - mean(1) t = 0.0000
Ho: diff = 0 degrees of freedom = 4696

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.5000 Pr(|T| > |t|) = 1.0000 Pr(T > t) = 0.5000

t-test treatment and firm size (number of employees)

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	2,349	.0523627	.0045971	.2228048	.0433479	.0613775
1	2,349	.0485313	.0044346	.2149318	.0398351	.0572275
combined	4,698	.050447	.0031935	.2188888	.0441862	.0567078
diff		.0038314	.0063874		-.008691	.0163538

diff = mean(0) - mean(1) t = 0.5998
Ho: diff = 0 degrees of freedom = 4696

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.7257 Pr(|T| > |t|) = 0.5486 Pr(T > t) = 0.2743

t-test treatment and established before 1980

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	2,349	.6134525	.0100495	.4870621	.5937458	.6331593
1	2,349	.6032354	.0100963	.4893305	.5834369	.6230339
combined	4,698	.608344	.0071222	.4881724	.594381	.6223069
diff		.0102171	.0142452		-.0177102	.0381444

diff = mean(0) - mean(1) t = 0.7172
Ho: diff = 0 degrees of freedom = 4696

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.7634 Pr(|T| > |t|) = 0.4733 Pr(T > t) = 0.2366

t-test treatment and establishment year in between 2000 and 2011

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	2,349	49254.02	470.9223	22823.95	48330.56	50177.49
1	2,349	49556.64	463.2559	22452.39	48648.21	50465.08
combined	4,698	49405.33	330.2652	22637.02	48757.86	50052.81
diff		-302.619	660.586		-1597.678	992.4395

diff = mean(0) - mean(1) t = -0.4581
Ho: diff = 0 degrees of freedom = 4696

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.3234 Pr(|T| > |t|) = 0.6469 Pr(T > t) = 0.6766

t-test treatment and NACE-kode

Appendix 4

99th percentile	SMEs	Large firms
2006	6625176	8000000
2007	7022000	8000000
2008	8000000	8000000
2009	8729594	1.10e+07
2010	8706846	1.10e+07
2011	9356105	1.10e+07
2012	8333067	1.10e+07
2013	8723300	1.10e+07
2014	1.05e+07	1.77e+07
2015	1.50e+07	2.25e+07

Appendix 5

Reported R&D costs of corporate groups.

Year	Total (NOK)
2006	3.5 billion
2007	3.09 billion
2008	3.1 billion
2009	3.7 billion
2010	3.8 billion
2011	4.06 billion
2012	4.50 billion
2013	50.3 billion
2014	7.1 billion
2015	10 billion
Sum	48 billion