Access (not) granted: What kinds of firms participate in technology programs?[1]

Tommy Høyvarde Clausen

Centre for Technology, Innovation and Culture (TIK), University of Oslo.

Correspondence: t.h.clausen@tik.uio.no

Abstract

In this paper we focus on the participation stage and analyze what kinds of firms that are granted access to the 5 most important technology programs in Norway. Based upon a combination of logistic regression and factor analysis we find that the public support system for R&D in Norway is built around export oriented, innovative and larger firms. Technology programs support these firms with "research" and "development" subsidies in order to support the development of national champions.

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Introduction

Research and development (R&D) policy interventions have traditionally been "justified" by market failure arguments. The market failure argument developed by Arrow (1962) and others states that due to market imperfections, such as incomplete appropriability and spillovers, firms can not reap the full benefits of innovative activities. As a result, firms will invest less than the socially optimum in R&D activities (Arrow, 1962; for a recent discussion see Lundvall & Borrás, 2005). Following this argument a large theoretical and empirical literature argues that firms left on their own face insufficient incentives to invest in R&D from the point of view of society (Hall, 2002).

Contemporary innovation policies are to a large extent based upon this reasoning. Public R&D programs have been designed to support commercial R&D projects with large expected social benefits but with inadequate expected returns to private investors (Klette et al, 2000). Studies have on the other hand shown that knowledge developed by rival firms is not costless to imitate (Levin et al, 1987). This reduces the incomplete appropriability and spillover problem for R&D doing firms, but does not eliminate the under-investment problem (Hall, 2002). Capital market imperfections are believed to exist in the sense that there is a wedge between the private rate of return required by a firm investing own funds in a R&D project, and the rate of return required by external investors (Hall, 2002). If firms are not already wealthy, or profitable, some innovations will not be developed because the cost of external capital is too high. Such "funding problems" justify R&D policy interventions. Supporting young, small and cash-constrained firms in the context of R&D and innovation is recommended (Hall, 2002).

There is little disagreement about the desirability of subsidizing private R&D activities among researchers and policymakers (Klette et al, 2000). Many researchers and policymakers have on the other hand grown frustrated with the lack of statistical evidence documenting a direct contribution from public R&D financing (David et al, 2000). This “frustration” has led to a rapid increase in the number of studies where the goal is to evaluate whether R&D subsidies stimulate or substitute private R&D spending. The empirical evidence has been mixed (see David et al, 2000 for a review of the “older” literature). Most recent studies seem to conclude that R&D subsidies are in fact capable of inducing additional R&D efforts at the firm level (see Hall, 2005; Aerts et al, 2006 for reviews of this literature). What these recent “effect studies” have in common is that differences between R&D programs are left unexplored.

To what extent are R&D programs designed differently? Do technology programs support different kinds of firms? If technology programs are different when it comes to the selection rules used to fund firms and projects, heterogeneous selection rules at the level of technology programs can lead to different outcomes among subsidized firms (Heijs, 2003; Blanes & Busom, 2004). It is recognized that R&D policies consist of a mix of different technology programs (Mytelka & Smith, 2002; Luukonen, 2000; Georghiou & Roessner, 2000). Prior research has on the other hand not explored to what extent major technology programs within a country are different from one another. Less is known about the actual combination of technology programs firms use and whether firms are supported by several R&D programs simultaneously. We will shed some empirical light on these questions in this paper.

We will evaluate how subsidies from the most important R&D programs within a National System of Innovation (NIS) are allocated among firms and projects in order to identity patterns of policy practice. Both R&D subsidies and policy objectives are taxonomized.

According to reviews of the literature it is an important avenue for further research to use taxonomies in econometric evaluations in order to understand how R&D programs differ, and whether the heterogeneity among technology programs can be related to outcomes (David & Hall, 2000). Taxonomic evaluations are further justified by the high and recent policy interest in finding some "R&D program design" that encourages additional spending on innovative activities in the private sector (Aerts et al, 2006).

We respond to these shortcomings in the following way. We will first analyze what kind of firm characteristics that can predict participation status in the 5 most important technology programs in Norway. A focus upon the participation stage will reveal whether R&D programs use different selection rules when they allocate R&D subsidies to firms. We will secondly analyze what kinds of firms that access several technology programs at the same time. Our third objective is to refine and develop a taxonomy where R&D programs in Norway are classified according to whether they distribute "research" or "development" subsidies to firms. The paper ends with a discussion of whether the observed policy practise is consistent with innovation policy goals.

The paper is organized as follows: In the next section we will discuss why it is important to focus on the participation stage. This is followed by a discussion of what kinds of firms that are believed to access technology programs, in section 3. Features of the Norwegian support system are discussed in section 4 in relation to Norway's adoption of the Lisbon Agenda. The technology program taxonomy is also discussed in that section. The methodology and data are discussed in section 5. The empirical analysis is conducted in section 6 where we estimate what kind of firms that are most likely to be subsidized from the most important R&D

programs in Norway. The analysis is accompanied by a discussion of the results. Concluding remarks are presented in section 7.

R&D program participation and innovation policy

It is important for both innovation policy and theory to focus on what kinds of firms that participate in R&D programs. A program participation focus can reveal the existence of unexpected barriers to “entry” into technology programs for some types of firms (Blanes & Busom, 2004). Technology programs can fail to support eligible firms. This can have consequences for what kind of effects subsidies have upon private R&D spending and the economic performance of recipient firms at a later stage. This will in turn have implications for innovation policy. By focusing on the participation stage we can identify how innovation policies are implemented in practice. The public support system for private R&D is a defining feature of the national system of innovation. Public provision of R&D funding is an inherently important part of most innovation policies. To identify the allocation and selection rules the most important R&D programs use can help us in detecting how R&D policies are implemented, whether subsidies are allocated to the intended business population, and to correctly interpret differences in observed behaviour and outcomes among subsidized firms. This last point is important for studies of the effectiveness of R&D subsidies. These studies have far too often neglected the existence of heterogeneity among R&D programs. Such heterogeneity can explain why some studies report that subsides stimulate private R&D spending, while others do not (see discussion in David et al, 2000; David & Hall, 2000; Aerts et al, 2006). Only when R&D programs are allowed to differ in impact evaluations is it possible to identify good policy practice with respect to the implementation of technology policies.

According to contemporary innovation policies such as the Lisbon Agenda – which Norway to a large extent follows – policymakers should facilitate innovation in the private sector by improving innovation support services, provide better access to finance for firms, especially SMEs, and create a supportive environment which strengthens the innovation potential of firms (NHD, 2006). A focus on the participation stage is an important first step in order to analyze whether policy practice is consistent with innovation policy goals. This is also a necessary first step in most R&D policy evaluations. Hence, a focus on what kind of firms that participate in the most important R&D programs within a country can enhance our understanding of how vital aspects of the national innovation and public support system interacts with the firm level.

It has been shown that a substantial proportion of subsidized firms have a free-riding behaviour towards the public support system (Heijs, 2003). The percentage of free-riders, understood as subsidized firms whose innovation projects do not depend upon public funding, were found to differ substantially between different types of R&D programs. This suggests that some R&D program designs are better at stimulating additional R&D efforts at the firm level compared to others. Recent reviews of the innovation systems literature (Edquist, 2005; Lundvall et al, 2002) have argued that it is important to better understand the relations between R&D activity at the firm level and institutional variables associated with the NIS. Analyzing what kinds of firms that are supported with different types of subsidies by the most important R&D programs in a national context can increase our understanding of such relations.

It is recognized that R&D policies consist of a mix of different technology programs that use different policy tools in order to reach innovation policy goals (Mytelka & Smith, 2002;

Luukonen, 2000; Georghiou & Roessner, 2000). Despite this insight, we know less about how R&D programs differ, whether some types of firms are excluded from participation, and whether some types of firms are supported by several technology programs at the same time. Few studies have analyzed firm participation status across technology programs (Blanes & Busom, 2004). An obvious reason is, as always, lack of relevant data on R&D programs. The database we draw upon in this paper does not suffer from such shortcomings. Below we summarize and discuss what is known about the firm level determinants of participation status with respect to the allocation rules technology programs use when firms and projects are funded.

Participation in technology programs: Firm factors and selection rules

Participation in technology programs is an outcome of both firm factors and decisions taken by policymakers in R&D programs. Some firms are believed to be more capable of drafting a good application, or simply possess the necessary competence to join a R&D program. Technology programs can however reject applications, and selection can differ across R&D programs. Both firm factors – and the selection rule used by R&D programs – will determine whether a firm is subsidized or not.

What kind of firms will apply for a subsidy?

Policymakers can reduce the private cost of doing R&D by offering tax-credits or subsidies to firms (Hall, 2002; David et al, 2000). The existence of R&D policy interventions will have an impact on firms' decision to embark upon innovation projects. According to the market failure argument subsidies should target areas where there is a large gap between the private – and the social – rate of return to R&D investments (Arrow, 1962). Subsidies can as such make

R&D projects profitable. Firms in this situation will have a strong motivation to apply in order to join a technology program. If the costs of applying are small, and the allocation criteria used by R&D programs are not very restrictive, most firms will have an incentive to apply for a subsidy. This is also the case for firms that do not need the subsidy in order to make the R&D project profitable (Blanes & Busom, 2004; Jaffe, 2002). Finally, the amount of the subsidy might be too small to make private R&D spending profitable. Firms in this situation are not expected to join a technology program. The decision to apply for participation status will as such differ across firms.

Firm size and age

The relationship between firm size and innovation is connected to the literature on the Schumpeterian Hypothesis (see Cohen & Levin, 1989; Cohen, 1995; Acs & Audretsch, 2003 for reviews). A standard interpretation of this hypothesis is that innovative activities increase more than proportionally with firm size. An argument in favour of such an interpretation is the belief that smaller firms are unable to finance innovative activities, and as such, are less inclined to innovate. According to Hall (2002) small, start-up and cash-constrained firms face a higher cost of external capital than larger firms when they try to finance their innovation projects. Larger firms are in addition more likely to use internally generated funds in the R&D process. Hence, smaller, younger, and cash-constrained firms should be more inclined to apply and to be included in technology programs by policymakers. Most firms have on the other hand an incentive to reduce the private cost of doing R&D by applying for a subsidy (Blanes & Busom, 2004; Jaffe, 2002).

Contrary to what one might expect, empirical evaluation studies suggest that larger firms are more likely to be subsidized. With the exception of Busom's (2000) study of a single R&D

program in Spain, prior research has found that larger and older firms are more likely to get access to public funding. Research from Germany (Hussinger, 2006; Czarnitzki & Fier, 2002; Almus & Czarnitzki, 2003; Czarnitzki & Hussinger, 2004), from France (Dugout, 2004), from Spain (Herrera & Heijs, 2004), from Belgium (Aerts & Czarnitzki, 2004) and from the US (Wallsten, 2000), shows that larger size is positively related to the probability of being subsidized. Furthermore, empirical studies have reported that older firms are far more likely to get access to subsidies (Busom, 2000; Hussinger, 2006; Czarnitzki & Hussinger, 2004).

According to a historical analysis of Norwegian R&D policy, economics of scale (size) and scope (diversification) have been important elements in public sector regulation of private R&D (Wicken, 2000). Large, R&D intensive, diversified and financially strong companies have been selectively targeted for public support since the 1950's and onwards in Norway. This discussion suggests that larger, diversified and innovative firms are more likely to be subsidized.

Group membership and diversification

Economies of scope have been an important element in Norwegian R&D policy, as just discussed. Diversified firms are believed to be more innovative due to complementarities that arise from uniting knowledge and experience from two or more industries in the R&D and innovation process. According to Nelson (1959) only diversified firms will spend funds on basic R&D. The main reason is that the outcome from basic science discovery is highly unpredictable. Only product-diversified firms with "fingers in many pies" are likely to market and profit from the technological knowledge that follows from such search activity. Diversified firms can as such be more inclined to apply for a subsidy and expect to be supported by policymakers. Diversified firms and / or firms with a corporate parent can also have a higher propensity to apply for a R&D subsidy because resources at the corporate level, such as information, expertise and funds, are made available to the applicant. However, two previous studies did not find group membership to be positively related to participation for Belgian and German firms (Aerts & Czarnitzki, 2004; Czarnitzki & Hussinger, 2004). It remains to be seen whether this is the case also in Norway.

Past- dependency of R&D and innovative activities

Firms that have successfully innovated in the past have had the opportunity to selectively retain organizational routines that promote future R&D activities (Nelson & Winter, 1982; Aldrich, 1999). Firms with established innovation capabilities are more inclined to keep doing R&D and to apply for public funding to finance this endeavour. Research has shown that firms with previous innovation activities, proxied by patents and R&D departments, are positively related to the probability of being subsidized (Aerts & Czarnitzki, 2004; Blanes & Busom, 2004; Czarnitzki & Hussinger, 2004; Hussinger, 2006; Wallsten, 2000). Based upon these findings, and the historical analysis of Norwegian R&D policy (Wicken, 2000), we expect firms with innovation activities in the past to be more likely to apply for a R&D subsidy.

Ownership and foreign capital

According to Archibugi & Iammarino (1999) governments must make a choice about whether or not to give affiliates of foreign firms access to national R&D subsidies. The dividing line is believed to go between governments emphasizing ownership, and those who do not, in relation to the technological knowledge developed as a result of public R&D investments. While the United States seems to follow a policy where foreign firms can get access to subsidies (Archibugi & Iammarino, 1999), studies from several European countries show that affiliates of foreign firms are likely to be excluded from R&D policies in the host country (Almus & Czarnitzki, 2003; Herrera & Heijs, 2004; Busom, 2000; Aerts & Czarnitzki, 2004 Hussinger, 2006). Affiliates of foreign owned companies may benefit from R&D developed in the home country of the mother company. Hence, foreign firms may face few incentives to engage in R&D activity in the host country. Innovative foreign firms can also be denied access to R&D subsidies in the host country. According to a historical analysis of Norwegian R&D policy, R&D has been seen by Norwegian policymakers as a major instrument in the industrialization of Norway. The major policy objective in this context has been to promote the development of R&D capabilities among Norwegian firms independent of the major foreign owned firms located in Norway, such as foreign owned oil companies. A policy response has accordingly been to selectively support and encourage R&D activities among national firms (Wicken, 2000). We will therefore expect foreign owned firms in Norway to be less likely to get a subsidy.

Export and competitiveness

Firms that export some, or all, of their products or services usually face strong international competition. These firms will have a major incentive to strengthen their competitiveness through innovation. With the exception of Busom's (2000) study of a single R&D program in Spain, prior evaluation research has shown that exporting firms are more likely to get access to subsidies (Almus & Czarnitzki, 2003; Aerts & Czarnitzki, 2004; Hussinger, 2006; Czarnitzki & Hussinger, 2004). Because Norway has a small and open economy where many firms export their goods, we expect R&D programs in Norway to be more inclined to support firms with more export revenues.

Industry and technological opportunity

Industries vary in terms of technological opportunities and to the extent to which the economic value of innovations can be reaped (Klevorick et al, 1995; Levin et al 1987). Firms in certain industries can as such have a higher propensity to be engaged in innovative activities and to apply for a subsidy. According to Wicken's (2000) historical analysis of Norwegian innovation policy, the public support system for R&D has traditionally supported certain industries over others in accordance with policy objectives to support strategic sectors (Wicken, 2000; Lundvall & Borrás, 2004). Recent policy initiatives suggest that the policy scope has been broadened and that subsidies are allocated to firms regardless of industrial affiliation (Wicken, 2000). For this reason we do not expect industrial affiliation to be an important predictor variable.

Financial characteristics, funding constraints and firm growth

Firms with better cash-flow are believed to be more likely to divert resources into R&D activity (Klette & Møen, 1998). Because cash-flow is an approximation of the internal resources that can be used for R&D purposes, firms with better cash-flow should be less inclined to be subsidized. Cash-flow has however not been found to be a significant predictor of R&D subsidies in the empirical literature (Aerts & Czarnitzki, 2004). Public agencies or R&D programs are further embedded in an institutional context where they fight over scarce resources. Program managers face strong pressures for high "success rates", as politicians are unlikely to support programs where a lot of the projects "fail". This can lead to a situation where program managers decide to "pick the winners" and support commercially attractive project proposals and firms with already high growth rates (Aerts, et al, 2006; Wallsten, 2000).

Selection criteria used by R&D programs

Policymakers usually have a range of different objectives when they design R&D programs. These objectives will determine the total budget allocated to specific programs, the distribution of money across industries, and the screening rules used to select what kinds of firms and projects that are eligible to be funded (Blanes & Busom, 2004). Although market failure arguments have provided policymakers with the economic rationale for intervening in the R&D market, other policy objectives can co-exist or dominate innovation policies. Among these are: (1) technological upgrading of firms (in traditional industries) of particular importance and (2) to support national champions (Blanes & Busom, 2000). These three policy objectives are discussed below in relation to public funding of R&D activities in the business sector.

Correcting market failures

Governmental interventions in the R&D market are usually justified by the existence of market failures. Policy interventions are justified by the sometimes large gap between the private and the social rate of return to R&D investments. Large gaps between the private and the social rate of return to R&D arise due to incomplete appropriability and spillovers between firms (Arrow, 1962). A second type of market failure also exists. This market failure addresses the wedge between the rate of return required by a firm investing own funds in a R&D project and the return required by external investors (see Hall, 2002 for a review). This latter “type” of market failure suggests that some innovations will fail to be developed because the cost of external capital is too high, especially for small, young and cash-constrained firms (Hall, 2002).

The main purpose of a R&D program can as such be to correct market failures. If so, we will expect the R&D program to fund private R&D projects that, in absence of support, would not have been initiated. R&D programs will as such use selection rules where more uncertain projects with larger knowledge spillovers are supported or to fund projects where the cost of external capital is high. It is hard to empirically identify the existence of market failures. Evidence suggests however that market failures affect cash-constrained firms, and especially young and small firms (Hall, 2002).

Following Blanes & Busom (2004) we argue that technology programs supporting this segment of the business population do so out of a desire to correct market failures. Recent innovation policy initiatives, such as the Lisbon Agenda, also stress the importance of encouraging innovative behaviour among firms with few proven innovation capabilities. Technology programs whose main aim is to correct market failures will be less inclined to fund firms with established innovation capabilities. Stimulating innovative efforts among firms that in absence of the subsidy would not spend money on innovation should as such be a feature of policies which aim to correct market failures. Diversified firms represent an odd case in this regard. On the one hand, Nelson (1959) argues that basic science discoveries are most likely to be developed by product differentiated firms. Based upon this reasoning one might expect technology programs to subsidize diversified firms, at least if they want to correct market failures. Reviews of the literature of the Schumpeterian hypothesis argue on the other hand that the relationship between diversification and R&D is ambiguous. Few empirical studies have concluded in favour of Nelson's theorizing in this particular context (Cohen, 1995; Cohen & Levin, 1989). For these reasons we will not treat policy support to diversified firms as an indicator of a policy aim to correct market failures.

Promoting national champions

A second objective in R&D and innovation policy is to foster national champions. Within the framework of this innovation policy we will expect policymakers to subsidize R&D activity with high (expected) commercial success. Public R&D funds will be distributed to firms and projects largely independently of whether the gap between the private and social rate of return to R&D investments is small or high. Technology programs established to promote national champions are expected to fund larger firms, with proven innovation capabilities, domestic firms and firms with a higher export orientation. Firms that are part of a group or diversified firms are also more likely to receive a subsidy under this policy scheme. We expect larger firms, with better cash-flow, domestic ownership, being a part of a group, and diversified firms to be most likely to receive public funding from a technology program if the objective is to promote national champions.

Technological upgrading

A third goal with high policy relevance is to promote technological upgrading of firms in traditional industries. Firms in traditional industries tend to be older and employ a large fraction of the workforce. We expect firm size and age to be positive predictor variables for obtaining a subsidy under this kind of R&D policy. Diversified firms or group membership will be negative predictors as these kinds of firms are less vulnerable to harsh market conditions. Prior innovation experience will be negatively related to the probability of getting access to subsidies under this policy scheme. Firms with better cash-flow are also less likely to participate in these technology programs. Export activity can on the other hand be a positive predictor variable under this policy logic.

Drawing and extending upon Blanes & Busom (2004) table 1 below summarizes the expected relationships between firm characteristics and the selection rules and policy objectives of R&D programs.

[TABLE 1 ABOUT HERE]

In table 1 the question marks (?) indicate an undetermined relationship between certain firm characteristics and the different policy objectives that R&D programs are expected to pursue. A "+" sign signals that larger values on the variable in question will enhance the probability of being subsidized. As an example, we expect larger size to be positively (and significantly) related to participation status in technology programs where the aim is to support national champions. A "-" sign signals that larger values on the variable in question will decrease the probability of being subsidized. As an example, we expect that better cash-flow will decrease the probability of being included in technology policy programs that are established with "technological upgrading" objectives in mind.

R&D support to firms in Norway

A recent policy document reveals that Norway has adopted the Lisbon Agenda in many respects, at least seen from policymakers' point of view (NHD, 2006). Major policies issues in this context are to facilitate growth, R&D and innovation. According to the Lisbon Agenda policymakers should create a supportive environment for SMEs in order to facilitate and strengthen the growth and innovative potential of these firms. Improved access to public R&D funds, more efficient use of subsidies to leverage private R&D spending, and improving innovation support services, are highlighted policy strategies in the Lisbon Agenda (NHD, 2006).

Norwegian policy documents do in some contrast argue that innovation policies should support "young firms", "large already innovative firms", "SMEs with a growth potential", and firms with an "international growth potential" (NHD, 2003; NHD, 2005) . With the exception of young firms, the focus in these policy documents upon already "innovating firms" and firms who already "possess a growth potential" stand out in some contrast to the recommendations in the Lisbon Agenda. The problem seen from market failure and innovation system perspectives is the policy desire to fund "the winners". Recent Norwegian policy documents thus seem to be in line with a policy objective to support the development of national champions.

The "comparison" of recent innovation policy documents from Norway with the recommendations in the Lisbon Agenda is stylized. In the spirit of this paper we are more concerned with what actually happens at the level of technology programs. To what extent do technology programs in Norway support "already innovating firms" and companies with a "growth potential" prior to their participation in technology programs? In the section below we describe and discuss the 5 most important technology programs in Norway. We will also provide some descriptive statistics that illustrate the importance of these five technology programs for different types of firms and industries in the Norwegian context. We are especially interested in the distribution of subsidies among industries and firm size classes, at both the aggregate level and at the level of technology programs.

There is no official production of statistics that reveals the distribution of subsidies at the level of technology programs in Norway. For instance, in Wicken's (2000) historical analysis of Norwegian technology policy, differences between technology programs are left unexplored in the statistical - descriptive analysis. Little is further known in Norway about EU subsidized firms. The allocation of EU subsidies to Norwegian firms is a recent phenomenon. Allocation of EU subsidies is also a policy area over which Norwegian policymakers have little control. Below the five most important technology programs in operation in Norway in 2001 are described.

(1) SND – is the State Industrial and Development Fund. SND was established in 1993 by merging the “Industry fund” (Industrifondet), the “SME fund” (Småbedriftsfondet) and the “Development fund” (Distriktenes utviklingsfond). Especially the Industry fund and the Development fund were originally established with a policy aim in mind to support private development activities. According to Wicken (2000) this included a strong policy focus upon the private rate of return from public R&D support. SND has to a large extent continued this policy focus (Wicken, 2000).

(2) NRC – is the Norwegian Research Council. NRC was established in 1993 when 5 different research councils were merged. The main type of R&D subsidy the NRC allocates to firms is in the form of a research grant where firms can decide how to use the subsidy largely by themselves. Subsidies from NRC are mainly allocated to firms in a competitive arrangement. The “best” proposals picked by industry experts and renowned researchers are funded.

(3) Ministries – Firms can also get support directly from Governmental Ministries. In the survey policy support from Ministries includes subsidies from local and regional authorities. Little is known about the actual role of Ministries in the public support system for R&D and innovation in Norway.

(4) European Union (EU) – Norwegian firms can also get support from the European Union, especially through the framework programs. Less is known about the role of EU subsidies in the Norwegian innovation system.

(5) FUNN – is the predecessor to the current R&D tax credit policy called SkatteFUNN in Norway. FUNN was however operated as a subsidy scheme by the NRC where the main policy goal was to provide firms with an "easy and un-bureaucratic" access to public R&D financing.

What is the importance of these technology programs for supporting and financing R&D activity among firms in Norway? Tables 2 and 3 provide some answers.

[TABLE 2 ABOUT HERE]

According to table 2, the value of total public R&D funding in Norway was 943 million NOK in 2001 (about 118 million Euro). At the same time, total internal R&D spending in Norway, in the private sector, constituted 12614 million NOK. Considerable differences between technology programs exist however when it comes to the total amount allocated to supporting internal R&D activities in the private sector. According to table 2, Ministries was in fact the largest source of direct public R&D funding for Norwegian firms in 2001, followed by the Research Council, EU, SND and then FUNN. The statistics underline that Ministries are a very important source of public R&D financing in the Norwegian innovation system. Because there is no prior data on public R&D funding per technology policy program in Norway we do not really know whether 2001 was a special year or not in that regard. In table 3 below, we explore differences between technology programs in more detail.

[TABLE 3 ABOUT HERE]

According to table 3 the lowest average subsidy is allocated from FUNN and SND. Firms seeking out subsidies from these two R&D programs received in average 0, 4 Mill NOK to finance their R&D projects in 2001. By far the largest subsidy was allocated from Ministries where firms in average were supported with 6, 5 mill NOK. Differences between R&D programs can partly be explained by the fact that the number of supported firms differs substantially. Whereas SND financed R&D projects among 208 firms, EU and Ministries financed R&D projects among respectively 49 and 79 firms.

Technology programs are heterogeneous when it comes to the importance of the subsidy in relation to total internal R&D efforts at the firm level. Subsidies from both Ministries and SND stand out in comparison to the other R&D programs. Firms subsidized by Ministries got in fact 40 % of their innovation costs covered by the subsidy, followed by SND where the subsidy covered about 12 % of the innovation costs. This stands out in comparison to NRC, EU and FUNN where subsidies covered between 3-6 % of total R&D costs (in average). The descriptive statistics provided in table 3 suggest the existence of one important source of heterogeneity among technology programs in Norway, namely the degree to which subsidies cover total internal R&D costs at the firm level.

In table 4 and 5, we explore the extent to which the 5 technology programs subsidize firms in the same industry. In order to provide readers with a sense of the “economic importance” of particular industrial sectors in Norway, we have provided the actual number of employees at the 2.digit NACE level, and industry employment as percentage of total employment. We have used the number of employees as provided by the firm managers in the R&D survey which is discussed below. These employment statistics will deviate from those produced by Statistics Norway because we use the R&D survey data in the calculation of the employment figures. The survey data is not representative for enterprises with less than 10 employees. The figures should be fairly accurate when it comes to the industry share of employment in firms with 10 employees or more. It is also important to use the same database for consistency reasons.

[TABLE 4 ABOUT HERE]

The figures for total R&D in table 4 are the actual level of expenditure reported by the firms in the R&D survey, aggregated to the 2. digit NACE industry level. It includes private and public R&D financing. The two first columns display the actual and relative level of R&D at the industry level in Norway in 2001. A brief look at the table informs us that a few industrial sectors account for most of the total R&D spending in Norway, most notably firms in NACE 72, 32, 24 and 29 which do about 45% total R&D. At the same time these four sectors got approximately 63 % of total available public R&D resources, and accounted for about 11 % of employment. Firms in NACE 29 stand out as firms in this industry did 7,4 % of total R&D, got 37 % of all public R&D, and accounted for only 3 % of employment. It can be noted here that the figures for total R&D include public financing. As a whole, table 4 shows that public R&D financing is concentrated to a few sectors and covers a relatively small proportion of the Norwegian business sector in terms of employment. Because the spirit of this paper is to explore the diversity of public R&D funding, table 4 is essentially reproduced below, but now exploring the extent to which the same industrial sectors are financed by different technology programs.

[TABLE 5 ABOUT HERE]

In table 5 we see that firms in the same 4 sectors still get access to a substantial amount of public R&D resources from our 5 technology programs. Considerable diversity exists however and this is the dominant tendency in table 5. Hardly any sector that received more than 10 % of total funding from a technology program, got access to more than 10 % of the funding from any other technology program in our study. The statistics suggest that our five technology programs have different policy objectives, subsidize different kinds of firms, and as such stimulate a diversity of approaches to innovation. Looking at essentially the same statistics, but now distributed according to size classes, reveals another interesting pattern.

[TABLE 6 ABOUT HERE]

When comparing the relative shares of total and public R&D, and the % of total employment in table 6 according to size classes, we find a high degree of “correspondence”. For instance, firms with 10-30 employees did 15 % of total R&D in the private sector, received 14,9 % of public funding, and accounted for about 19 % of employment. But as table 7 reveals, the aggregate distribution of public R&D funding according to firm size classes “hides” some diversity when we reproduce table 6, but now exploring differences between technology programs.

[TABLE 7 ABOUT HERE]

In table 7, we see that over 50 % of total public funding from NRC, EU and Ministry are allocated to firms with more than 500 employees. The technology programs SND and FUNN stand out in comparison to the others. SND diverts about 42 % of total funding to firms with 10- 30 employees, and subsidies from FUNN are evenly distributed among the size classes in the business sector. The figures in tables 6- 7 suggest that there is some overlap between technology programs, as firms in some industrial sectors, and especially firms in the largest size classes, participate in more than one technology program. Table 8 sheds some light over these policy dynamics.

[TABLE 8 ABOUT HERE]

In table 8 we can see that about 81 % of the subsidized firms participate in only one technology program. The remaining 19 % participate in 2 or more programs. In section 6 below we will analyze the firm level propensity to access several technology programs simultaneously. We will first shed some light on the actual combination of technology programs firms use. This is done in table 9.

[TABLE 9 ABOUT HERE]

In table 9 we can see that firms in most cases only get access to one technology program, as already discussed. R&D policy does however include a complex "residual component" where some firms access a diverse mix of technology programs simultaneously. As we can see in table 9, many different combinations of technology programs are actually used by firms to finance innovation activities. There is, in other words, a high degree of complexity to innovation policies that aim to stimulate R&D activity in the private sector.

For practical evaluation purposes such complexity should ideally be reduced. Although it is important to understand the sources of a diverse R&D policy, it is arguably equally important to be able to reduce the variety, for instance displayed in table 9, into some more analytical dimensions for analytical purposes such as evaluations of technology policies. As discussed by reviews of the literature (David et al, 2000; David & Hall, 2000), taxonomies are helpful theoretical tools in this regard. Below we will present and discuss a taxonomy which has been developed by Rye (2002). The taxonomy sheds light on the pattern and dynamics of R&D policy participation amongst firms in Norway.

The taxonomy: "Close to" and "far from" the market funding

Based upon a review of 12 evaluation studies of the public support system for R&D and innovation in Norway over two decades, Rye (2002) argues that a "division of labour" between R&D programs in Norway has emerged. It is argued that two main types of R&D programs exist and that they subsidize different kinds of firm projects, according to the phases in the product cycle. The first type of technology program supports firms with uncertain private projects with a high research component "far from the market". Mainly NRC and its predecessors are associated with this kind of public R&D funding. The second type of R&D program supports firms with less uncertain projects "close to the market" and the commercialization phase. These projects contain a high development component, and are mainly associated with R&D support from SND and its predecessors.

The taxonomy discriminates between technology programs according to the degree of technological uncertainty of private R&D projects. The taxonomy captures as such a fundamental source of heterogeneity among R&D programs in Norway. For the non-Norwegian reader without particular familiarity to the landscape of technology programs in Norway there are significant degrees of overlap between the concepts "far from the market" and "research" on the one hand, and "close to the market" and "development" on the other hand. In our opinion these concepts can be used interchangeably without loss of much precision.

Since Ryes (2002) review there has been a large-scale re-organization of the number of technology programs, where also new R&D programs such as FUNN and EU have come to play a major role as sources of public R&D funding for Norwegian firms. Direct financing from Ministries was further not covered in the review. Based upon discussions with Norwegian technology historians, as well as policymakers, we have included the Ministry technology program in the “close to the market” category together with SND, and included the technology programs EU and FUNN in the “far from the market” category together with NRC. A factor analysis has also been conducted in order to see whether R&D support from Ministries, EU and FUNN can be taxonomized into either “close to the market” or “far from the market” type of policy support. The results from the factor analysis supported our expectations. The reader can refer to the appendix for details.

Method, data and variables

In this section we will discuss the methodology, data and variables used in the analysis. The taxonomy of R&D programs we draw upon in the analysis is based upon the discussion in section 4 and the analysis done by Rye (2002). In comparison to Rye (2002) we have access to a different dataset and to some extent also access to information about more R&D programs. Another important distinction is that we have access to a representative sample of the entire Norwegian firm population (with 10 employees or more). In her analysis Rye (2002) had access to important - but mainly ad-hoc - policy evaluations.

We will thus refine the taxonomy discussed in section 4 above by adding more R&D programs to the analysis. A substantial part of this task is to analyze the firm characteristics that are able to discriminate between “non-funded” and “funded” status in relation to our 5 technology programs. We will use logistic regression for this task. Logistic regression is useful for binary dependant variables where the presence or absence of an outcome is analyzed (getting access to a subsidy or not).

Data

The research in this paper utilizes a novel database well suited to analyze what kind of firms that get access to subsidies. The main part of the data is based upon the third version of the Community Innovation Survey (CIS 3) and a R&D survey. The surveys were combined and initiated in 2002, but mainly refer to the 1999-2001 time period. The combined survey contains large amounts of information about firms' innovation activities (CIS survey) and questions about how firms finance their R&D activities (R&D survey). Questions about whether firms had received a subsidy from the most important R&D programs in Norway were also asked in the questionnaire. Because it is frequently claimed that cash-constrained firms seek out public financing due to liquidity constraints we also collected the firms' annual accounts which contain information about the financial performance of the firms in CIS 3 / R&D survey.

The combined questionnaire was directed to a representative sample of Norwegian firms with 10 employees or more. Every firm with 50 or more employees was included in the sampling frame. The questionnaire was returned by 3899 firms which constitute a response rate of 93 %, due to its compulsory nature. Because not all firms are obliged to report their annual accounts, the total sample size drops by approx. 10 % when variables constructed from the annual accounts data are used in the analysis. In the analysis we will assume that receiving a subsidy from one technology program will not increase the probability of receiving a subsidy from another technology program within the same year (2001). This assumption is similar to what Busom (2000) makes in her analysis of national and EU programs in Spain. The dependent variables used in the logistic regression analysis are skewed in the sense that many firms do not receive a subsidy (the value 0). Although logistic regression analysis is robust in relation to these issues, in an ideal world many more firms would get access to R&D subsidies which would reduce this skewed distribution problem. But most evaluators live in the world of practical policymaking and must suffice with the data that such processes generate.

Variables

In the analysis we use five subsidy dummy variables, corresponding to whether or not a firm has received a subsidy from **FUNN, NRC, SND, EU** or **Ministries**. Firms reporting to have revived a subsidy from these R&D programs are given the value 1 on the respective binary subsidy variables. Firm characteristics that are believed to be important for firms' probability of receiving a subsidy have also been measured. The variable **patent** is the firm manager's answer to the following question: Did the firm have any valid patents in 2001? Due to the time lag between patent application and the granting of a valid patent by patent offices, simultaneity problems should be avoided (1 = yes). Because of the time lag our patent variable is a measure of innovation activity in the past that has had a successful outcome (in terms of getting a valid patent). As such, our patent variable is a measure of established innovation capability. This variable is highly important for our analysis of innovation policy practice at the level of technology programs. Recent Norwegian policy documents highlight the importance of supporting firms with already established innovation capabilities.

We discussed above that some R&D programs might be tempted to support firms with a high growth trajectory prior to the allocation of the subsidy, due to political pressures for "high success rates". Growth is a clear measure of success and success is believed to be highly correlated with the degree of innovativeness. Firms' **growth** rate is also a highly important explanatory variable in the context of our study as Norwegian policy documents seem to highlight the importance of supporting firms with a "growth" potential. To account for this, we include the percentage growth in employment from 1999 to 2001. Because a small fraction of the firms did not have any employees in 1999, we added the value 1 to the number of employees at the firm level in 1999 before we calculated our growth measure. As such we count the founder of the firm as an employee. **Export activity** is measured as the share of exports in total turnover in 1999. Information about turnover and exports was provided by the firm manager. Export activity measures the degree to which firms with an "international growth potential" are funded by technology programs in the Norwegian Innovation System. This is also highlighted by recent innovation policy documents as discussed in section 4.

The variable **group** is a dummy and indicates whether a firm is a part of a group or not (1 = yes). **Diversification** is an aspect of "economics of scope" and measured as a simple dummy indicating whether the firm is diversified or not (1=yes). Larger firms are more likely to get access to public resources, at least under some innovation policy support schemes. **Size** is measured by the number of employees in 1999. As discussed in section 4, technology programs are recommended to fund innovative large firms. Most large firms in Norway are innovative according to the most recent innovation surveys (Statistics Norway, 2007). We have dummy coded size into different kinds of size classes. The highest size class, "500 +" is the reference category. **Age** is defined as the number of years from when the firm was established. The importance of funding young firms is highlighted in both the Lisbon Agenda, and in recent Norwegian policy documents. Age is dummy coded into different age classes. The highest age class, "50+", is used as the reference category. From the annual accounts database we use firms' cash-flow in order to create a measure of liquidity constraints. **Cash-**

flow is defined as cash-flow divided by the number of employees in 2000. **Foreign ownership** is also included**,** measured as whether or not the firm's headquarter is located in another country (1 = yes).

[TABLE 10 ABOUT HERE]

Analysis

We will start the analysis by estimating whether the measured firm characteristics can discriminate between “non-funded” and “funded” participation status in relation to our 5 technology programs. As such, we will analyze how innovation & R&D policies are implemented in practice, and whether policy patterns exist when it comes to what kind of firms that get access to R&D subsidies in Norway. An important part of this analysis is to discuss whether the 5 most important technology programs in Norway are driven by an innovation policy objective to (1) correct market failures, (2) support national champions, or (3) encourage technological upgrading, according to the scheme developed in table 1. This is done below, where we estimate the following equation using logistic regression:

$$Y_1 = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + B_7X_7 + B_8X_8 + B_9X_9 + B_{10}X_{10} + B_{11}X_{11} + B_{12}X_{12} + B_{13}X_{13} + B_{14}X_{14} + B_{15}X_{15} + E_1$$

Where Y_1 is a binary variable indicating whether a firm has received a subsidy from a specific technology program, X_1 is size0-10, X_2 is size11-50, X_3 is size51-100, X_4 is size101-300, X_5 is size301-500, X_6 is age0-5, X_7 is age6-10, X_8 is age11-20, X_9 is age21-50, X_{10} is group, X_{11} is patent, X_{12} is export activity, X_{13} is diversification, X_{14} is foreign ownership, X_{15} is growth, and E_1 is the error term.

The results are presented in tables 11-16 below. In the analysis we have dropped the cash-flow variable because it did not come out significantly (results not reported). The reason is that some firms have missing values for the cash-flow variable. Industrial sector dummies are also included but not reported due to space considerations.

NRC Subsidies

In table 10 we showed that 40 % of our subsidized firms got access to a NRC subsidy. Below we analyze (some of the) firm characteristics that arguably can predict participation status in this technology policy program.

[TABLE 11 ABOUT HERE]

According to table 11, the largest firms are more able to attract public R&D funding from the NRC program. The reference category is firms with more than 500 employees and the reference category is included in the constant. We thus see that firms in the smaller size categories are significantly less likely to participate in this technology program compared to firms in the highest size categories. Export oriented firms and companies with proven innovation capabilities are significantly more likely to attract funding from NRC. Hence, NRC funds innovation projects “far from the market”, or research activities, among these kinds of firms. According to the classification of technology program policy aims in table 1, it seems like NRC follows a policy objective to support the development of national champions, as firm size, patent and export activity can predict participation status in this R&D program.

SND subsidies

Subsidies from SND are allocated, in relative terms, to many firms. Among our subsidized firms, 35 % got access to a SND subsidy in 2001 as shown in table 10. Below we analyze (some of the) firm characteristics that can predict participation status in this technology policy program.

[TABLE 12 ABOUT HERE]

In table 12 we see that “middle aged” companies between 21-50 years old have a significantly higher propensity to be included in the SND program compared to the reference category (50 years or older firms). “Middle-sized” firms with 101-300 employees have on the other hand a significantly lower propensity to be included in the SND program compared to the reference category (firms with more than 500 employees). These results suggest that medium-sized firms are far less inclined to be included in this technology program compared to small and large firms while “middle aged” companies are significantly more inclined to get access to a subsidy from the SND program compared to old and young companies.

Companies with group membership, proven innovation capabilities, and a higher export orientation are more likely to participate in this technology program. Diversified firms and companies with foreign ownership are on the other hand less inclined to obtain SND support. The SND program thus seems to be driven by combined policy logic to support both national champions and to undertake technological upgrading of existing industry according to the scheme in table 1. SND thus finances innovation projects “close to the market” in the private sector in order to reach these policy objectives.

We have so far examined the firm level determinants of participation status among the two most well-known technology programs in Norway. In the table below we explore what kinds of firms that are subsidized directly by Ministries. This is an under-explored issue in our Norwegian context.

Ministry subsidies

According to table 10, about 16 % of our subsidized firms got access to a subsidy from one of the Ministries. As such, Ministries do not seem to support many firms directly, although a lot of money is usually involved when they first support firms. Below we analyze (some of the) firm characteristics that can predict participation status in this technology policy program.

[TABLE 13 ABOUT HERE]

According to table 13, foreign owned firms, and smaller firms are less inclined to be subsidized directly by Ministries. All the firm size categories / dummies are negative and significant which implies that the largest companies in Norway, those with 500 or more employees, are significantly more inclined to get access to a subsidy from one of the Ministries compared to smaller firms. Relatively few variables emerge as significant predictors. It is as such hard to classify R&D support from Ministries according to the underlying policy objectives developed in table 1.

It is clear on the other hand that Ministries do not fund companies with an aim to correct market failures. Both technological upgrading and supporting the development of national champions seem to be predominant policy objectives when Ministries subsidize innovation activities “close to the market” at the firm level. It is important to point out that R&D

subsidies from different Ministries can be driven by different policy objectives. This can explain why we are incapable of distinguishing whether R&D support from Ministries is allocated according to a single policy objective. The role of R&D support from Ministries to firms in Norway continues to pose a research challenge. Less is also known in Norway about what kinds of companies that get access to EU subsidies. This is explored below.

EU subsidies

According to table 10 about 14 % of our subsidized firms got access to an EU subsidy in 2001. Below we analyze (some of the) firm characteristics that determine whether firms are funded by EU within the context of the Norwegian innovation system.

[TABLE 14 ABOUT HERE]

In table 14 we see that larger firms, with previous innovation and export activity are more inclined to get access to an EU subsidy. This is a pattern that is fairly close to what we found in table 11, where we analyzed what kinds of firms that participated in NRC technology program. There is one exception: Younger companies are significantly more inclined to participate in EU programs. Firms in the age range of 0 to 5 years are significantly more inclined to get access to public R&D finance from EU compared to firms in the other age categories. Although one should not overstate this finding, it is one of the few signs so far that technology programs in our Norwegian case actually aim to correct market failures. This is done by supporting firms with innovation projects "far from the market". It is interesting that EU policy support, a policy area over which Norwegian policymakers have little control, at least partly aims to correct market failures in the Norwegian innovation system. However, firm size, export and innovation activity also act as positive and significant predictors. These firm characteristics are closely related to the objective to support the development of national champions.

FUNN subsidies

The FUNN program was a rather small technology program in 2001, measured in terms of the total amount of public R&D funding distributed to firms. 28 % of the subsidized firms in our sample were on the other hand funded by this technology program. Below we analyze what kind of firms.

[TABLE 15 ABOUT HERE]

When it comes to obtaining subsidies from the FUNN program, export orientation and prior innovation activity alongside with large firm size are positive predictor variables as can be seen in table 15. Being a part of a group is however a negative predictor. The results displayed in table 15 more or less show that also the FUNN program aims to support the development of national champions. This is mainly done by financing innovation projects “far from the market” in the Norwegian enterprise sector.

Participation in several programs

Having explored the firm characteristics that predict participation status among our 5 technology programs, we will now move on to analyze what kinds of firms that are supported by more than 1 technology program. To do this we have run a simple OLS regression where the dependent variable is the number of technology programs a firm participates in, ranging from zero to five. Because the dependent variables are both censored (they are censored at zero) and involve a count of the number of technology programs, we will experiment some and estimate the same regression equation using both Tobit and Poisson regression, in addition to the standard OLS. The equation we estimate is similar to equation 1 above, although the dependent variable is the number of technology programs. The results are rather similar across estimation techniques with the exception that diversification is insignificant (though the coefficient is negative) in the OLS regression.

[TABLE 16 ABOUT HERE]

According to table 16, the largest firms in Norway are significantly more inclined to access several technology programs simultaneously. Firms with developed innovation capabilities and export intensive companies are also significantly more inclined to get access to funding from several programs at the same time. Some firm characteristics also emerge as negative predictors. Somewhat contrary to our expectation it turns out that diversified companies are significantly less likely to access several technology programs simultaneously. We expected the opposite due to economies of scope advantages where firms with several business units would be more inclined to apply for participation in several technology programs at the same time. This is not the case. Foreign firms are also less likely to get funding from several technology programs in Norway, which demonstrates that the Norwegian public support system for innovation is mainly developed with an aim to support domestic companies and national champions.

Summary and discussion of the results

The results inform us that most technology programs aim to support the development of national champions, although the SND program also allocates innovation funding according to criteria that are close to "technological upgrading" objectives. There are few, if any, signs that technology programs in Norway aim to correct market failures. A possible exception is EU financing which is more inclined to be allocated to young firms. A consideration of the most important firm characteristics reveals that export intensive companies were significantly more likely to get access to public R&D subsidies from all of our five technology programs. This finding suggests that the public support and innovation system for R&D is, to some extent, built around the importance of export active firms.

In standard economic textbooks Norway is usually put forth as a small and open economy where trade with other countries is important. Thus, increasing and subsidizing innovation activity in the export active segment of the firm population in Norway could be a continuation of more traditional policies to encourage Norwegian firms to compete in international markets. In this context one should not downplay the importance of the Lisbon process in the EU for Norwegian firms. Although the Lisbon strategy has a diverse range of implications, the overall policy goal of the strategy is to make the EU area one of the most dynamic and knowledge based economies in the world by 2010. In order to compete in the EU market, Norwegian firms should raise the knowledge content – or R&D content – of their products and services. The public support system for R&D in Norway seems to be more than willing to help Norwegian firms do just that. This is a policy strategy that can be described as "supporting the development of national champions".

The importance of having established innovation capabilities in order to access public R&D support is also highlighted in the analysis. Firms with successful innovative activities in the past were significantly more likely to access public R&D funding from 4 out of 5 technology programs. This suggests that the public support system for R&D is built around an innovative business segment, where firms without previous innovation activity are not included. To what extent this is an intended R&D policy, in the sense that non-innovative Norwegian firms are denied access to public R&D funding, or whether non-innovative Norwegian firms do not apply for public funding because they are not innovative, is an important question for further research. The first scenario would in fact suggest the existence of a self-reinforcing mechanism in the Norwegian public support system for R&D where technology programs fund innovative firms, which due to public support are able to initiate more innovation projects, and as a result are even more likely to require public funding in subsequent years. The second scenario implies the existence of a large business segment in Norway where firms devote few resources to innovation and as such do not apply for public R&D funding.

The largest firms in Norway are further much more likely to access R&D subsidies. The importance of both large firm size and established innovation capabilities as important firm level determinants of public R&D funding is also highlighted by evaluations of the public support system in other European countries. The Norwegian public support system for R&D is not a "deviating" case in this regard, although we have been able to explore the extent to which the most important technology programs follow the same policy objectives.

The overall results suggest that considerable "barriers to entry" might exist for smaller and younger firms when it comes to participation in technology programs. A reason why these firms are not included in contemporary R&D policy might be due to the fact that technology programs in Norway pursue a technology policy where the development of national champions is important. If so, the main "barrier to entry" is found at the level of practical policymaking where smaller and younger firms are denied access to technology programs. Another "barrier to entry" can also exist. If most young and small companies simply do not innovate, then the inability to launch new innovation projects is the main barrier to entry in technology programs. In this latter context R&D policy objectives can only to a lesser extent be “blamed”.

To find out whether small and young firms apply for - but are declined - access to technology programs is thus an important avenue for further research. Such research will lead to a better understanding of how innovation policies are implemented in practice and how policies can be improved. Because it is frequently argued that small and young firms are highly innovative (Acs & Audretsch, 2003; Rothwell, 1989) an “innovation potential” might exist in the small and young segment of the Norwegian enterprise sector. R&D policies can arguably stimulate and enhance this potential. Because small and young firms are significantly less likely to be subsidized, changing or allocating more public R&D resources to this segment of the business population can be an efficient R&D policy response to the current decline in innovative activity in the private sector in Norway.

According to the most recent innovation surveys conducted by Statistics Norway (SSB, 2007), there has been a decline of “innovativeness” in the Norwegian firm population over the last few years. The biggest firms are however highly innovative (SSB, 2007). It is as such interesting that the largest firms in Norway are much more likely to be subsidized and that these firms at the same time are highly innovative. Differences in the distribution of R&D subsidies between large and small firms could as such be a part of the explanation as to why the largest firms are able to persistently innovate in Norway.

A somewhat crude conclusion is that the public support system for R&D in Norway is built around companies with a strong export orientation, with developed innovation capabilities, and around the largest firms. This segment of the firm population is heavily supported and firms within this segment are much more inclined to access several technology programs simultaneously. Innovation policy interacts with the innovative, export-intensive and large firm segment of the firm population in complex ways. As we saw in table 8 and 9 and in the analysis in table 16, this business segment is more inclined to access several technology programs simultaneously and the actual combination of technology programs these firms access is highly diverse.

The co-existence of 5 important technology programs in Norwegian Innovation System may at first sight give the impression that there is a high degree of variety at the level of technology programs. This is true to some extent: Technology programs support both “development” and “research” projects at the firm level. The business segment of subsidized firms is on the other hand rather homogenous. As we discussed above, export-oriented, innovative and large firms are significantly more likely to get access to R&D funding by all our five technology programs, with a few small exceptions. An implication is that R&D policies stimulate the realization of diverse innovation projects among this rather narrow part of the enterprise population in Norway, according to a policy objective to stimulate the development of national champions.

Our interpretation of these empirical results is that the policy practice observed at the level of technology programs in Norway are largely consistent with recent innovation policy documents where the importance of funding large firms, companies with established innovative capabilities, and firms with an international growth potential are highlighted. It is notable that these companies already possess innovative capabilities and an international growth potential before they are funded by technology programs. An important question in this context is whether R&D subsidies can make these companies even more innovative and increase their international growth potential even more.

The observed policy practice is somewhat inconsistent with some recommendations in the Lisbon Agenda. With the exception of EU subsidies, young firms are less inclined to access technology programs in Norway. Smaller firms are also to a considerable extent excluded from Norwegian innovation policy, most notably from technology programs with a high research component (EU and NRC programs). Most importantly however, firms without established innovative capabilities and companies without an "international growth potential" seem to be denied access to technology programs. As such, technology programs in Norway do not "turn" these companies into "innovating" and "high performing" companies. The observed policy practice is inconsistent with a notion about an "active innovation policy" that has been set forth by Norwegian policymakers recently.

From a market failure perspective an active innovation policy attempts to "turn" firms without growth potential and innovative capabilities into companies with the opposite characteristics. From an innovation systems perspective our results suggest that technology programs do not increase the number of innovating firms in the enterprise sector. Rather, innovation policies are oriented towards stimulating established innovators to innovate more intensively. Hence, firms with established approaches to innovation are subsidized with "research" and "development" subsidies.

There is a time lag here between the data used in the analysis and the formulation and implementation of innovation policy. If the innovation policy process is inert – as we suspect it is – then we do not believe that much has changed since 2001. We will explore this issue in the future as more recent survey data will become available to us. Our empirical investigation is also conducted within the context of public R&D policy. Whether non-R&D policies that interact with the firm level are established with an aim to support the development of national champions is a rather open – an interesting – question for further analysis.

It is important to emphasise in this context that we can not infer any relationship about how R&D policy interacts with the smaller firm size segment of the enterprise population. The database we draw upon in this paper is limited to firms with 10 employees or more. An avenue for future research is to analyze how innovation policy impacts upon enterprises with less than 10 employees in Norway and elsewhere. This segment of the enterprise population accounts for 91,6 % of the enterprise population with 1 employee or more. Hence, little is known about what kind of R&D and innovation activities that are undertaken by these firms. Even less is known about how innovation policies impact upon innovation processes in this segment of the enterprise population. Within the context of the Lisbon Agenda, where the importance of small and young companies has been highlighted, this issue is more important then ever. An important issue to be addressed in future innovation surveys is to include questions about whether firms have applied for an R&D subsidy but were subsequently declined funding by technology programs. In present innovation surveys we only know whether a firm is funded or not.

Conclusion

The main goal in this paper has been to focus on the participation stage and analyze what kinds firms that access public R&D subsidies from the five most important technology programs in Norway. The analysis showed that the public support system for R&D in Norway is built around companies with a strong export orientation, with developed innovation capabilities, and around the largest firms. Firms within this segment of the firm population are more inclined to get access to “development” and “research” subsidies by technology programs. Subsidies are mainly allocated to firms according to innovation policy criteria that can be described as the development of national champions.

Our analysis suggests that observed innovation policy practice is consistent with recent Norwegian innovation policy documents and recommendations, but somewhat inconsistent with recommendations in the Lisbon Agenda. From an innovation system perspective, and a market failure perspective, the main innovation policy challenge in Norway is to allocate innovation support to firms without established growth and innovative capabilities. “Turning” companies without prior innovative capability and international growth potential into companies with the opposite characteristics can strongly stimulate to more growth and innovation in the Norwegian Innovation System.

These findings illustrate the following: By using a taxonomy of R&D programs, and by focusing upon the participation stage, one can better analyze and understand the pattern of interaction between firms and vital aspects of the national innovation and public support system for R&D. Based upon such analyses it is possible to get an understanding of how the public support system for R&D and innovation works in practice, how innovation policies actually are implemented, and how innovation policy can be improved.

Notes

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Appendix

We have conducted a principal components factor analysis with varimax rotation in order to analyze whether there are some similarities between R&D projects subsidized by technology programs in Norway. The analysis is motivated by Rye's (2002) review of 12 major evaluations of the public support system for R&D in Norway. In this review R&D subsidies from SND were deemed to be allocated to firms with projects "close to the market" while subsidies from NRC were distributed to companies with projects "far from the market". We will use these two technology programs as reference indicators. Based upon the analysis done by Rye (2002), we argue that technology programs grouped together with SND support firm projects "close to the market" and that R&D programs grouped together with NRC support firm projects "far from the market". The main assumption behind the analysis is that the pattern of correlations between the R&D subsidies from different technology programs is caused by underlying non-observable similarities in the type of private R&D projects supported. In table A1, results from the first factor analysis are reported.

[TABLE A1 ABOUT HERE]

In table A1 we have reported the results from the rotated factor solution. In the rotated factor solution each loading represents the partial correlation between the latent factor and the single item indicator (the binary subsidy variable). According to the reported results, two underlying latent factors are identified. The subsidies allocated by FUNN, NRC and EU all load high on the first factor. NRC is the reference indicator in this regard. Because the NRC program has been found to support firm projects "far from the market", other technology programs grouped together with NRC share this characteristic. The SND and Ministry subsidy variables load high on the second factor. This finding suggests that subsidies from these two technology programs are allocated to firm projects “close to the market”.

The column “cumulative %” reports the percent of the variance accounted for by each specific factor. As we can see in the table, the two factors can explain 53 % of the variance in the subsidy variables, which is rather good. Although principal components factor analysis is a rather robust method, binary items are not ideal. Therefore we will re-run the principal components factor analysis. Instead of binary subsidy indicators we will use the actual amount of the subsidy (in log form) firms get from the technology programs. Taking the amount of the subsidy into account can introduce some “noise” in the analysis because we are not primarily interested in identifying latent structures when it comes to how much money R&D programs allocate to firms. Our main interest is to identify latent factors in association with the types of private R&D projects technology programs fund in Norway. The results are however similar, as illustrated in the table below.

[TABLE A2 ABOUT HERE]

The factor solutions reported in table A1 and A2 are practically identical. Results from the two factor analyses suggest that public support from the five most important R&D programs in Norway is allocated to either projects “far from the market” or to projects “close to the market”. We have also experimented by constraining the factor analysis to R&D doing firms. The results were similar to those reported above.

Table 1. R&D program policy objective and their expected selection rules

	Market failure	National champions	Technological upgrading
Prior innovation activity	-	+	-
Firm age	-	?	+
Firm size	-	+	+
Foreign ownership	?	-	?
Group	-	+	-
Diversified	-	+	-
Cash-flow	-	+	-
Export activity	?	+	+
Growth	?	+	-

Table 2. R&D and subsidy statistics in mill. NOK for the private sector in Norway

	Sum in Mill. NOK.
Subsidies from EU	101
Subsidies from Ministries	514
Subsidies from SND	85
Subsidies from FUNN	42
Subsidies from NRC	202
Total public funding	943
Total internal R&D in private sector	12614
N =	3899 / 11832 (weighted)

Source: Own calculation based upon weighted R&D survey data for 2001 (data discussed below).

Table 3. R&D and subsidy statistics in Mill. NOK for the sub-sample of subsidized firms.

	Sum subsidies (mill. NOK)	Average subsidy (mill. NOK)	Sum internal R&D (mill. NOK)	% of the subsidy in total internal R&D	N
NRC	202	1	3488	6 %	190
EU	101	2,1	2124	5 %	49
FUNN	42	0,4	1369	3 %	107
SND	85	0,4	712	12 %	208
Ministries	514	6,5	1298	40 %	79

Source: Own calculation based upon weighted R&D survey data for 2001 (data discussed below).

Table 4. Actual and relative distribution of total – and publicly financed - R&D and employment according to industries.

	Internal R&D in Mill. NOK.	% of total R&D	Public R&D in Mill. NOK	% of total public R&D	Number of employees	% of total employment
Fishing & fish farming (5)	272,5	2,2	15,1	1,6	3799	0,5
Mining of coal and lignite (10)	0	0,0	0	0,0	273	0,0
Petroleum and natural gas (11)	754,5	6,0	22	2,3	30204	4,3
Mining of metal ores (13)	5,5	0,0	28	3,0	360	0,1
Other mining (14)	12,8	0,1	4,6	0,5	2441	0,4
Food prod. and beverages (15)	369	2,9	23,2	2,5	52653	7,6
Tobacco (16)	0	0,0	0	0,0	480	0,1
Textiles (17)	25,5	0,2	0,5	0,1	3961	0,6
Apparel & dying (18)	35,5	0,3	1,7	0,2	1090	0,2
Leather products (19)	6,6	0,1	0,6	0,1	359	0,1
Wood products (20)	56,6	0,4	7,5	0,8	13178	1,9
Pulp & paper (21)	159,9	1,3	0,9	0,1	8503	1,2
Publishing & printing (22)	32,1	0,3	0,5	0,1	28641	4,1
Chemicals (24)	1057,8	8,4	24,8	2,6	23182	3,3
Rubber & plastics (25)	57,9	0,5	7,7	0,8	5783	0,8
Non-metallic minerals (26)	66,8	0,5	3,9	0,4	9001	1,3
Basic metals (27)	405,7	3,2	2,2	0,2	12981	1,9
Fabricated metal prod. (28)	140,9	1,1	12,6	1,3	16648	2,4
Machinery & equip. N.E.C (29)	934,3	7,4	351,6	37,3	20761	3,0
Office machinery & comp. (30)	67	0,5	2,5	0,3	367	0,1
Electric machinery & app. (31)	392	3,1	11,6	1,2	7585	1,1
Radio, television, com. (32)	1742	13,8	35,2	3,7	6161	0,9
Medical & optical instr. (33)	511,3	4,1	32,7	3,5	5652	0,8
Motor vehicles (34)	417,2	3,3	6,6	0,7	5555	0,8
Other transportation equip. (35)	274	2,2	16,2	1,7	30823	4,4
Furniture (36)	128,3	1,0	5	0,5	10541	1,5
Recycling (37)	28,3	0,2	2	0,2	1001	0,1
Electricity, gas and water (40)	89,7	0,7	6	0,6	16420	2,4
Coll. and distrib. of water (41)	0,5	0,0	0	0,0	247	0,0
Construction (45)	278,5	2,2	14,2	1,5	104526	15,0
Wholesale trade (51)	345,8	2,7	35,7	3,8	74061	10,6
Land transport (60)	12,9	0,1	7,3	0,8	32180	4,6
Water transport (61)	40,4	0,3	1,6	0,2	23663	3,4
Air transport (62)	4,2	0,0	0	0,0	14330	2,1
Auxiliary transport act. (63)	27,4	0,2	0,6	0,1	22863	3,3
Post & telecommunication (64)	693,8	5,5	20,1	2,1	12145	1,7
Financial intermediation (65)	262,2	2,1	7,5	0,8	31459	4,5
Insurance & pension (66)	93,8	0,7	0,2	0,0	8533	1,2
Act. Auxiliary to nace 65 (67)	98,9	0,8	0	0,0	3331	0,5
Computers and related act. (72)	1885,6	14,9	177,6	18,8	29158	4,2
Research and development (73)	113	0,9	20	2,1	166	0,0
Other business activities (74)	712,9	5,7	61	6,5	20564	3,0
Total	12613,6	100,0	943,4	100,0	695629	100

Source: Own calculation based upon weighted R&D survey data for 2001 (data discussed below).

Table 5. Distribution of public R&D funding at the industry level

	EU finance in Mill. NOK	% of EU finance	Ministry finance in Mill. NOK	% of Ministry finance	SND finance in Mill. NOK.	% of SND finance
Fishing & fish farming (5)	0,87	0,9	0	0,0	3,6	4,3
Mining of coal and lignite (10)	0	0,0	0	0,0	0	0,0
Petroleum and natural gas (11)	16	15,9	0	0,0	0	0,0
Mining of metal ores (13)	0	0,0	0,3	0,1	0	0,0
Other mining (14)	0	0,0	0,8	0,2	3	3,5
Food prod. and beverages (15)	0	0,0	2,3	0,4	5	5,9
Tobacco (16)	0	0,0	0	0,0	0	0,0
Textiles (17)	0	0,0	0	0,0	0	0,0
Apparel & dying (18)	0	0,0	0	0,0	0	0,0
Leather products (19)	0	0,0	0	0,0	0,6	0,7
Wood products (20)	0,1	0,1	0	0,0	6,9	8,1
Pulp & paper (21)	0	0,0	0	0,0	0,1	0,1
Publishing & printing (22)	0	0,0	0	0,0	0,5	0,6
Chemicals (24)	7,3	7,2	1,4	0,3	0,3	0,4
Rubber & plastics (25)	0	0,0	0,5	0,1	1,5	1,8
Non-metallic minerals (26)	0,6	0,6	0	0,0	1,7	2,0
Basic metals (27)	0	0,0	0	0,0	0,5	0,6
Fabricated metal prod. (28)	1	1,0	1,3	0,3	6,1	7,3
Machinery & equip. N.E.C (29)	4,3	4,3	308,2	59,7	13,3	15,7
Office machinery & comp. (30)	0	0,0	0	0,0	1,2	1,4
Electric machinery & app. (31)	0	0,0	0	0,0	2,8	3,3
Radio, television, com. (32)	16,1	16,0	4,6	0,9	0,1	0,1
Medical & optical instr. (33)	12,8	12,5	3	0,6	2,8	3,3
Motor vehicles (34)	0	0,0	0	0,0	1,9	2,2
Other transportation equip. (35)	0,1	0,1	1	0,2	2,3	2,7
Furniture (36)	0	0,0	0	0,0	1,1	1,3
Recycling (37)	0	0,0	0	0,0	1,8	2,1
Electricity, gas and water (40)	2	2,0	2	0,4	0	0,0
Coll. and distrib. of water (41)	0	0,0	0	0,0	0	0,0
Construction (45)	1,5	1,5	4,9	1,0	1,2	1,4
Wholesale trade (51)	0	0,0	2,6	0,5	5,5	6,5
Land transport (60)	0	0,0	6,2	1,2	0,9	1,1
Water transport (61)	0,3	0,3	0	0,0	0	0,0
Air transport (62)	0	0,0	0	0,0	0	0,0
Auxiliary transport act. (63)	0	0,0	0,1	0,0	0,6	0,7
Post & telecommunication (64)	15	14,9	3	0,6	0	0,0
Financial intermediation (65)	0	0,0	7,5	1,5	0	0,0
Insurance & pension (66)	0	0,0	0,2	0,0	0	0,0
Act. Auxiliary to nace 65 (67)	0	0,0	0	0,0	0	0,0
Computers and rel. act. (72)	4,7	4,7	147	28,6	12,9	15,2
Research and development (73)	4,3	4,3	1	0,2	0	0,0
Other business activities (74)	13,8	13,7	16,5	3,2	6,5	7,7
Total	100,77	100	514,4	100	84,7	100

Table 5 continued.

	NRC finance in Mill. NOK	% of NRC finance	FUNN finance in MILL. NOK	% of FUNN finance
Fishing & fish farming (5)	10	4,9	0,6	1,5
Mining of coal and lignite (10)	0	0,0	0	0,0
Petroleum and natural gas (11)	5,9	2,9	0	0,0
Mining of metal ores (13)	0	0,0	0	0,0
Other mining (14)	0,1	0,0	0,7	1,7
Food products and beverages (15)	9	4,4	6,9	16,8
Tobacco (16)	0	0,0	0	0,0
Textiles (17)	0	0,0	0,5	1,2
Apparel & dying (18)	0,6	0,3	0,1	0,2
Leather products (19)	0	0,0	0	0,0
Wood products (20)	0,5	0,2	0,1	0,2
Pulp & paper (21)	0,6	0,3	0,3	0,7
Publishing & printing (22)	0	0,0	0	0,0
Chemicals (24)	12,7	6,3	3,2	7,9
Rubber & plastics (25)	5,4	2,7	0,3	0,7
Non-metallic minerals (26)	0,2	0,1	1,5	3,7
Basic metals (27)	0,4	0,2	1,3	3,2
Fabricated metal products (28)	2	1,0	2,1	5,1
Machinery & equip. N.E.C (29)	20,4	10,1	5,5	13,5
Office machinery & computers (30)	0,3	0,1	1	2,4
Electric machinery & app. (31)	4,8	2,4	4	9,8
Radio, television, com. (32)	14	6,9	0,5	1,2
Medical & optical instruments (33)	13,1	6,5	1	2,4
Motor vehicles (34)	3,2	1,6	1,5	3,7
Other transportation equip. (35)	11,8	5,8	1	2,4
Furniture (36)	1,8	0,9	2	4,9
Recycling (37)	0	0,0	0,2	0,5
Electricity, gas and water (40)	1,7	0,8	0,3	0,7
Collection and distrib. of water (41)	0	0,0	0	0,0
Construction (45)	6,2	3,1	0,35	0,9
Wholesale trade (51)	27,6	13,6	0	0,0
Land transport (60)	0	0,0	0,2	0,5
Water transport (61)	1	0,5	0,3	0,7
Air transport (62)	0	0,0	0	0,0
Auxiliary transport activities (63)	0	0,0	0	0,0
Post & telecommunication (64)	2,66	1,3	0	0,0
Financial intermediation (65)	0	0,0	0	0,0
Insurance & pension (66)	0	0,0	0	0,0
Act. auxiliary to nace 65 (67)	0	0,0	0	0,0
Computers and related act. (72)	9,9	4,9	3,3	8,1
Research and development (73)	13,5	6,8	1,1	2,7
Other business activities (74)	23,1	11,4	1,1	2,7
Total	202,46	100	40,95	100

Source: Own calculation based upon weighted R&D survey data for 2001 (data discussed below).

Table 6. Actual and relative distribution of total – and publicly funding – R&D and employment according to size classes.

	Total R&D in Mill. NOK	% of total R&D	Public R&D in Mill. NOK.	% of public R&D	Number of employees	% of total employment
10-30 emp.	1920	15,2	140,2	14,9	133953	19,3
31-50 emp.	1103	8,7	70	7,4	60420	8,7
51-100 emp.	1033	8,2	60,6	6,4	76629	11,0
101-300 emp.	2510	19,9	209,3	22,2	117364	16,9
301-500 emp.	745,9	5,9	31,4	3,3	62244	8,9
501> emp.	5302	42,0	431,9	45,8	245019	35,2
SUM	12613,9	100	943,4	100	695629	100

Source: Own calculation based upon weighted R&D survey data for 2001 (data discussed below).

Table 7. Actual and relative distribution of different types of public R&D funding according to size classes.

	EU finance in Mill. NOK	% of EU finance	Ministry finance in Mill NOK.	% of Ministry finance	SND finance in Mill. NOK.	% of SND finance
10-30 emp.	5,8	5,7	29,9	5,8	35,3	41,5
31-50 emp.	15,4	15,3	2,4	0,5	17,9	21,0
51-100 emp.	7,3	7,2	4,7	0,9	11,3	13,3
101-300 emp.	17	16,8	153	29,7	9,4	11,0
301-500 emp.	4,2	4,2	8,5	1,7	6,2	7,3
501> emp.	51,2	50,7	315,9	61,4	5	5,9
SUM	100,9	100	514,4	100	85,1	100

Table 7 continued.

	NRC finance in Mill. NOK	% of NRC finance	FUNN finance in Mill. NOK.	% of FUNN finance
10-30 emp.	60,3	29,9	9	21,6
31-50 emp.	30,1	14,9	4,3	10,3
51-100 emp.	29,3	14,5	8	19,2
101-300 emp.	19,4	9,6	10,6	25,4
301-500 emp.	10,8	5,4	1,7	4,1
501> emp.	51,7	25,6	8,1	19,4
SUM	201,6	100	41,7	100

Source: Own calculation based upon weighted R&D survey data for 2001 (data discussed below).

Table 8. Participation in technology programs, sub-sample of subsidized firms

Number of technology programs	Frequency and percentage of firms using one – or more – technology programs.
1 technology program	409 (80,9 %)
2 technology programs	73 (14,4 %)
3 technology programs	17 (3,4 %)
4 technology programs	7 (1,4 %)
N	505 (100 %)

Source: Own calculation based upon weighted R&D survey data for 2001 (data discussed below).

Table 9. The degree of overlap between technology programs, sub-sample of subsidized firms

Combinations of technology programs used by firms	Frequency and percentage of firms using the actual combination of technology program(s).
Only EU	14 (2, 8 %)
Only SND	169 (33, 4 %)
Only Ministry	45 (8, 9 %)
Only NFR	118 (23, 3 %)
Only FUNN	63 (12, 5 %)
SND & FUNN	5 (1, 1 %)
FUNN & Ministry	1 (0, 2 %)
Ministry & NRC	9 (1, 9 %)
EU & NRC	14 (2, 7 %)
FUNN & NRC	14 (2, 7 %)
EU & FUNN	5 (1 %)
SND & Ministry	9 (1, 9 %)
SND & NFR	11 (2, 3 %)
EU & Ministry	3 (0, 6 %)
FUNN, EU & NRC	5 (1 %)
SND, FUNN & NRC	3 (0, 6 %)
EU, Ministry & NRC	2 (0, 4 %)
FUNN, Ministry & NRC	3 (0, 6 %)
SND, Ministry, & NRC	1 (0, 2 %)
EU, SND & NRC	3 (0, 6 %)
EU, SND, FUNN & NRC	2 (0, 4 %)
EU, FUNN, Ministry & NRC	1 (0, 2 %)
SND, FUNN, Ministry & NRC	4 (0, 8 %)
Total	505 (100 %)

Source: Own calculation based upon weighted R&D survey data for 2001 (data discussed below).

Table 10. Descriptive statistics

	Non-subsidized firms		**Subsidized firms**	
	Mean	Std.dev	Mean	Std.dev
Age 0-5	0,11	0,32	0,09	0,29
Age 6-10	0,23	0,42	0,23	0,42
Age 11-20	0,35	0,47	0,35	0,48
Age 21-50	0,23	0,42	0,26	0,44
Age 50+	0,08	0,26	0,07	0,26
Size 0-10	0,14	0,35	0,08	0,27
Size 11-50	0,45	0,5	0,36	0,48
Size 51-100	0,19	0,4	0,17	0,37
Size 101-300	0,14	0,34	0,18	0,38
Size 301-500	0,03	0,27	0,07	0,25
Size 500 +	0,04	0,2	0,14	0,35
Group	0,61	0,49	0,72	0,26
Patent	0,11	0,32	0,4	0,49
Export activity	0,13	0,26	0,3	0,34
Diversification	0,31	0,46	0,32	0,47
Foreign ownership	0,14	0,35	0,14	0,34
Growth	3	46,1	0,3	2,2
NRC subsidy (binary)	-	-	0,4	0,5
SND (binary)	-	-	0,35	0,48
Ministry subsidy (binary)	-	-	0,16	0,37
EU subsidy (binary)	-	-	0,14	0,34
FUNN subsidy (binary)	-	-	0,28	0,45
	N = 3342		N = 291	

Source: Own calculation based upon weighted R&D survey data for 2001 (data discussed below).

Table 11. Determinants of getting access to a NRC subsidy

Variables	***Beta***	***Std. err***	***Odds ratio***
Size 0-10	-2,0877***	0,605502	0,123972
Size 11-50	-1,68226***	0,364792	0,185954
Size 51-100	-1,90992***	0,390963	0,148092
Size101-300	-1,27353***	0,34027	0,279841
Size 301-500	-0,90337**	0,427627	0,405203
Age 0-5	-0,01612	0,482296	0,984009
Age 6-10	0,218701	0,392955	1,244459
Age 11-20	0,074396	0,374029	1,077233
Age 21-50	-0,00845	0,389693	0,991589
Group	0,097152	0,27356	1,102028
Patent	1,599101***	0,235009	4,948581
Export activity	0,621174**	0,32218	1,861112
Diversification	-0,25545	0,259298	0,774565
Foreign ownership	-0,25924	0,273093	0,771641
Growth	-0,39331	0,264789	0,674818
Constant	-2,25466	0,535553	0,104909
R^2 = 0,22 / N = 3633			

*** sig at the 0,01 level, ** sig at the 0,05 level and * sig at the 0,1 level

Table 12. Determinants of getting a SND subsidy

Variables	***Beta***	***Std. err***	***Odds ratio***
Size 0-10	0,103846	0,55693	1,10943
Size 11-50	-0,34117	0,486443	0,710938
Size 51-100	-0,56519	0,497528	0,568253
Size 101-300	-1,00807**	0,533793	0,364924
Size 301-500	-0,50103	0,664967	0,605907
Age 0-5	0,494334	0,706125	1,639406
Age 6-10	0,618934	0,641887	1,856947
Age 11-20	0,77788	0,62084	2,176852
Age 21-50	1,196828**	0,622162	3,309603
Group	0,510233*	0,249761	1,665679
Patent	1,031007***	0,250504	2,803889
Export activity	0,747663**	0,335829	2,112059
Diversification	-0,48214*	0,297362	0,617462
Foreign ownership	-0,93443**	0,391942	0,392811
Growth	-0,01958	0,028237	0,980612
Constant	-4,47165	0,781455	0,011428
R^2 = 0,12 / N = 3633			

*** sig at the 0,01 level, ** sig at the 0,05 level and * sig at the 0,1 level

Table 13. Determinants of getting access to a Ministry subsidy

Variables	***Beta***	***Std. err***	***Odds ratio***
Size 0-10	-2,55878***	0,902757	0,077399
Size 11-50	-1,46663***	0,500063	0,230702
Size 51-100	-2,00379**	0,601407	0,134824
Size101-300	-1,22109**	0,512157	0,294908
Size 301-500	-1,30595*	0,800445	0,270915
Age 0-5	0,115587	0,735924	1,122532
Age 6-10	0,543859	0,593315	1,722641
Age 11-20	0,249604	0,590104	1,283516
Age 21-50	-0,08705	0,637665	0,916634
Group	-0,04905	0,357305	0,952133
Patent	0,47813	0,396453	1,613054
Export activity	1,085068**	0,497602	2,95964
Diversification	-0,1818	0,383877	0,833769
Foreign ownership	-1,8624**	0,745313	0,1553
Growth	-0,07733	0,161477	0,925587
Constant	-2,59259	0,765101	0,074826
R^2 = 0,14 / N = 3633			

*** sig at the 0,01 level, ** sig at the 0,05 level and * sig at the 0,1 level

Table 14. Determinants of getting access to an EU subsidy

Variables	***Beta***	***Std. err***	***Odds ratio***
Size 0-10	-3,1551***	1,206394	0,042634
Size 11-50	-2,07148***	0,56427	0,125999
Size 51-100	-1,82772***	0,564091	0,16078
Size101-300	-1,87257***	0,564869	0,153729
Size 301-500	-1,21686*	0,643047	0,296158
Age 0-5	1,605094*	0,872792	4,978326
Age 6-10	0,982436	0,831779	2,670954
Age 11-20	1,202154	0,799942	3,327278
Age 21-50	0,435078	0,859807	1,545083
Group	-0,23468	0,500561	0,790821
Patent	1,855309***	0,408473	6,393677
Export activity	1,132767**	0,528508	3,104234
Diversification	-0,17194	0,417375	0,842034
Foreign ownership	0,57272	0,388534	1,773083
Growth	-0,0559	0,154207	0,945636
Constant	-3,92841	1,007183	0,019675
R^2 = 0,28 / N = 3633			

*** sig at the 0,01 level, ** sig at the 0,05 level and * sig at the 0,1 level

Table 15. Determinants of getting access to a FUNN subsidy

Variables	***Beta***	***Std. err***	***Odds ratio***
Size 0-10	-2,54367***	0,727484	0,078578
Size 11-50	-2,39518***	0,474413	0,091156
Size 51-100	-1,28577***	0,41845	0,276437
Size101-300	-0,77964**	0,383842	0,458571
Size 301-500	-0,28515	0,458445	0,751901
Age 0-5	-0,49355	0,544008	0,610455
Age 6-10	-0,03656	0,423655	0,964098
Age 11-20	-0,32165	0,404343	0,724951
Age 21-50	-0,05582	0,404388	0,94571
Group	-0,52312*	0,310026	0,592668
Patent	0,68851***	0,267484	1,990746
Export activity	1,200534***	0,352745	3,32189
Diversification	-0,16582	0,284897	0,847194
Foreign ownership	-0,08245	0,311436	0,920855
Growth	9,64E-06	0,01154	1,00001
Constant	-2,50375	0,620342	0,081778
R^2 = 0,22 / N = 3633			

*** sig at the 0,01 level, ** sig at the 0,05 level and * sig at the 0,1 level

Table 16. Determinants of getting access to more than one technology program

Variables	***Coef.***	***Std. err***	***Coef.***	***Std. err***	***Coef.***	***Std. err***
Size0-10	-.2858152***	.0367231	-2.150151***	.4104504	-1.567193***	.2726597
Size11-50	-.2684335***	.0326471	-1.944462***	.3217381	-1.382503***	.185947
Size51-100	-.2679384***	.033074	-1.946301***	.3307154	-1.333275***	.1906079
Size101-300	-.2368398***	.0334333	-1.501134***	.3155806	-1.042841***	.178147
Size301-500	-.1565692***	.0445378	-.8969148**	.402476	-.6472646***	.2207772
Age0-5	.0108469	.0314124	.2503539	.3799374	.0807701	.25482
Age6-10	.0363652	.027799	.4685396	.3307795	.2425972	.2128456
Age11-20	.027081	.0266946	.3020558	.3181355	.1662561	.2039449
Age21-50	.0326029	.0276545	.4723552	.3258004	.2194241	.208415
Group	-.0013394	.0153444	.0925524	.1827897	.0479585	.1353841
Patent	.2025154***	.0205165	1.42256***	.1949225	1.037911***	.121266
Export activity	.1431536***	.0256303	1.032201***	.2577549	.7994481***	.1583639
Diversification	-.0257298	.0163629	-.3770871**	.195912	-.2785728**	.1313057
Foreign ownership	-.0472282**	.020277	-.6210739***	.23455	-.3356597**	.1454789
Growth	-1.94e-06	.0001506	-.0242617	.025248	-.0260007	.0244447
Constant	.3058334	.0410459	-2.209364	.4579672	-1.479007	.279217
N = 3633	OLS (R^2 = 0,09)		Tobit (R^2 = 0,11)		Poisson (R^2 = 0,15)	

*** sig at the 0,01 level, ** sig at the 0,05 level and * sig at the 0,1 level

Table A1. Factor loadings among binary R&D subsidies (rotated solution).

Variables	***Factor loadings***	***Factor loadings***
NRC subsidy (binary)	0,73	0,22
EU subsidy (binary)	0,75	-0,01
Ministry subsidy (binary)	0,15	0,66
SND subsidy (binary)	-0,01	0,81
FUNN subsidy (binary)	0,64	0,04
Cumulative proportion of variance explained	33 %	53 %
N = 3899	First factor	Second factor

Table A2. Factor loadings among continuous R&D subsidies

Variables	***Factor loadings***	***Factor loadings***
Amount of NRC subsidy (log)	0,74	0,20
Amount of EU subsidy (log)	0,76	0,04
Amount of Ministry subsidy (log)	0,21	0,57
Amount of SND subsidy (log)	-0,05	0,87
Amount of FUNN subsidy (log)	0,61	0,04
Cumulative proportion of variance explained	34 %	54 %
N = 3899	First factor	Second factor