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Who Gets the Money? The Dynamics of R&D Project Subsidies in Germany

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Discussion Paper No. 08-018

Who Gets the Money? The Dynamics of R&D Project Subsidies in Germany

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ZEW

Zentrum für Europäische Wirtschaftsforschung GmbH

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Non-technical Summary

Each year over 4,000 Research and Development (R&D) projects in more than 2,500 firms receive public grants from the German Federal Government under the non-defense *D*irect R&D *P*roject *F*unding (DPF) scheme. This scheme is the most important tool used by the German government to fund R&D in private businesses. However, the number of subsidized firms does not reveal whether it is always the same group of companies that receive funding, or whether the beneficiaries change over time. Understanding the temporal structure of subsidy distribution could help future research explain the effects and effectiveness of subsidies. In the face of shrinking government budgets and intensified international competition in the field of technology, knowing and increasing the efficiency of innovation policies has become crucial.

In this study the focus is set on the DPF. The aim of this paper is to analyze the structure of the firms receiving R&D subsidies over time. In particular, I tackle the question of whether the same firms enjoy subsidies over time. There is still very little empirical evidence on the dynamics of firms' participation in public funding schemes. In order to investigate the persistence of funding it is necessary to distinguish between two types of persistence. One is simply due to the fact that funded projects may run for more than one calendar year. The other is due to newly approved projects. In the DPF scheme, approved projects last on average for about three years.

The empirical part of this paper is based on an annual innovation survey, the German part of the Community Innovation Survey (CIS). This is merged with the DPF database in order to identify a firm's subsidy status in each year. The sample consists of over 6,000 different firms covering the manufacturing and knowledge-intensive service sectors over the time period from 1994 to 2005. Transition rates are calculated which describe the participation in the DPF scheme between two periods in a univariate context. The share of innovating firms which enter the funding scheme is extremely low. But if a firm has made it into the DPF scheme, the probability of getting subsidies for new projects in the following year is higher than that of dropping out of the scheme. Overall, participation in the funding scheme is found to be quite stable.

The multivariate analysis also shows that for the probability of getting new projects approved for the funding scheme, experience in the same scheme matters, beyond the subsidy status in the preceding year. In order to enter the DPF scheme, experience with other subsidy programs is also helpful. At the same time, it is important to control for the overall supply of subsidies. In addition, large firms are more successful in receiving funding for new projects. Thus the evidence cannot confirm that the scheme is achieving the government's aim of supporting SMEs in particular. The hypotheses that firms with higher knowledge capabilities are more likely to enter and stay in the scheme can be supported as I found positive impacts of R&D activities and human capital.

Das Wichtigste in Kürze (Summary in German)

In den meisten OECD-Ländern fördert der Staat Forschungsaktivitäten der Unternehmen, um damit die Innovationskraft und Wettbewerbsfähigkeit zu stärken. In Deutschland ist das wichtigste Instrument des Bundes für die finanzielle Förderung von FuE-Tätigkeiten in der Wirtschaft die direkte Projektförderung (DPF). Diese Maßnahme fördert im Rahmen von Fachprogrammen FuE-Projekte mittels nicht zurückzahlbarer Zuschüsse, die in bestimmten Schlüsseltechnologien angesiedelt sind. Im Rahmen der DPF werden jedes Jahr über 4.000 FuE-Projekte in über 2.500 Unternehmen gefördert. 2005 erhielten die Unternehmen auf diesem Wege über 700 Millionen Euro.

Informationen über die Anzahl der geförderten Unternehmen geben jedoch noch keinen Aufschluss über die Struktur der Zuwendungsempfänger im Zeitverlauf, d.h. ob die Zusammensetzung der geförderten Unternehmen eine hohe Dynamik aufweist. Aber gerade die zeitliche Struktur spielt unter Umständen eine wichtige Rolle bei der Beurteilung der Auswirkungen der Förderung.

Daher ist das Ziel dieser Studie, die Teilnahme der Unternehmen an der DPF hinsichtlich der zeitlichen Struktur empirisch zu analysieren. Die Untersuchung basiert auf dem Mannheimer Innovationspanel, einer jährlich durchgeführten Innovationserhebung. Dieser Datensatz wurde mit Informationen der DPF-Datenbank ergänzt, um den Förderstatus der Unternehmen in jedem Jahr zu identifizieren. Der Datensatz für die Untersuchung besteht aus über 6.000 verschiedenen Unternehmen aus dem Verarbeitendem Gewerbe und Dienstleistungssektor.

Im ersten Schritt werden Übergangswahrscheinlichkeiten berechnet, die die Teilnahme der Unternehmen an der DPF in zwei aufeinander folgenden Jahren beschreiben. Dabei erweist sich der Anteil der Unternehmen, die neu an der DPF teilnehmen, als extrem klein. Wenn jedoch ein Unternehmen bereits an der DPF partizipiert, ist die Wahrscheinlichkeit höher, weitere neu geförderte Projekte zu bekommen, als aus der Förderung auszuscheiden. Insgesamt kann die Teilnahme an der Maßnahme als recht stabil beurteilt werden. Die darauf aufbauende multivariate Untersuchung zeigt ferner, dass die Wahrscheinlichkeit ein neues Projekt genehmigt zu bekommen, nicht nur vom Förderstatus im vorhergehenden Jahr abhängig ist, sondern mit der Erfahrung insgesamt im Programm steigt. Um an der DPF zu partizipieren, spielt auch die Erfahrung mit anderen Fördermaßnahmen eine positive Rolle. Außerdem sind große Unternehmen erfolgreicher neu an der DPF teilzunehmen und auch weitere Projekte gefördert zu bekommen. Die Hypothese, dass Unternehmen mit besseren Fähigkeiten in Bezug auf Wissenserzeugung und -management mit einer höheren Wahrscheinlichkeit öffentliche Zuschüsse für neue FuE-Projekte erhalten, kann bestätigt werden, da FuE-Aktivitäten und Humankapital jeweils einen positiven Einfluss ausüben.

Who Gets the Money?
The Dynamics of R&D Project Subsidies in Germany

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Birgit Aschhoff*

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Abstract

This paper looks at which firms receive R&D project grants and how this public support evolves over time by considering in particular firm's previous participation. The question of the allocation of public R&D funding is becoming particularly important when it comes to identifying the effects of subsidies. Using firm-level data on German manufacturing and knowledge-intensive service firms, it turns out that participation in the funding scheme shows a rather high level of continuity. This is also confirmed by applying a multivariate approach. Firms who received funding in the past are more likely to be selected for public funding again. Moreover, a firm's size and knowledge capabilities increase the probability of entering the scheme. It is also revealed that in an analysis of the allocation of grants it is important to control for the overall supply of corresponding subsidies.

Keywords: R&D, Public Subsidies, Program Participation, Germany

JEL Classification: C20, H32, O38

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1 Introduction

Each year over 4,000 Research and Development (R&D) projects in more than 2,500 firms receive public grants from the German Federal Government under the *D*irect R&D *P*roject *F*unding (DPF) scheme.[1] However, the number of subsidized firms does not reveal whether it is always the same group of companies that receive funding, or whether the beneficiaries change over time. Thus the first question which arises is how public subsidies are allocated across firms over time.

The question of the allocation of public R&D funding across firms is particularly important when it comes to identifying the microeconomic effects of subsidies with respect to input or output additionality. In order to answer the question appropriately a potential bias needs to be controlled for. Many studies begin by determining a firm's probability of receiving a subsidy. For this purpose it is necessary to know in detail how specific schemes allocate subsidies in practice. Understanding the temporal structure of subsidy distribution could help future research explain the effects and effectiveness of subsidies. Especially in the face of shrinking government budgets and intensified international competition in the field of technology, knowing and increasing the efficiency of innovation policies has become crucial.

The aim of this paper is to analyze the structure of the firms receiving public R&D funding over time. In particular, I tackle the question of whether the same firms enjoy subsidies over time which would mean that there is, to some extent, a pool of firms which are funded continuously. The other alternative is that the composition of subsidized firms is highly dynamic thanks to a steady entry into and exit from the subsidy scheme at the firm level. Thus the funded firms change continuously.

There is still very little empirical evidence on the dynamics of firms' participation in public funding schemes. In the empirical literature there are several studies which include an analysis of firms' subsidy participation. However there are only a few papers which consider the subsidies over time by controlling for the experience of applying for or receiving public awards. Based on these studies it seems that firm's subsidy histories have an impact on obtaining awards in the future.

A lot of subsidy programs are available on the regional, national and European level which might have different allocation rules due to different goals and eligibility criteria. Thus, it is important to make a distinction in the analysis of these programs. This means one analysis should concentrate on one specific program in order to get precise results. The focus on specific funding schemes is lacking in most empirical studies. Another issue is the length of the period over which a single award is distributed to a firm. Since subsidies are often granted for projects that run over several years, the persistence of subsidies will be over-estimated if

[1] Excluding DPF grants awarded as contract research. The database on which the calculations are based is described in section 4.

this fact is not taken into account. I contribute to the literature by considering these two issues in this study.

In this study I concentrate on the German Federal Government's non-defense DPF scheme. This is the most important tool used by the German government to fund R&D in private businesses. In 2005, firms received a total of 745 million euros under this scheme (BMBF, 2006a).[2] The importance of this funding scheme will increase in Germany in the coming years since it is the main distribution channel for the new High-Tech strategy launched by the Federal Government (BMBF, 2006b). I focus on the question of which firms receive the new grants awarded under this scheme. In the DPF scheme a subsidy is granted for three years on average. The duration of each project is known and is considered in the analysis.

The paper is organized as follows. The next section 2 outlines the arguments, aims and mechanisms of direct R&D project subsidies delivered by the Federal Government of Germany. Section 3 reviews the empirical literature concerning firms' participation in R&D subsidy programs. The subsequent section 4 depicts some stylized facts on the population of awarded DPF grants with respect to the participation history of the firms which receive these grants. The data set underlying the empirical analysis is a representative sample of German firms covering the manufacturing and knowledge-intensive service sector and consists of over 6,000 firms. The sample and results of a descriptive analysis of subsidized and not subsidized firms are shown in section 5. The funding scheme is then examined in a multivariate context with the help of markov chains. The econometric model and the estimation results are presented in section 6, before drawing conclusions in the last section.

2 The Direct Project Funding (DPF) Scheme

Rationale and Mechanisms

The German Federal government supports the view that in a market economy competition makes sure that new products and processes are generated and that demand potentials and profit opportunities are ascertained by the companies. Even though, theoretically, companies are responsible for their own R&D and innovation decisions, the government states that public support can be beneficial and refers to the external effects of R&D (BT-Drs., 1988). The externalities of R&D lead to the problem that leaking knowledge increases social returns but reduces private returns. If R&D generates higher social returns than private returns, the level of R&D activities in the economy in question is below the socially desirable level (see Arrow, 1962; Levin et al., 1987; Adams and Jaffe, 1996). Public support should increase private R&D investment to the socially optimal level. In addition the government argues that public support of R&D related to public goods like, for example, the quality of air or water is justified due to the lack of corresponding markets. Other reasons for state aid for private R&D

[2] € 448.5 million were given by the Federal Ministry of Education and Research, € 296.1 million by the Federal Ministry of Economics and Technology.

can be an extremely long time horizon of R&D projects, high economic or technical risk or extremely high costs which one firm alone cannot bear (BT-Drs., 1984; BT-Drs., 1988; BT-Drs., 1993).

The German government employs a variety of instruments in its R&D policy, for example, institutional funding and indirect and direct support schemes. In cases when a selective solution is aimed at and other support instruments are insufficiently target-oriented, too intricate, or a cross-industry key technology is targeted, direct R&D project funding is used (BT-Drs., 1984). The overall objective of this support scheme is to achieve a high level economic performance and competitiveness of R&D in selected areas (BT-Drs., 1984; BMBF, 2000). The DPF scheme has become the most important tool used by the national government to support private businesses' R&D. Therefore, the focus in this paper is set on this tool.

The DPF scheme offers grant aid funding for R&D projects in predefined fields of technology. Targeted areas include ICT, biotechnology, optical technology, transport technology, space technology, environmental and energy technologies, health research and medical technology. The fields of technology are selected by the government and the financial support is thematically restrictive to these technologies. Within the technology fields several programs are defined which include funding objectives and rules. These programs run for several years, are made public through calls and applications have to be made within defined dates. Either companies or research institutions – or both together in a joint project – submit project-based applications for funding. In most programs, applications based on a cooperation of firms and research institutions are recommended though not obligatory. Program agencies authorized by the government and responsible for specific thematic areas decide on the application. The criteria for approving a project do not differ between firms that have already participated in the scheme and firms which want to participate for the first time.[3] The funding is granted on a cost sharing basis. Up to 50 percent of the R&D project costs are covered by the government. Thus, the funding directly reduces firms' R&D costs.

Within the empirical analysis an issue arises due to the mechanisms of the subsidy allocation process. The allocation of subsidies is based on a multi-stage decision-making process. First of all, the company needs to be aware of the program in order to apply. Secondly, before submitting a proposal it is usually recommended in the guidelines of the funding programs that companies should contact the program agency. Communication with the program agency may lead to a withdrawal or redesign of the application. Finally, the application can be rejected by the agency. Thus, there are several points where the application process can be broken off. The government does not report data on these issues, such as rejection rates or the share of applications being withdrawn by the applicant after contacting the program agency

[3] In contrast, for example, within the SBIR program additional criteria apply for the evaluation of SBIR applications of firms who had received awards in the past (Lerner, 1999).

(BT-Drs., 2005). Therefore, I cannot differentiate between the different reasons why a firm does not participate in the funding scheme. A similar problem occurs in many other studies.[4]

Hypotheses for Empirical Analysis

The government states in its program guidelines that public financial support to firm R&D should be only temporary. "Support programmes run for several years. It is important that they be properly balanced: On the one hand, applications need a certain amount of time in order to reach maturity; on the other hand, they should not become permanently dependent on support" (BMBF, 2005). A permanent alimentation of specific research areas and thus of firms is not intended (BT-Drs., 1979; BMBF, 2004).

The first question to analyze is whether the same firms receive the new allocated subsidies over time so that some firms receive public money permanently. Though the intention of the government is not to support firms permanently, there are several reasons why the same firms might be receiving the new grants. First, firms who have participated in the scheme might realize learning effects. They can use their experience for submitting a successful application. They might also be more capable of rating which R&D projects might be suitable for funding. In addition, the transaction costs might be less for them since the effort for submitting a (additional) proposal is smaller. Secondly, due to asymmetric information not all eligible firms are aware of the funding opportunity and do not submit an application. Therefore, the probability of receiving further subsidies is higher for firms which have successfully applied for funding in the past. Moreover firms which have already participated in the support scheme might know the support opportunities better than the other firms. Thirdly, a firm may have specific characteristics which increase its probability of success or it may belong to a group of firms who enjoy priority treatment by the government, for example, because of their location, sector activity or technology specialization. Considering the argumentation in favor of a more stable participation pattern, it is assumed that a rather persistent participation pattern will be found due to an augmented allocation of new grants to previously participating firms.

Program agencies' decisions are based on the proposed R&D projects, not on firm characteristics. But information on the project-level is not available for not subsidized projects. However, it can be analyzed which firms had submitted successful applications and received new DPF grants. Thus the second question to answer is what types of firms are participants and are thus actually addressed by the government's subsidy program. Looking at the government's reasoning for running the DPF scheme, i.e. funding of R&D projects with high economic and technical risk, long time horizon and budget requirements that go beyond the capabilities of a single firm which not would have been carried out without the public support, it can be assumed that this applies more likely to small and young firms due to their limited resources. Thus the probability that applications from these firms are selected and approved by the program agency should be higher. Another reason why smaller firms are

[4] The only exceptions are basically studies for Finland, such as those of, for example, Ali-Yrkkö (2005) or Tanayama (2007), since the number of rejected applications are known.

more likely to be chosen by program agencies is that small and medium-sized enterprises (SME) have become a key target group of innovation policy in Germany (BMBF, 2004). They have started activities which focus on promoting and supporting SMEs. Also in the DPF scheme special attention is paid to SMEs. Thus, the probability that program agencies approve project proposals should be higher for SMEs.

On the other hand large firms may have information advantages because they are able to provide more resources for tracing funding opportunities, since the costs can be spread over more revenue. Therefore, large firms may have a higher probability of applying to R&D funding schemes. Overall size is expected to be an important variable in explaining the participation in the public support program although the direction of the impact is ambiguous.

The final goal of the government when offering subsidies to firms is to increase their competitiveness. Program agencies might think that certain firms are more capable of achieving this and favor more experienced and capable firms or firms which are already on a high level of technology or on a promising path (picking-the-winner strategy). Thus regular R&D activities and human capital might positively influence the agencies' decisions. Furthermore, firms with a high patent stock compared to other firms in their industry might be in a more favorable position to achieve international competitiveness and thus have the advantage of being awarded by the agencies. Furthermore, firms with impressive growth rates in the past might be more likely to be successfully selected in the program. If the firm is subsidized in the previous years, this growth can also be an effect of the previous support. This could be an indicator that the project had a positive effect and the firm might have an advantage to get further projects granted.

3 Previous Empirical Studies

In the empirical literature there are several studies which include an analysis of firms' participation in public R&D programs. This is often related to investigating the effects of public funding on firms' R&D inputs or outputs. In order to analyze this question appropriately a potential selection bias has to be taken into account. For this purpose the determinants of receiving public funding have to be analyzed. There are only a few papers however, which consider receiving subsidies over time by including at least one variable for the previous receipt of public awards.

Duguet (2004) is one of these exceptions. He looks at the subsidy status at the firm-level in two consecutive years within the time period between 1985 and 1997 and identifies the entries and exits. The overall receipt of R&D subsidies from any national ministry is taken into account. About a quarter of the firms are subsidized in two consecutive years whereas about 60 percent are not subsidized in the previous and current year. The entry and exit rates vary between 5 and 9 percent per year. He concludes that the stability of recipients in his sample is rather strong. Estimating the probability of receiving subsidies, he finds that both the former receipt of subsidies and the average amount of subsidies have a significantly positive effect. González et al. (2005) use an unbalanced panel data set of Spanish manufacturing firms and

aggregate subsidies from varies sources, such as regional, national and EU programs. They estimate firms' expectations of subsidies. Controlling for other firm characteristics they find that the subsidy dummies lagged by one period and by two periods both have a significantly positive influence on the receipt of a subsidy. Tanayama (2007) focuses on the application process for R&D subsidies by the Finish Funding Agency for Technology and Innovation (Tekes) via the number of filed applications between 2000 and 2002 in her study. She finds that the number of applications before 2000 increases both the probability of being a potential applicant for the subsidy scheme and the number of filed applications conditional on being a potential applicant. Feldman and Kelley (2001) investigate factors influencing the decision to grant an Advanced Technology Program (ATP) award in 1998. Explaining winning an ATP award the two variables concerning the ATP experience, namely first-time application to ATP and number of previous ATP awards, have – in contrast to the other studies – no significant effect.[5]

It seems that a firm's subsidy history has an impact on the receipt of further awards but it is not unambiguous. In most studies analysis of experience effects are not program specific but rather aggregate regional, national and European-wide program participation into one single experience measure. But allocation rules differ between programs as was shown in a study by Blanes and Busom (2004). All of the studies except the one by Feldman and Kelley (2001) and Tanayama (2007) have neglected that a subsidy is often given for longer time period than one year. In such a case the same grant is responsible for the subsidization of a firm for two consecutive years and the identified effect might be overestimated.

This review makes it clear that firm-level empirical evidence on persistence in participation of subsidy programs is rather scarce and not very detailed. I want to contribute to this literature by controlling for these two mentioned shortcomings. I focus on one specific support scheme – the DPF scheme – and take into account the duration of the subsidized projects to correct for a bias due to longer lasting projects. Therefore, I am particularly interested in the question of which firms receive the new awarded grants. Furthermore, it is the first time that information is provided with respect to previous firm participation in the DPF scheme for the population of awarded DPF grants.

4 Stylized Facts of the German DPF scheme

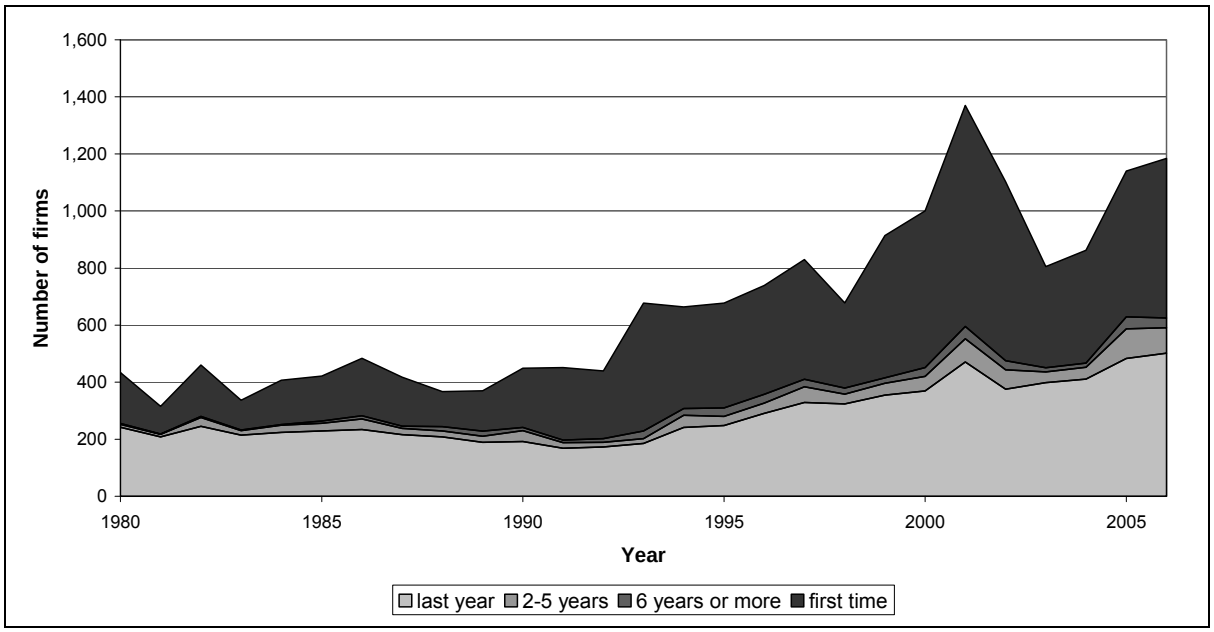
Information on the Federal Government's DPF scheme is collected in a separate database called PROFI. This database encompasses detailed information on all projects funded under the DPF scheme, including starting and end dates of the funded projects, amount of public funding, total project costs and all names of firms and public research organizations involved in the project. The database serves as the basis for the description of the DPF scheme. Public financing of R&D projects by the way of contract research is excluded from the data set.

[5] An overview of all empirical studies analyzing the probability of receiving subsidies is shown in Table 5 in the appendix.

Regarding the overall trend in the DPF scheme in the last 25 years, the number of projects and firms funded each year has changed considerably. In the early 1980s, on average about 2,600 projects of about 1,000 different private firms were funded every year with more than 900 million euros of public funding per year. By the year 2005 the number of projects increased by a factor of about 1.6 and the number of involved firms by a factor of 2.5. At the same time the amount of the public subsidies decreased by 50 percent in the same period.

Since a project is subsidized on average for about three years, about one third of the projects to be observed for a particular year have begun in that year. In 1980 there were almost 800 starting projects which were carried out by about 400 different firms (see Figure 1).[6] The number of firms with new projects remained the same until 1992 and then began to increase. The peak in 2001 is due to the temporarily expanded budget for the DPF scheme. This was financed by the savings from the interest from the appropriation of the revenues of the auction of the UMTS licenses for public debt repayment. The number of new projects and firms involved therein has developed similarly to the overall trend. In recent years around 1,500 new projects in almost 1,200 different firms were subsidized. Consequently, a lot more firms receive subsidies but each firm has fewer subsidized projects on average and the average award amount also decreased.

Figure 1: Number of firms with new projects subsidized in the DPF scheme, controlling for the period since the firm was last subsidized (in years), 1980-2006



Note: Last year: Firm had a subsidized project last year; 2-5 years: Firm had subsidized projects between 2 and 5 years ago; 6 years or more: Firm had a subsidized project 6 or more years ago; first time: Firm participates in the DPF scheme for the first time. Source: PROFI database; own calculations.

[6] The classification of firms whether they are subsidized or not is based on the announced period of the project. For example, when a project runs from August 2002 until March 2004 the firm is marked as being subsidized from 2002 to 2004. This does not necessarily correspond exactly to the years when the firm receives the payments. Since often the last payment is made in the year or the second year after the expiration of the project, the calculated transition rates (next section) are not biased due to delayed payments.

Since the main interest is the participation pattern in the funding scheme over time, I decompose the number of firms with newly subsidized projects in a year in terms of their participation history. A look at the firms' funding history reveals that in the early 1980s 30 to 40 percent of the participating businesses received subsidies for the first time.[7] As new technology areas were emphasized and funding was increasingly directed towards SMEs, the share of first time participants increased in the 1990s to 50 to 60 percent and remained at that level. In the meantime, however, the total number of firms that have participated in the DPF scheme at least once has increased substantially.

The share of firms which receive subsidies occasionally is rather low as shown by the share of firms that were last funded two or more years ago. This indicates that once a firm exits the program and does not receive subsidies anymore, it is not very probable that this firm will re-enter the program.

From the perspective of the DPF scheme – by looking at all participating firms – some dynamic is detected within the scheme since about 40 percent of firms who get starting projects in a specific year participate for the first time. In order to assess the participation pattern further it is necessary to relate these subsidized firms to all firms, i.e. the population of firms. The PROFI database only includes participating firms since it is based on information on the subsidized projects.

5 Data Set and Some Statistics

Data Set

This analysis intends to examine the program participation structure in Germany in a dynamic context. The focus is set on the allocation of new grants and the corresponding role of the firm's previous participation. I use a representative sample of the population of firms so that it consists of both participants of the DPF scheme and non-participating firms who might be potential applicants. The sample used is based on the Mannheim Innovation Panel (MIP), an annual innovation survey conducted by the Centre for European Economic Research (ZEW) on behalf of the BMBF since 1993. The MIP is the German part of the European-wide harmonized Community Innovation Survey (CIS). It is a stratified random sample of firms according to firm size, industry and region. I pool the observations from all years to one dataset. Then I merge this firm level data with subsidy data which is extracted from the PROFI database. An advantage of this PROFI data set is that in contrast to other studies it contains information on subsidies on a project-level. Thus the exact duration of the projects is known and it is possible to identify the years in which firms have newly granted projects or

[7] Since the PROFI database begins in 1973, it is not possible to control for subsidies given before that year. This data restriction might result in a slight shift from the group of firms which were funded six or more years ago to the first time funded firms where the firms were subsidized before 1973. But this bias is assumed to be rather small and therefore negligible since the share of firms who re-enter the program after nine years is fairly low.

whether projects are just ongoing.[8] The project-level data about the subsidies is aggregated to the firm-level because the analysis is carried out on the firm-level. The firm's subsidy status is known for every year since the subsidy information is extracted from another database which covers all years. Thus it is not necessary to observe the firm in two consecutive years in order to calculate transition rates for the subsidy status from one year to another.

Basically the programs within the DPF scheme are open to all firms. But naturally the DPF scheme is only interesting for firms if a program is placed within the industry in which the firm is active. Therefore, I restrict the sample to firms from the manufacturing sector and selected knowledge intensive services since the DPF scheme mainly targets these branches.[9] Furthermore, I keep only observations for which all variables needed in the multivariate analysis are given.[10] In the end, the sample consists of about 6,800 different firms covering the manufacturing sector from 1994 to 2005 and the knowledge intensive service sectors since 1996. In addition, it can be presumed that R&D subsidies are more relevant for firms which seek innovations. Therefore I mark the firms which are engaged in innovative activities, i.e. their innovative expenditures are positive in *t*. About 5,200 of these firms have innovative activities.

Since participation in the survey is not obligatory for firms, the observed firms change from year to year in the dataset. Over 40 percent of the firms from the whole sample are only observed once. About 18 percent of the firms are surveyed for two years, less than one percent for all 12 years. Overall the sample consists of 19,265 observations, of which 12,797 are from firms with innovating activities (for firms' observation pattern see Table 7 in the appendix).

Descriptive Results

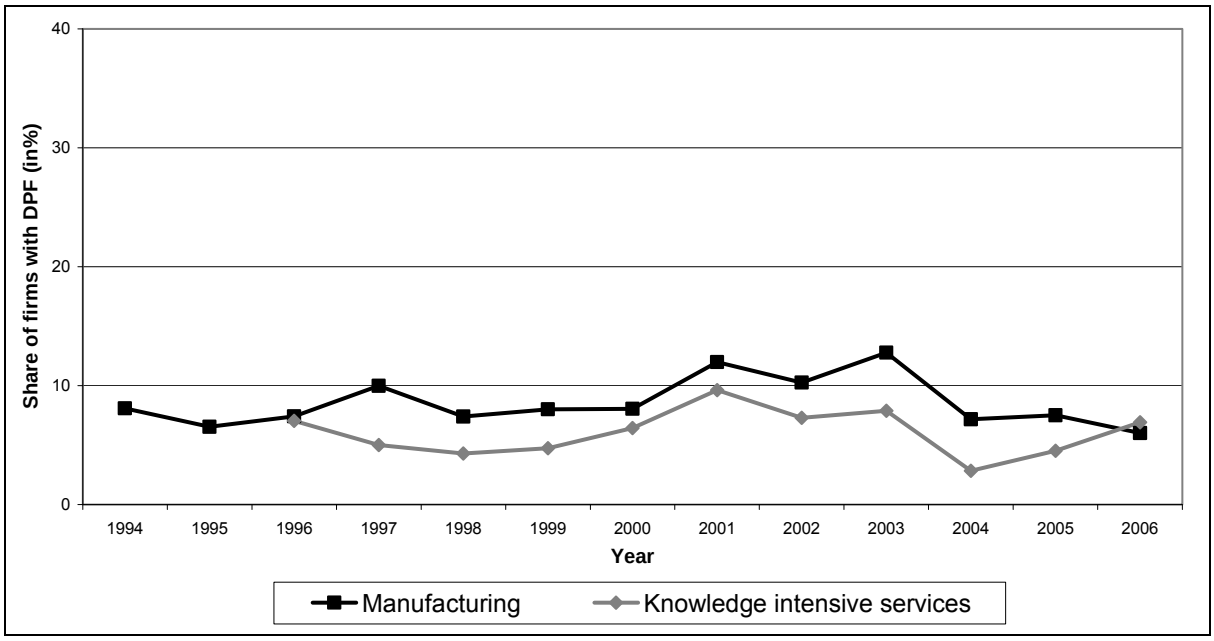
The sample includes firms who participated in the DPF scheme and firms who did not participate. The share of firms who received funding in the DPF scheme is shown in Figure 2. Firms with positive innovation expenditures serve as a basis for calculating the share of subsidized firms. In the manufacturing sector the share of firms who participated in the funding scheme remained around 8 percent from 1994 till 2000. Between 2001 and 2003 it increased to 13 percent and then decreased again to its initial level. For the firms in the knowledge intensive service sectors basically the same pattern can be observed but at a three percentage points lower level on average. In 2006 the share of DPF recipients converged to the level in the manufacturing sector. The overall slight increase of subsidized firms between 2001 and 2003 can be explained by the overall increase of firms participating in the funding scheme in this period as shown in section 3.

[8] The classification of firms according to whether they are subsidized or not is based on the announced period of the project.

[9] Table 6 in the appendix for an overview of the included sectors.

[10] In addition, firms with more than 10,000 employees are dropped since for these firms the assignment of the subsidies is fairly difficult.

Figure 2: Share of innovating firms which receive DPF, 1994-2006



Notes: Innovating firms are firms with positive innovation expenditures. Contract research is not taken into account. Source: Own calculations.

As shown a certain share of firms participate every year in the DPF scheme. However, the graph does not exhibit whether the same firms receive subsidies over time or whether and to what extent firms enter and exit the subsidy scheme. In order to analyze this issue, the transition rates between being subsidized and not subsidized – ongoing or newly subsidized – are calculated and presented in Table 1.

Table 1: Transition rates

		Status in *t*+1			
Status in *t*	**No. of obs.**	**Not subsidized**	**Ongoing subsidized**	**Newly subsidized**	**Total**
Whole sample					
Not subsidized	17,780	98.80	0.00	1.20	100.0
Subsidized	1,485	17.31	58.92	23.77	100.0
Total	19,265	92.47	4.69	2.84	100.0
Sub-sample of innovating firms[a]					
Not subsidized	11,312	98.25	0.00	1.75	100.0
Subsidized	1,485	17.31	58.92	23.77	100.0
Total	12,797	88.86	6.84	4.31	100.0

Note: [a] Innovating firms are firms with positive innovation expenditures in *t*. Firms which have newly subsidized projects may additionally have ongoing subsidized projects.

Looking at the whole sample it becomes apparent that the subsidization status is fairly permanent. Almost 99 percent of the firms who do not participate in the funding scheme in year *t*, do not receive this type of funding in the following year. Thus the share of firms who enter the funding scheme is extremely low. Thereby, no upward or downward trend of the yearly transition rates can be observed.[11] Considering the non-subsidized firms in *t* who also

[11] Table of yearly transition rates for not subsidized firms in *t* can be found in Table 8 in the appendix.

had no innovation activities in that period, the probability of them innovating by conducting R&D in *t*+1 and receiving subsidies is even below 0.3 percent. Virtually all of the newly subsidized firms in *t*+1 are firms which had already undertaken some type of innovation activities – almost always R&D activities – in *t*. Thus, it can be concluded that the funding scheme is not a method of stimulating firms to undertake R&D activities. But this is also not a goal of this support scheme.

The status of the subsidized firms is constant to a large extent. Over 80 percent of the subsidized firms maintained their status in the following period while almost 20 percent did not receive further funding and dropped out of the funding scheme.[12] Compared to the results of the study conducted by Duguet (2004) who considers R&D subsidies from national ministries in France, a slightly higher dynamic can be observed in France. Recalculating the given percentages in his study it turns out that, for example, 7.5 percent of the firms without subsidies in 1996 receive subsidies in the following year. Given that a firm is subsidized in 1996, 75.6 percent of these firms also got subsidies in 1997.

However, it has to be considered that grants once approved in the DPF scheme last for several years, about three years on average. Continuation rates will be overestimated if the persistence due to multi-year projects is not taken into account. Therefore, the subsidized status is split in *t*+1. A distinction is made between firms which have newly subsidized projects – and additionally maybe ongoing funded projects – and firms which have only ongoing subsidized projects. It turns out that a little more than 20 percent of the subsidized firms in *t* start actual newly subsidized projects in *t*+1. About 60 percent of the subsidized firms receive subsidies in *t*+1 due to the fact that projects are approved for several years. Thus, the probability for firms to receive further funding in a new project is six percentage points higher than the probability of dropping out of the scheme (23.8% vs. 17.3%). The results show that once a firm has made it into the DPF scheme which is rather rare event, the probability of getting DPF grants for a new project in the following year is more likely than dropping out of the scheme.

Table 2 gives some more information on the dynamic of subsidization for innovating firms by their sector and size class. Looking at the firms' sector, the share of firms which enter the scheme in the manufacturing sector is about twice as high as in the service sector. This is not surprising since R&D activities are more frequently undertaken in manufacturing firms. Differences in the transition rates for subsidized firms between the industry and service sectors are rather small. Differences in the transition rates are more pronounced with respect to firm size. Both the probability of switching into the subsidization status and that of staying in this status increases with firm size. Therefore, the overall share of subsidized firms is higher for large firms than for small ones. As the next step, I want to identify firm-specific

[12] Taking into account that in 2000 and since 2002 some firms which had received subsidies were added to the sample, the number of firms which are funded in *t* is higher than otherwise, but the inclusion of these observations does not have a severe effect on the transition rates. For example, the transition rate of firms which remain subsidized from *t* to *t*+1 even slightly increases from 82 to 85 for the sample when the extra firms were dropped. To check the representativeness of the sample, Table 9 in the appendix compares the transition rates for the subsidized firms in t of the population and the sample in each year. It turns out that the firms also subsidized in *t*+1 are slightly over-represented in the sample. But the bias is rather small.

factors which influence the probability of getting DPF grants for a new project in the subsequent period conditional on whether a firm is subsidized in period *t*. For not subsidized firms in *t* this is the probability of entering the scheme, for subsidized firms this means renewing the subsidization status with a new DPF grant.

Table 2: Transition rates of innovating firms by firms' sector and size class

Status		Sector		Size Class		
in *t*	**in *t*+1**	**Manu.**	**Service**	**<50**	**50-249**	**>=250**
Not subs.	Not subs.	98.04	99.05	99.26	98.40	96.15
	Ongoing subs.	0.00	0.00	0.00	0.00	0.00
	Newly subs.	1.96	0.95	0.74	1.60	3.85
	Total	100.00	100.00	100.00	100.00	100.00
Subs.	Not subs.	16.97	18.42	20.42	17.38	14.64
	Ongoing subs.	58.97	58.77	59.37	58.47	58.91
	Newly subs.	24.06	22.81	20.21	24.15	26.46
	Total	100.00	100.00	100.00	100.00	100.00
No. of obs.		10,133	2,664	5,320	4,311	3,166

Notes: [a] Innovating firms are firms with positive innovation expenditures in *t*. Firms which have newly subsidized projects may additionally have ongoing subsidized projects.

6 Econometric Analysis

Econometric Model

In this section the dynamics of firms' participation in the German DPF scheme are investigated in a multivariate context. It concentrates on the probability of a transition from one state of subsidization to another in the next period. In particular I am interested in the question of which firms receive the new awarded DPF grants conditional on whether the firms receive subsidies in the previous period. Therefore, I focus on entry into the scheme and getting new projects approved if already in the scheme. In order to estimate these transitions I use the approach of markov chains which is seen as a powerful instrument for analyzing dynamic economic phenomena (e.g. Nguyen Van et al., 2004). I use a model based on Gouriéroux (2000) and applied by, for example, Nguyen Van et al. (2004) in the context of transitions between different states of firm performance or Fryges (2007) who analyzed changes between sales modes used by firms in international markets.

Let Y_{it} denote the status of subsidization *j* of firm *i* in time *t* and takes value 1 if firm *i* has a newly approved grant in *t* and value 0 otherwise. Assuming a logistic form for the transition probabilities and a set of explanatory variables *x*, the probability of transition of firm *i* from state *j* in *t* to state *j'* in *t*+1 is given by

$$P_{ijj'}(t+1) \equiv P(Y_{it+1} = j' \mid Y_{it} = j) = \frac{\exp(x_{it+1}\beta_{jj'})}{\sum_{j'=0}^{1} \exp(x_{it+1}\beta_{jj'})}, \tag{1}$$

i = 1,…, N, t = 0,…, T, and j, j' = 0, 1. For identification I impose the restriction $\beta_{j0} = 0$ and obtain

$$P_{ij0}(t+1) = \frac{1}{1+exp(x_{it+1}\beta_{j1})}, \tag{2}$$

$$P_{ij1}(t+1) = \frac{exp(x_{it+1}\beta_{j1})}{1+exp(x_{it+1}\beta_{j1})}, \tag{3}$$

with j = 0, 1. Consequently, each row of a transition matrix can be estimated by a binary logit model, assuming two possible states in t+1. Let us define $n_{i,t,t+1}(jj') = 1$ if firm i occupies status j in t and status j' in t+1, and 0 otherwise. Then the log-likelihood conditional on the state occupied at time t is

$$ln\, L = \sum_{j=0}^{1}\sum_{j'=0}^{1} ln\, L_{jj'}, \qquad \text{with} \qquad ln\, L_{jj'} = \sum_{i=1}^{N}\sum_{t=0}^{T} n_{i,t,t+1}(jj')\, ln\, P_{ijj'}(t+1). \tag{4}$$

Because the quantity $\sum_{j'=0}^{1} ln\, L_{jj'}$ only depends on β_{j1}, the maximum likelihood estimator $\hat{\beta}_{j1}$ can be obtained by separate maximization of the elements of $\sum_{j'=0}^{1} ln\, L_{jj'}$, where j = 0, 1.

By applying logit models it is possible to identify firm-specific factors which influence the probability of switching the subsidy status between two periods. I apply a logit type model that firstly explains the transition from the non-subsidized status in t to being subsidized in t+1, i.e. subsidy program entry. The share of firms who change their status, i.e. enter the scheme, is rather small compared to the event of remaining non-subsidized. King and Zeng (2001) show that the maximum likelihood estimator $\hat{\beta}$ is biased in rare events data in finite samples because the probability of the rare event is underestimated – in this case the estimated probability $\hat{P}_{i01}$. They introduce a bias-correcting estimator $\tilde{\beta}$ and derive an analytical approximation for estimating the probability P_{i01} as

$$P_{i01} \approx \frac{1}{1+exp(x_i\tilde{\beta}_{01})} + C_i = \tilde{P}_{i01} + C_i, \tag{5}$$

where the correct factor C_i is

$$C_i = (0.5 - \tilde{P}_{i01})\tilde{P}_{i01}(1-\tilde{P}_{i01})x_i Var(\tilde{\beta}_{01})x_i'.^{13} \tag{6}$$

[13] For simplicity, I have neglected the time subscript t in this formula.

The estimator $\tilde{P}_{i01} + C_i$, which is denoted as an approximate Bayesian estimator, is less biased – though not completely unbiased – but it is superior in the sense that it has a smaller mean square error than other estimators of P_{i11} (King and Zeng, 2001). Thus, I apply this rare event logit model to estimate the first element of the log-likelihood function in equation (4), i.e. the entry into the DPF program.

Secondly, the transition from participating in the subsidy scheme in t to getting a new project subsidized in t+1 – renewing the subsidization status – is examined by means of a conventional logit model. If a firm gets a DPF grant for a new project in t+1, the dependent variable equals 1. If a firm takes on value 0 for the dependent variable in t+1 it does not necessarily exit the subsidization status completely because firms may have ongoing subsidized projects. But it implies that the firm does not receive a grant for a new project in t+1. The two states of being not subsidized at all in t+1 and having ongoing subsidized projects in t+1 are combined. In these two states 'nothing' really happens to the firm.

I assume that the participation pattern follows a first-order Markov process, i.e. the state in t+1 only depends on the state of the previous period t. A Markov-chain of higher order is not necessary because the status of t includes both newly and ongoing subsidized firms. Therefore, a large share of these firms is also subsidized in the prior period $t-1$ or before due to the average duration of approved projects. Instead I use an additional exogenous variable − the number of projects that were granted within the last five years (between $t-4$ and t) − which accounts for the overall experience with the funding scheme based on the firm's DPF history. This ensures that each earlier funded project is counted only once.

An alternative model to analyze persistence could be a dynamic panel discrete choice model. However due to the limited number of observations in specific and consecutive years and the few status changes between the years this model cannot be applied. Due to the lack of time series data for the firms, a survival analysis would also be not very meaningful since it cannot change over time. Instead, I pool the data from the different years.

Econometric Implementation

The selection of variables used to explain the allocation of new DPF grants is based primarily on the hypotheses described in section 2 and on the results of previous empirical studies (see Table 5 in the appendix). The means of the explanatory variables are presented in Table 3, separately for the four possible state combinations of the dependent variables.

Subsidy-related variables

Previous experience with the DPF scheme is assumed to have a positive effect on the probability of entering the subsidy program again. There are various reasons for this as explained in section 2. In order to analyze whether the experience with this specific subsidy scheme has an effect beyond the status at time t which is given, the variable *DPF history* is generated. It contains the number of approved projects within the preceding five years, i.e. between $t-4$ and t. By counting the projects the experience that the firm has gathered is

revealed. Regarding the sample of non-subsidized firms in *t*, 26 percent of the firms who switch into the subsidy scheme had at least one subsidized project between *t*−4 and *t*−1. This share is only 3 percent for the firms who discontinue subsidization in *t*+1. Regarding the firms that were subsidized in *t*, the most successful firm in terms of getting projects approved in the last five years has 21 beginning projects. The average *DPF history* variable is also significantly higher for firms who get further funding via a new project in *t*+1. These firms have, on average, 3.5 subsidized projects within the last five years, i.e. about twice as many as firms with no or no new projects in *t*+1.

Table 3: Comparison of means of the explanatory variables

Status in *t*	**Not subsidized**			**Subsidized**		
Status in *t*+1	**Not subs.**	**Subs.[a]**		**Not newly subs.**	**Newly subs.**	
DPF history $_{t\text{-}4\rightarrow t}$	0.029	0.258	***	1.708	3.476	***
Ongoing $_{t+1}$	0.000	0.000		0.773	0.878	***
Sub_EU $_{t\text{-}2\rightarrow t}$	0.052	0.157	***	0.224	0.397	***
Sub_regional $_{t\text{-}2\rightarrow t}$	0.139	0.293	***	0.307	0.456	***
Sub_supply $_{t+1}$	3.585	4.982	***	4.677	5.406	***
Ln(Employees)	4.225	5.380	***	4.805	5.235	***
Employees change	0.029	0.051		0.040	0.065	*
Ln(Age)	2.728	2.798		2.728	2.685	
R&D_no	0.276	0.051	***	0.000	0.000	
R&D_occ	0.237	0.152	***	0.151	0.062	***
R&D_con	0.486	0.798	***	0.849	0.938	***
Qualification	0.213	0.263	***	0.340	0.387	***
Patent_stock_dev	0.634	2.647	***	3.204	5.105	**
Group national	0.362	0.414		0.418	0.476	*
Group foreign	0.095	0.116		0.135	0.122	
East	0.336	0.333		0.317	0.419	***
Low tech ma.	0.150	0.086	**	0.062	0.025	***
Med-low tech ma.	0.256	0.187	**	0.138	0.153	
Med-high tech ma.	0.268	0.389	***	0.318	0.269	*
High tech ma.	0.120	0.227	***	0.249	0.331	***
Low tech service	0.123	0.051	***	0.106	0.066	**
High tech service	0.083	0.061		0.127	0.156	
No. of obs.	11,114	198		1,132	353	

Notes: [a] All firms which do not receive subsidies in *t* and enter the program in *t*+1 are newly subsidized. *** (**,*) indicates that the means are significantly different on the level of 1% (5%, 10%) based on a t-Test. Unless otherwise specified the explanatory variables refer to time t. Time dummies are not shown.

It is also controlled for whether a firm still gets subsidies from ongoing projects in *t*+1 with the help of the dummy variable *Ongoing*. The question is whether the currently ongoing contact with the program agency has an additional positive impact on the likelihood of receiving further projects. On the other hand the variable indicates when it takes the value 0, i.e. if the firm does not get a new project granted in *t*+1 then it will drop out of the scheme because it has no ongoing projects in *t*+1. Thus these firms might be especially eager to get a new project funded.

In order to control for experience with other sources of subsidies, dummy variables are included to indicate whether the firm received subsidies from a European (*Sub_EU*) or a regional (*Sub_regional)* funding scheme within the preceding three year period *t*−2 to *t*. On

one hand firms who participate in a broad range of funding programs probably know the subsidy system with its funding opportunities quite well and have a lot of expertise in applying for and getting public grants. On the other hand, the DPF scheme might particularly support firms which do not get other subsidies. However if the firms apply to other sources for subsidies for projects unrelated to DPF, these subsidy sources are usually unknown to the agencies that decide on the DPF projects. Therefore a positive effect of applying and granting is expected. The comparison of means shows that firms with new subsidized projects in t+1 also get subsidies from the two other sources of funding significantly more often than the other firms.

From time to time the government launches sub-programs within the DPF scheme in 'new' technology areas or shifts the focus from one area of research to another. Firms from other industries might be addressed so that new firms are recorded – naturally – within the DPF scheme. In contrast in other technology areas where programs end the chances of getting a new DPF grant decrease. In order to take these shifts over time into account in the estimation, the variable *Sub_supply* is generated which includes the amount of subsidies (in 10 million euros) which are approved for starting projects within a certain industry in year t+1. It is a proxy for the supply of subsidies for a firm. This variable is constructed based on the PROFI database and represents the population of the DPF scheme.[14] Comparing the firms with newly subsidized projects and with no (new) projects it becomes apparent that the supply of subsidies is larger for firms with approved projects. Wallsten (2000) constructed a similar variable in his study which approximates the SBIR budget potentially available to each firm, depending on the type of research. He found a positive effect of this variable on the probability of winning a SBIR Phase I and II award.

Other variables

As explained in section 0, firm size is expected to be an important variable in explaining the participation in the DPF program though the direction of the impact is ambiguous. A firm's size is measured by the number of employees in logarithms (*Employees*). The comparison of means exhibits that firms with newly subsidized projects are significantly larger than those firms without (new) projects.

Besides the level of the employees, the change in the number of employees between $t-1$ and t relative to the number of employees in $t-1$ is also included in the regressions (*Employees_change*). Firms who are already on a growth path may most likely be picked by the program agency in order to augment this development. If the firm has been subsidized in the previous years this growth can also be an effect of the public support. However looking at the descriptive statistics the average firm growth is not significantly larger for firms who enter the scheme than for the current not subsidized firms. Indeed employment growth is slightly larger for the subsidized firms which get a new DPF grant.

[14] The programs within the DPF scheme are linked to technology areas which cannot be directly converted into industries, for example, based on the NACE classification. However, in order to control for the supply, the industries to which the participating firms belong to are taken into account.

Young firms should also enjoy special attention under the Federal innovation policy. Young high-tech firms may suffer from a lack of financial capacity due to insufficient resources of their own and limited access to capital markets. However, the DPF scheme does not focus on start-up firms in particular though there are some sub-programs which target high-tech start-ups, for example, BioChance in the biotechnology field. Whether age plays an actual role in receiving subsidies is examined by the logarithm of a firm's age (in years, *Age*). The mean of a firm's age does not exhibit a significant difference between the groups.

Overall, the sample is restricted to firms with positive innovation expenditures. However this does not necessarily imply that the firms actively conduct R&D. Innovation expenditures also include expenditures for extramural R&D, the acquisition of machinery, software or other external knowledge etc. Since the DPF scheme is directed towards R&D activities the past conducting of these activities indicates the experience with R&D and the accumulated knowledge in R&D. Furthermore firms with in-house R&D might also be aware of potential support programs offered. Thus in-house R&D activities probably enhance the probability of applying to the DPF scheme. The program agency might also favor firms with the capability to carry out R&D. The variable *R&D_occ* (*R&D_con*) indicates that the firm performs R&D on an occasional (continuous) basis. A proportion of the not subsidized firms in *t* may also have no such activities (*R&D_no*). Continuous R&D activities are significantly more often observed for newly subsidized firms.

In addition to R&D activities, another measure of firms' capabilities to generate and acquire knowledge is included in the regressions – the share of employees with a university degree (*Qualification*). Since qualified employees within the R&D process increase the human capital within R&D and the absorptive capacity, more ideas for future R&D projects are generated (Blanes and Busom, 2004). Hence the pool of potential R&D projects is larger and thus the probability of promising projects among them increases. Qualified employees in the administration area might be more successful in fund-raising for R&D projects (Czarnitzki and Fier, 2002). Therefore this variable is expected to have a positive effect on the likelihood of applying for a subsidy and this being approved by the program agency. Indeed firms with new DPF grants have a higher share of qualified personnel.

A proxy variable for a firm's capacity to create new knowledge is its patent stock. Firms have proved to be able to transfer R&D into inventions which is one of the main success criterion under the DPF scheme. This variable is generated by depreciating the sum of all patent applications which were filed at the European Patent Office since 1979 until *t*. The depreciation rate is constant and equals 0.15, which is common in the literature (e.g. Hall, 1990).[15] Since the patent behavior varies between industries, the variable used in the regressions is scaled to the industry mean and measures the deviation rate from the industry average (2-digit-level, *Patent_stock_dev*). The descriptive statistics show that firms with a higher patent stock, when compared to the industry, on average both enter into the scheme and renew their status with new grants more often.

[15] The resulting formula for the calculation of the patent stock of firm *i* at time *t* is: $Patent_stock_{it} = (1 - DR) * Patent_stock_{it-1} + PA_{it}$ where DR is the Depreciation Rate and PA the number of filed patent applications.

Firms which belong to a company group might benefit from this membership due to knowledge transfers within the group. However, SMEs which belong to a group with a large parent company are then not eligible anymore for DPF sub-programs designed for SMEs. The DPF scheme might also be oriented in particular towards domestic firms since the government wants to generate economic effects located in Germany. Two corresponding dummy variables are included in the regression. *Group_national* takes on the value 1 if the firm is part of domestic company group. If the firm has a foreign headquarter then *Group_foreign* equals 1. In the descriptive statistics no significant difference can be observed.

In Germany there is a special situation due the reunification in 1989. The Eastern part is still significantly behind in terms of productivity and large transfer payments and promotion programs are directed to this geographic region. The DPF scheme is not part of this system and does not focus particularly on firms located in the Eastern part, except the two sub-programs InnoRegio and Innovative Regional Growth Cores. However, due to still existing differences between the West and the East, I include a dummy variable (*East*) for firms located in Eastern Germany in the regressions. With regard to entering into the scheme there is no systematic difference. However once firms have entered the scheme and are subsidized, firms from the Eastern part are more likely to receive subsidies for new projects. To capture additional industry specific effects dummy variables are included in the regressions indicating the sector to which a firm belongs to. The sectors are defined based on the technology-level (OECD, 2003). In addition, year dummies should control for temporal heterogeneity. Since the dependent variables refer to period t+1, all explanatory variables are lagged by one period except the measure for the subsidy supply. This reduces potential endogeneity problems.

To identify the determinants for the receipt of new DPF grants conditional on being subsidized in the preceding period basically the same variables are used as for the explaining of entering into the DPF scheme. In order to get further projects approved it can be assumed that firms had to prove themselves in previously DPF supported projects. However in this case variables indicating the success of former subsidized projects are not available and so cannot be taken into account. Instead firm variables are included in order to detect which characteristics these firms have. It is also possible that receiving DPF funding over a long time may have changed firm characteristics. Comparing the firms with new DPF grants in t+1 who do not receive subsidies in t, with the firms who received subsidies in t, it becomes apparent that in fact most explanatory variables differ.

Empirical Results

The results of the regressions are presented in Table 4.[16] The second column includes the vector of coefficients which explain the transition from the status non-participant at time t to the status participant at time t+1, i.e. entry into the DPF scheme.[17] The fourth column shows

[16] The results were obtained using the statistical software package STATA, version 10.1 MP. For the estimations of the rare events logit model, I used a program written by Michael Tomz, Gary King, and Langche Zeng, which is available at http://gking.harvard.edu (King and Zeng, 2001).

[17] By applying a conventional logit model the coefficients increase or decrease slightly and the standard errors are slightly larger. However the category of the significance level of the variables remains the same.

the coefficients which discriminate between firms that have a newly approved project in *t*+1 and those which do not, conditional on being subsidized in *t*. In columns three and five the respective marginal changes, calculated as first differences, are shown.

Table 4: Regression results

	Not subsidized → subsidized		Subsidized → newly subsidized	
	Rare events logit model		Logit model	
Variable	**Coefficient (Std. Err.)**	**FD**	**Coefficient (Std. Err.)**	**FD**
DPF history $_{t\text{-}4\rightarrow t}$	1.252 ***	0.0215	0.333 ***	0.0487
	(0.176)		(0.045)	
Ongoing $_{t+1}$			0.220	0.0352
			(0.201)	
Sub_EU $_{t\text{-}2\rightarrow t}$	0.509 **	0.0058	0.320 **	0.0555
	(0.234)		(0.151)	
Sub_regional $_{t\text{-}2\rightarrow t}$	0.570 ***	0.0066	0.107	0.0180
	(0.213)		(0.153)	
Sub_supply $_{t+1}$	0.054 ***	0.0002	0.041 **	0.0033
	(0.016)		(0.018)	
Ln(Employees)	0.544 ***	0.0000	0.217 ***	0.0015
	(0.054)		(0.060)	
Employees_change	0.345	0.0003	0.529 *	0.0089
	(0.253)		(0.283)	
Ln(Age)	-0.024	0.0005	-0.049	-0.0008
	(0.065)		(0.070)	
R&D_occ	0.945 **	0.0113		
	(0.373)			
R&D_con	1.276 ***	0.0125	0.511 *	0.0758
	(0.340)		(0.269)	
Qualification	1.165 ***	0.0011	0.760 ***	0.0129
	(0.275)		(0.286)	
Patent_stock_dev	0.005 *	0.0000	-0.000	-0.0000
	(0.003)		(0.003)	
Group_national	-0.439 **	-0.0038	-0.055	-0.0091
	(0.172)		(0.165)	
Group_foreign	-0.652 **	-0.0046	-0.417	-0.0632
	(0.264)		(0.263)	
East	0.109	0.0010	0.495 ***	0.0860
	(0.194)		(0.166)	
Constant	-8.193 ***		-4.285 ***	
	(0.452)		(0.445)	
No. of obs.	11,312		1,485	
Wald chi2 all	322.89 ***		141.88 ***	
Log-Likelihood			-698.760	
Mc Fadden's R2			0.142	

Note: *** (**,*) indicates significance level of 1% (5%, 10%); FD = First Difference. The first difference gives the discrete change in the expected value caused by increasing dummy variables from 0 to 1, *DPF history* from 0 to 1 (1 to 2) in first (second) regression, the mean of *Sub_supply*, *Employees, Age,* and *Patent_stock_dev* by 10 percent and the mean of *Employees_change* and *Qualification* by 10 percentage points, while holding the other explanatory variables at their means. Unless otherwise specified the variables refer to time *t*. Standard errors are clustered by firm because more than 50% of the firms appear more than once in the sample.

Subsidy-related variables

The results show that prior experience with the funding schemes (DPF history), measured as the number of approved projects within the last five years, helps firms to enter the program again when compared to firms who did not participate in the program before. The positive impact of experience on getting a new DPF grant is also found for firms which receive subsidies at time t. The relationship between experience and the predicted probability of getting a new project funded for subsidized firms in t is depicted by the lower right graph in Figure 3 in the appendix. Setting all other variables to their mean, the graph clearly reflects the positive correlation between the number of prior grants and the predicted propensity to get a new project approved. The large impact of firm's experience can also be seen by the high probability reached by this variable.[18]

The ongoing support in *t*+1 for a previously approved project (*Ongoing*) has no effect on getting a new DPF grant. Thus the possibility that a firm drops out of the scheme does not increase the likelihood of getting a new project granted. This also indicates that subsidies are not necessarily approved after another project has ended. Instead firms may have several subsidized projects at the same time.

Experience with other innovation programs has a significant effect on the probability of entering the program. The effect of having participated in an EU program (*Sub_EU*) is the same as the participation in regional programs (*Sub_regional*). However, for getting new subsidies approved once a firm is in the DPF scheme only successful applications to EU programs have a positive impact. Overall experience with the specific subsidy scheme greatly helps to place another successful application. Experience with other subsidy programs has a favourable effect in particular on entering the program.

Besides the experience with subsidy programs it is of course imperative that subsidies are offered to the particular industry in which a firm operates at the 'right' time (*Sub_supply*). This is particularly relevant to the DPF scheme which offers thematically focused R&D funding within predefined areas of technology. If the supply is large in the industry in *t*+1, the probability of entering the program and receiving new subsidies increases. Thus, in order to explain the allocation of new DPF grants it is important to control for the overall supply of subsidies by sectors and years.

Other variables

The objective of the government to subsidize particularly SMEs in this scheme cannot be confirmed. The probability of receiving a new DPF grant increases with firms' size for both non-subsidized and subsidized firms in t.[19] The upper graphs in Figure 3 in the appendix

[18] One might think that firms which conduct the subsidized projects in a co-operation with other firms or research institutions have a higher probability of getting new projects approved since the support of joint projects become more important. However by including a corresponding dummy variable in the regression, we see that this does not have a significant effect probably because 90% of all firms with subsidized projects in t are involved in joint projects.

[19] I also included the squared employee variable in the regression in order to control for a potential non-linear relationship. But the squared term was not significant in both regressions.

depict the predicted probability for the two transitions dependent on the number of employees, with all other variables set to their mean. The corresponding, predicted probability is fairly low in absolute terms and only reached 0.3 percent for firms with less than 1,000 employees. But it is not negligible since the program entry constitutes a rare event. While the graph shows that the predicted probability of entering the scheme increases for all firm sizes in this range, the corresponding graph for the probability for already subsidized firms of getting a new project approved only has a relatively steep slope for smaller firms. The graph becomes more flat with more than 200 employees. Overall the positive correlation between firm size and the propensity of getting a new project approved can be seen. The source of this divergence from the government's objective cannot be detected. Either SMEs do not apply more frequently for subsidies, the agency does not enforce this focus, or the focus is only set in very few programs within the DPF scheme so the effect does not show when all industries are taken into account. Bearing in mind that the sample covers the period 1994-2005 it is also possible that there was a shift towards SMEs over this period, however, that this was not revealed due to the pooling of cross-sections. Firms' age (*Age*) does not matter since it does not have a significant effect on either transition probability.

A firm's employment growth in the past (*Employees_change*) does not have an effect on the probability of entering the scheme but positively influences the likelihood of getting further subsidies. The growth might be seen as an indicator of the successful conduct of previously subsidized projects. All of these latter firms have received subsidies from DPF before.

As mentioned before, in order to enter the DPF scheme it is important that firms are engaged in R&D. It is not sufficient to have innovation activities – the sample is restricted to firms with positive innovation expenditures – but in addition firms should undertake their own R&D. The likelihood of entering the scheme increases if R&D activities are conducted. But it does not matter whether R&D is conducted continuously or occasionally since both effects are statistically equal. On average the probability increases by one percent if a firm conducts its own R&D. In those cases in which a firm receives subsidies from the DPF scheme in *t*, the firm conducts R&D at least occasionally. Discriminating between the two levels, it is shown that continuous R&D activities only slightly increase the likelihood of getting funding for a new project.[20] Furthermore, human capital is relevant (*Qualification*). When a firm has a larger share of graduated employees the probability of entering the program increases either because, for example, they apply more often, have better elaborated applications or are chosen more often by the agencies. The effect on the probability is larger for firms with higher shares of qualified employees as is displayed in the lower left graph in Figure 3. These capabilities still affect the probability of getting new DPF grants if the firm already participates in the scheme.

It is assumed that firms which already have a better technological performance – measured by firm's patent stock compared to the industry average (*Patent_stock_dev*) – might be picked by the program agencies because they are promising candidates. It turns out that the patent stock

[20] By including innovation intensity as an explanatory variable no significant effect on the probabilities was detected.

has a weakly positive effect on the probability of entering into the support scheme. No significant impact is found for firms who already participate in the scheme. I also ran a regression with the firms' patent stock not related to the industries average but the results remained the same.[21] Thus former success with R&D activities in terms of patent applications does not matter in this context.

Overall, differentiating between the two measures which either indicate that the firm is already technologically further developed than others (*Patent_stock_dev*) or that the firm is on a promising and successful path because it grows (*Employees_change*), none of the variables have a strong impact on getting a new grant. It seems to be sufficient that a firm shows that it has the overall capabilities to finish the suggested project successfully.

The affiliation to a domestic company group (*Group_national*) and whether the headquarters are located abroad (*Group_foreign*) negatively affect the allocation process if a firm enters the program. Once a firm is in the scheme the status of belonging to a company group has no further effect on getting new projects approved. For the probability of entering the funding scheme it does not matter where the firm is located (*East*), i.e. whether it is located in the Eastern or Western part of Germany. But if a firm from the Eastern part receives subsidies, it has a higher probability of getting further projects approved. This result is noteworthy since for East Germany a variety of other public support programs are available for firms in this area.

The industry classified according to the technology scope in which a firm operates does not have a significant effect on the transition probabilities. Performing a Wald test, joint significance of the industry dummies could not be found in any regression and are thus dropped from the presented regressions. Industry effects may only relate to the supply-side effects of program volumes offered to a certain sector. The year dummies were also not significant in the regressions and therefore left out. The overall low additional explanation power of these two sets of dummy variables may be due to the inclusion of the overall subsidy supply variable which is generated on a more detailed industry level and a yearly basis.

Sensitivity tests

In order to test the sensitivity of the results, I split the sample according to a firm's size or location and run the regressions for the sub-samples again (see Table 10 in the appendix). In order to conduct separate estimations depending on firm's size, I differentiate between small, medium and large firms. Firms with 50 employees or less are considered as small firms. Medium-sized firms have between 51 and 500 employees. Firms with more than 500 employees are deemed to be large firms. It becomes apparent that some factors differ with firm size regarding the entry into the subsidy scheme. In the group of small firms, young

[21] In one regression I included the patent stock variable but excluded the variable Qualification since it might be suspected that a potential effect of the patent stock is captured by the qualification variable, though the correlation between these two variables is low (-0.02 (-0.08) in the sample of not subsidized (subsidized) firms in t). Excluding the variable Qualification from the regression does not change the results.

firms are more likely to enter the scheme. Participating experience in other subsidy programs particularly helps medium-sized firms to get into the funding scheme. Large firms do not need to exhibit their knowledge capabilities. Neither the R&D activities nor the share of qualified employees or previous patents have an effect. I also split the sample into two sub groups, according to whether firms in the sample are located in the Western or Eastern part of Germany. Noticeable differences are that experience in other funding schemes increases the probability of entering the scheme only for Western firms. Also the negative effect of the membership in a group is only significant for firms located in Western Germany.

The analysis also shows that the results differ for the two transition probabilities, i.e. different variables have an effect on the receipt of a new subsidy, depending on whether the firm participated in the previous period. These differences indicate a different selection for the two groups, either on firms' application side or authorities' approving side, although there are no official rules to evaluate projects of already participating firms differently.

7 Conclusions

In this study the participation pattern of firms over time within the German R&D funding scheme, the DPF scheme, is analyzed. In order to investigate the persistence of funding it is necessary to distinguish between two types of persistence. One is simply due to the fact that funded projects may run for more than one calendar year. The other is due to newly approved projects. In the DPF scheme approved projects last on average for about three years. Therefore, I focus in particular on the allocation of new grants.

Looking at all firms who participate in the DPF scheme some dynamic is detected since about 40 percent of firms who get starting projects in a specific year participate for the first time. In a second step the DPF scheme is related to the population of firms by using a representative sample of German firms. Transition rates are calculated which describe the participation in a univariate context. The share of innovating firms who enter the funding scheme is extremely low. Over 98 percent of the firms who do not participate in the DPF scheme in a particular year do not receive DPF funding in the following year. Thus, the detected dynamic within the DPF scheme decreases if the new entrants are related to the population of potential entrants.

Considering firms who receive subsidies, 24 percent of these firms get new DPF grants in the following year and almost 60 percent of the firms remain subsidized due to previously approved projects. Thus, the subsidization level is rather persistent in the examined support scheme. Several reasons might be responsible for this finding. On the side of applying firms, it might be due to the existence of asymmetric information. Not yet subsidized firms may have information deficiencies regarding possible sources of funding. Subsidized firms might also have realized learning effects due to previous applications or participation in the scheme, with the result that they are selected more often. On the other hand the finding could also be due to the program agencies' selection rules and the result of a policy favoring a certain clientele. In this case the subsidy policy should be reconsidered. However, the continuous support of the same firms might also be simply the 'natural' result of a search by the

government to pick those projects which the firms would not have conducted without this grant. It cannot be distinguished whether the allocation pattern found is due to the application behavior of firms or because of the decision of the program agencies. I can only observe the net outcome: whether a firm is (newly) subsidized or not. It would definitely be a step forward if the corresponding data was available for this support scheme from the firm's first contact with the program agency onwards.

The multivariate analysis examines the factors which influence the receipt of new DPF grants conditional on whether the firms receive subsidies in the previous period. The results show that for the probability of getting new projects approved in the funding scheme, experience in the same scheme matters beyond the subsidy status in the preceding year. It is also shown that in an analysis of the allocation of new DPF grants it is important to control for the overall supply of corresponding subsidies. In addition, large firms are more successful in receiving funding for new projects. Thus the evidence cannot confirm that the scheme is achieving the government's aim of supporting SMEs in particular. The hypotheses that firms with higher knowledge capabilities are more likely to get new DPF grants applies in particular for not previously subsidized firms as I found positive impacts of the variables measuring firm's R&D capabilities. Thereby the achieved technological performance of a firm – measured by a firm's patent stock compared to the industry average – has the least significant impact. For already subsidized firms, human capital matters primarily. Recent firm growth only slightly increases the probability of receiving further grants in the following year if a firm participates. Thus, the most promising and best equipped firms participate more frequently in the DPF scheme which indicates a picking-the-winner strategy on the part of the program agency. Firms located in East Germany have a higher probability of renewing their subsidy status via new grants once they make it into the scheme. The disproportionate participation of East German firms is noticeable since a variety of other public support programs exist solely for this area.

The differences in the regressions results indicate a different selection for the two groups – new DPF entrants and new projects for DPF participants. As argued earlier, the source of the difference cannot be identified. Another shortcoming in the data used in this study is that no variables regarding the success of prior subsidized projects are known. This project-level information might have an impact on the decision to approve a further project.

This analysis looks at which firms receive new DPF grants and how this public support evolves over time by considering a firm's previous participation. It tries to assess whether the allocation corresponds to the government's announcements of whom they aim to reach with the DPF scheme. Thereby the receipt of the DPF grant is a binary variable, either a firm receives public money or not. But it would also be worthwhile to consider the amount of money in order to weight the participation and assess its importance. The causality between the subsidy allocation and the effects it induces is beyond the scope of this paper. But in a further step the effects of public funding should be investigated so that the allocation can be evaluated. In doing so it would be important to distinguish between the different types of participants, i.e. whether a firm is new or frequently in the scheme. The program effects might change if a firm is continually publicly funded so that they count on the money.

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Appendix

Table 5: Overview of empirical studies

Authors	Country	Data (sector; reference period; number of observations)	Estimation method[a]	Program	Significant variables[b]
Feldman and Kelley (2001)	USA	Mainly manufacturing[c]; 1998; 239	logit	Advanced Technology Program	+existing linkages to other businesses, +openness regarding results, +new partnerships in project, +new technical area in project, +maximum score on reviewers' rating of technical plan, +maximum score on reviewers' rating of business plan & economic potential[d]
Duguet (2004)	France	Manufacturing and service; 1985-1997; 16,776	logit[e]	no specific program; national R&D subsidies from all ministries	+past subsidy dummy, +past subsidy rate(ln), +size(ln sales), +private R&D/sales(ln), +debt/sales(ln)[f]
González et al. (2005)	Spain	Manufacturing; 1990-1999; 9,455 (2,214 firms)	probit (in second step: tobit for subsidy amount)	no specific program; regional, national, EU programs aggregated	+subsidy dummy lagged one and two periods, −abnormal subsidy dummy, +size (emp) lagged, +age, +technological sophistication, +capital growth, +domestic exporter dummy lagged, +foreign capital dummy
Tanayama (2007)	Finland	Manufacturing and knowledge intensive service; 2000-2002; 12,275	count data model (zero-inflated negative binomial) for no. of applications	Finnish Funding Agency for Technology and Innovation (Tekes)	binary and count process: +no. prior applications, -no. prior applications^2, +size(ln emp), +no. board members; only binary: +export dummy; only count: -age, +age^2, -sales/emp(ln), +sales/emp^2, +parent company
Busom (2000)	Spain	Manufacturing; 1988; 147	probit (used in Heckman's two step model for R&D effort)	no specific program; national or European programs separately	−size(emp), +age, −patents obtained over last 10 years, −foreign ownership[g]
Wallsten (2000)	USA	Manufacturing and service; 1990-1992; 481	3-Stage Least Squares; 1st (2nd) stage: Number Phase 1(2) Awards	SBIR, Phase 1 and Phase 2 awards	+SBIR budget, +prior patent applications
Czarnitzki and Fier (2002)	Germany	Service; 1994-1996 & 1996-1998; 1,084	probit[e]	no specific program; local, national, EU programs aggregated	+size(ln emp), +location in Eastern Germany, +continuous R&D, +share of emp. with univ. degree in business admin./economics etc., −districts population density
Almus and Czarnitzki (2003)	Eastern Germany	Manufacturing; 1992- 1994, 1994-1996, 1996- 1998; 925	probit[e]	no specific program; local, national, EU programs aggregated	+size(ln emp), +patentstock/emp., −foreign parent comp., +export
Aerts and Czarnitzki (2004)	Belgium	Manufacturing & service; 1998-2000; 776	probit[e]	no specific program; local, national, EU programs aggregated	+size(ln emp), +patentstock/emp., −foreign parent comp., +export
Blanes and Busom (2004)	Spain	Manufacturing; 1990- 1996; 15,186 (463 different subsidized firms)	multinomial logit (no R&D; R&D, no participation; R&D and participation), bivariate probit (national and regional program)[h]	no specific program; regional and national programs aggregated	+size(emp), +domestic; only nat.: +human capital; only reg.: −cash flow[i]
Czarnitzki, Ebersberger and Fier (2004)	Western Germany & Finland	Manufacturing & service; 1994-1996 & 1998-2000; DE: 1,464; FI: 1,520	multinomial probit (subsidization, collaboration, both)[e]	no specific program; local, national, EU programs aggregated	+size(ln emp), +share of R&D emp., +lagged patent application; only FI: +export
Czarnitzki and Licht (2006)	Germany	Manufacturing; 1992- 1994 & 1994-1996 & 1996-1998 & 1998-2000; 6,462 (3,409 R&D performing firms)	probit[e]	no specific program; local, national, EU programs aggregated	-no patent stock lagged, -foreign parent company, +export dummy; only Eastern: +size(ln emp), -size^2, -age(ln), +R&D department, -Western German group association; only Western: +patent stock lagged, +credit rating (ln)

Notes: [a] If not otherwise mentioned, the dependent variable is a dummy indicating participation in the subsidy program. [b] Significant at least on the 5%-level; + and − indicates positive and negative effects, respectively. emp = employees. Significant industry and time dummies are not listed. [c] Sectors are not explicitly mentioned. [d] Variables for first-time application to ATP and number of previous ATP awards are included but are not significant. [e] First step estimation within matching approach. [f] Separate estimations for each year (12 estimations). Variable is listed when it is significantly in the same direction for at least in ten out of the twelve years. [g] Results are for national programs since results for European programs must "be interpreted with caution" (Busom, 2000, p. 127). [h] Separate estimations for six industry groups and national and regional programs; results from the multinomial logit, variable is indicated as significant when it is significantly in the same direction for at least in three out of the six industries. [i] By applying a bivariate probit model the effect of this variable is different.

Table 6: Overview of industries

Industry sector		Service sector	
Branches of industry	**NACE**	**Branches of industry**	**NACE**
Manufacturing		Knowledge intensive services	
Textile.	17-19	Computer/telecomm.	72, 64.2
Wood/paper/printing	20-22	Technical services	73, 74.2-74.3
Chemicals	23-24	Consultancies	74.1, 74.4
Plastic/rubber	25		
Glass/ceramics	26		
Metals	27-28		
Machinery	29		
Electrical engineering	30-32		
Medical, precision, and optical	33		
Vehicles	34-35		
Furniture/recycling	36-37		

Table 7: Firms' observation pattern in the sample

No. of observations	Whole sample			Innovating firms[a]		
	No. of firms	Percent	No. of obs.	No. of firms	Percent	No. of obs.
1	2,939	42.8	2,939	2,450	46.9	2,450
2	1,265	18.4	2,530	1,038	19.9	2,076
3	856	12.5	2,568	636	12.2	1,908
4	524	7.6	2,096	385	7.4	1,540
5	326	4.8	1,630	210	4.0	1,050
6	274	4.0	1,644	177	3.4	1,062
7	226	3.3	15,82	127	2.4	889
8	155	2.3	1,240	78	1.5	624
9	111	1.6	999	55	1.1	495
10	85	1.2	850	26	0.5	260
11	61	0.9	671	25	0.5	275
12	43	0.6	516	14	0.3	168
Total	6,865	100.00	19,265	5,221	100.00	12,797

Note: [a] Innovating firms are firms with positive innovation expenditures in *t*.

Table 8: Transition rates for not subsidized firms in t, based on the sample

	Status in *t*+1			
Year	**No. of obs.**	**Not subs.**	**Subs.**	**Total**
1994	307	97.39	2.61	100.0
1995	500	97.80	2.20	100.0
1996	1,142	97.64	2.36	100.0
1997	666	99.40	0.60	100.0
1998	1,332	98.87	1.13	100.0
1999	765	97.65	2.35	100.0
2000	1,147	97.91	2.09	100.0
2001	647	97.53	2.47	100.0
2002	1,054	98.58	1.42	100.0
2003	724	98.48	1.52	100.0
2004	1,647	98.06	1.94	100.0
2005	1,381	98.77	1.23	100.0
Total	11,312	98.25	1.75	100.0

Table 9: Transition rates for subsidized firms in t, based on the population and on the sample

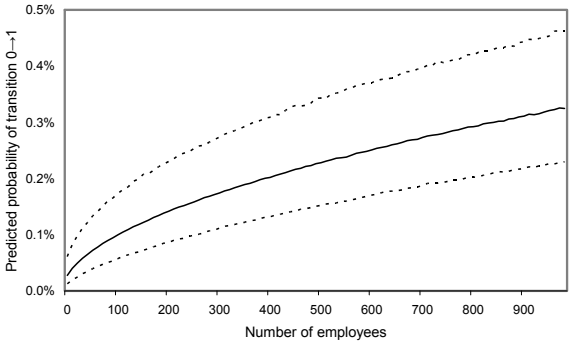
	Status in *t*+1							
	Population				Sample			
Year	**No. of obs.**	**Not subs.**	**Subs.**	**Total**	**No. of obs.**	**Not subs.**	**Subs.**	**Total**
1994	1,697	14.79	85.21	100.0	27	14.81	85.19	100.0
1995	1,875	27.04	72.96	100.0	35	31.43	68.57	100.0
1996	1,816	16.85	83.15	100.0	91	4.40	95.60	100.0
1997	2,011	16.16	83.84	100.0	66	13.64	86.36	100.0
1998	2,040	17.84	82.16	100.0	97	17.53	82.47	100.0
1999	2,235	20.76	79.24	100.0	62	20.97	79.03	100.0
2000	2,402	22.69	77.31	100.0	176	20.45	79.55	100.0
2001	2,756	9.98	90.02	100.0	83	6.02	93.98	100.0
2002	3,208	16.02	83.98	100.0	299	12.71	87.29	100.0
2003	3,101	25.51	74.49	100.0	172	20.93	79.07	100.0
2004	2,761	24.92	75.08	100.0	213	26.76	73.24	100.0
2005	2,730	18.50	81.50	100.0	164	16.46	83.54	100.0
Total	25,727	19.26	80.75	100.0	1,485	17.31	82.69	100.0

Notes: [a] The population is calculated from the PROFI database. Only firms which are subsidized in *t* are considered. Contract research is not included.

Figure 3: Predicted probability of transition

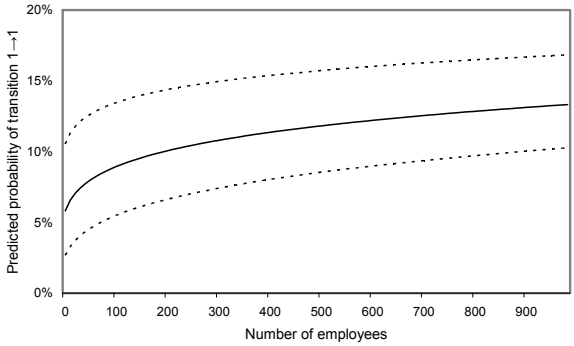
Transition:
not subsidized → subsidized (0 → 1)

Predicted probability
depending on the number of employees

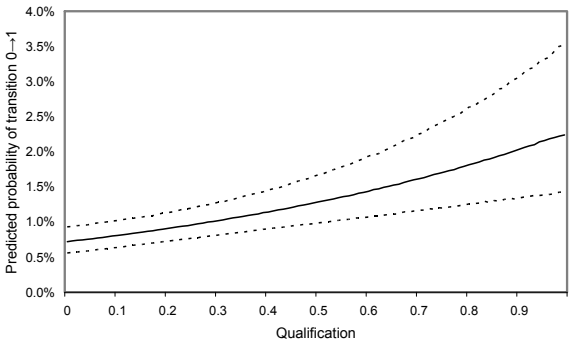


Transition:
subsidized → newly subsidized (1 → 1)

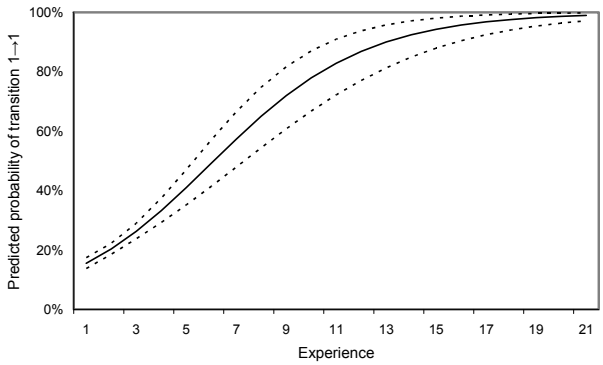
Predicted probability
depending on the number of employees



Predicted probability
depending on the qualification
(share of employees with a university degree)



Predicted probability
depending on the DPF history
(no. of approved projects in the last 5 years)



Solid line: predicted probability of transition depending on the specific variable, all other variables set to their mean.

Dotted lines: simulated 90% confidence interval for the predicted probability of transition, using 10,000 simulations.

Source: own calculations.

Table 10: Regression results for sub-samples (coefficients are shown)

	Not subsidized → subsidized Rare events logit model					Subsidized → newly subsidized Logit model				
	Firm size			Firm location		Firm size			Firm location	
Variable	**Small**	**Medium**	**Large**	**West**	**East**	**Small**	**Medium**	**Large**	**West**	**East**
DPF history $_{t\text{-}4\rightarrow t}$	1.476 ***	1.391 ***	0.935 ***	1.192 ***	1.295 ***	0.252 **	0.448 ***	0.260 ***	0.368 ***	0.319 ***
Ongoing $_{t+1}$						0.359	-0.035	0.364	0.012	0.512
Sub_EU $_{t\text{-}2\rightarrow t}$	0.548	0.564 *	0.495	0.542	0.449	0.533 **	0.019	0.498	0.343	0.429 *
Sub_regional $_{t\text{-}2\rightarrow t}$	0.552	0.887 ***	0.046	0.960 ***	0.173	0.196	0.063	0.360	0.240	0.064
Sub_supply $_{t+1}$	0.101 ***	0.032	0.093 ***	0.080 ***	0.025	0.036	0.011	0.117 **	0.056 **	0.006
Ln(Employees)	0.425	0.778 ***	0.293	0.578 ***	0.408 ***	0.345	0.416 **	0.642 ***	0.248 ***	0.185 **
Employees_change	0.590 *	0.431	0.055	0.341	0.589 *	0.431	0.619	1.333	0.214	1.191 *
Ln(Age)	-0.375 *	0.025	0.008	0.023	-0.190	-0.028	-0.025	0.060	-0.083	0.004
R&D_occ	1.118 *	0.692	0.388	0.613 *	1.088 *					
R&D_con	1.106 *	0.774 *	1.332	1.081 **	1.245 **	0.897 *	0.530	-0.418	0.476	0.422
Qualification	1.342 ***	1.751 ***	-0.002	1.419 ***	0.965 **	0.487	1.035 **	1.286	1.130 ***	0.501
Patent_stock_dev	0.244	0.020	0.005	0.005 *	0.043	0.046	-0.008	-0.002	-0.000	-0.009
Group_national	-0.439	-0.343	-0.293	-0.497 **	-0.128	0.175	-0.089	-0.358	-0.112	0.206
Group_foreign		-0.743 *	-0.428	-0.693 **	-0.225		-0.324	0.585	-0.654 *	0.064
East	-0.145	0.265	0.028			0.375	0.541 **	0.610		
Constant	-7.181 ***	-9.366 ***	-6.751 ***	-8.256 ***	-6.884 ***	-4.939 ***	-5.186 ***	-8.692 ***	-4.235 ***	-5.499 ***
No. of obs.	4,975	5,105	1,232	7,511	3,801	487	600	398	978	507
Transition rate	0.76	1.86	5.28	1.76	1.74	20.33	24.00	27.64	20.96	29.19
Wald chi2_all	102.47 ***	140.39 ***	57.28 ***	235.91 ***	103.89 ***	51.01 ***	81.38 ***	126.64 ***	120.58 ***	110.78 ***
Wald chi2_year			18.29 *	19.92 **				28.43 ***	25.01 ***	17.24 *
Wald chi2_industry								15.08 ***		
Mc Fadden's R2						0.115	0.166	0.243	0.168	0.149

Notes: [a] Small firms have 50 employees or less, medium-sized firms between 51 and 500 employees and large firms more than 500 employees. *** (**,*) indicates significance level of 1% (5%, 10%). In the regressions for small firms the foreign variable is excluded since no small firm which is foreign-owned gets a newly subsidized project. Unless otherwise specified, the variables refer to time *t*. Standard errors are clustered because almost 50% of the firms participate more than once. Year and industry dummies are included in the regressions if they are jointly significant.