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Abstract

This paper investigates the allocation of R&D subsidies given to start-ups. Considering the coexistence of various R&D project schemes, we take an aggregate view and analyze the determinants of the receipt of (any) R&D subsidies within the first three business years of the start-ups. We argue that policymakers and funding authorities follow a strategy of "picking the winner". Analyzing a unique data set of start-ups in the East German state of Thuringia, we conduct logistic regressions and find ambiguous support. R&D subsidies are given to start-ups with innovative business ideas, especially academic spin-offs. On the other hand, the ambitions and the patent stock of the founder(s) do not decide the receipt of R&D subsidies. These insights into the overall allocation of R&D subsidies are important since they have implications for policy effectiveness and efficiency. The implied difficulties of policy targeting fundamentally question the massive subsidization of private R&D.

Key words: Start-ups; R&D subsidies; Subsidy allocation

JEL classification: O38; L26; L52

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1. Introduction

Policy measures which aim to foster innovative activity in young and/or small firms have become increasingly popular among policymakers. Screening relevant policy programs delivers a great variety of different schemes on the regional, national and European level[1]. This points to a major issue in policy making: the targeting of programs. Targeting is defined as designing policy programs with respect to certain target groups. Looking at both regional and national support schemes that are targeted at private research and development (R&D), Blanes and Busom (2004) find that funding authorities pursue different allocation rules.

The allocation of subsidies has important implications for policy effectiveness and efficiency. First, the distinguishing characteristics of subsidized and non-subsidized ventures have to be identified to estimate the effectiveness of R&D subsidies. Otherwise, better (worse) performance of subsidized projects might be attributable to different pre-treatment characteristics. Second, the targeting of policy measures also decides the extent and the manner of crowding out effects. Subsidies give recipients an artificial competitive edge. Therefore, they have the potential to keep inefficient recipients alive and/or to induce a crowding out of non-subsidized firms. In order to minimize these distortions, subsidies should be targeted at truly “good” firms (Shane, 2009).

Previous studies analyzing subsidy allocation schemes mainly focus on one single program (e.g., Aschoff, 2008). Given the coexistence of various programs, we take an aggregate view on the allocation of R&D subsidies. Does this variety of programs with different target groups translate into systematic differences between subsidized and non-subsidized start-ups and their founders? Or does the variety of programs conceal that there is actually no overall policy focus?

These questions are addressed by this paper’s focus on the allocation of R&D subsidies to start-ups in the East German state of Thuringia. Our representative sample allows us to take an aggregate view of the allocation of R&D subsidies and thus enables us to make generalizations from single programs which often change their designs over time. In order to get unbiased results only those subsidized and non-subsidized start-ups which are engaged in R&D are examined. Our analysis is structured as follows. Section 2 describes the economic rationale for the targeting of R&D subsidies. Assuming a strategy of “picking the winner”, hypotheses regarding the characteristics of subsidized firms are derived. We use data from the Thuringian Founder Study which is introduced in section 4. The determinants of the receipt of

[1] An overview about currently available programs gives the online database http://www.foerderdatenbank.de/, administered by the German government.

R&D subsidies are examined with the help of a logistic regression (section 5). Section 6 discusses the results and section 7 concludes.

2. Targeting of R&D Subsidies: Economic Rationales and Policy Implementation

This section begins with the rationale for the targeting of R&D subsidies and follows up with how policy targeting can be implemented in praxis.

Economic rationales

The rationale for R&D policy programs is found in the presumed existence of neoclassical market failures (Arrow, 1962; Hall, 2002). Conversely, system failures, as discussed in neo-Schumpeterian approaches, are held responsible for an insufficient amount of innovative activity, also justifying certain policy measures (Chaminade and Edquist, 2005; Lundvall et al., 2002).

Referring to the somewhat traditional market failure approach, positive external effects resulting from innovative activity provide a first rationale for public policy intervention. A second rationale for policy intervention stems from capital market imperfections: mainly due to uninsurable risk and information asymmetries R&D projects are not likely to receive the same funding conditions as normal investment and not all R&D projects are likely to attract adequate funds from private sources.

If entrepreneurs cannot completely appropriate the returns from innovative activity and/or cannot raise the funds for R&D investments at reasonable costs, they invest in R&D at a socially suboptimal level. This implies that firms either do not invest in R&D at all or conduct projects at a smaller scale. Then, subsidies reduce the costs and uncertainty of private R&D activity and thereby aim to induce firms to undertake R&D that would otherwise be unprofitable (Wallsten, 2000). The framework for most evaluations is captured by the concept of additionality which focuses on additional R&D activity that should be stimulated by public R&D funds (Luukkonen, 2000).

Based on that reasoning, those projects should be funded, which yield high social returns (i.e. returns above the risk-adjusted opportunity costs of capital) but would not be started in the absence of subsidies, because the private returns are not expected to exceed the risk-adjusted opportunity costs of capital (Stiglitz and Wallsten, 2000). The funding of inframarginal projects should be avoided because they are expected to be privately profitable and therefore are pursued anyway. In this case, the subsidization would just form a transfer payment (without any additionality) and would not have any allocative effect – thus constituting windfall gains.

However, the identification of the private and social returns of an R&D project requires detailed information about highly uncertain outcomes. Policymakers and program officials have to quantify private and social returns ex-ante, a monumental if not unsolvable task considering the uncertainty of R&D activities as well as the difficulties to identify and quantify diffuse spillovers (Stiglitz and Wallsten, 2000).

Another line of reasoning considers cooperative or collective innovative activities being superior to those activities performed in isolation (Edquist, 2001). Such a systemic view claims that due to the division of labor, cooperative R&D projects with other companies, customers or researchers are more promising. Systemic failures in the sense that innovators do not actively search for a cooperation partner (problem of intermediation) or are afraid of a partner's non-reciprocal behavior in knowledge exchange (problem of reciprocity) may serve an anchoring point for policy intervention. Subsidies for cooperative R&D projects would encourage the search for appropriate partners and/or dampen (or compensate for) any fear of non-reciprocity (Eickelpasch and Fritsch, 2005). Hence, R&D co-operations should be more liable to be subsidized. Here the focus is quite clearly on those marginal projects which do not get activated because of system failures.

Equivalent to the problems raised by identifying private and social outcomes of R&D projects are the challenges of identifying and quantifying systemic failures. Again, considering the uncertainty involved in R&D projects as well as measuring the exchange of knowledge spillovers, this task is not easily, if at all, being performed in praxis.

Policy implementation and "picking the winner strategy"

Facing these information problems, we argue that the actual targeting of R&D support schemes does not focus on identifying malfunctions in markets or systems or on finding marginal projects, but rather follows a strategy of "picking the winner". When first looking at established firms, evidence for a policy focus on the most promising and best-equipped firms has been found for a large German R&D project funding scheme (Aschhoff, 2008). Policymakers and program officials focus on ventures that promise to favorably contribute to employment growth and structural change.

There are four additional arguments in favor of a policy approach of "picking the winner". First, the focus of R&D funds to these presumably truly "good" firms intends to minimize substitution effects, i.e. the crowding out of non-subsidized competitors. Subsidies give beneficiaries an artificial competitive edge and in this way equalize ex-ante less efficient and more efficient firms. If only truly good firms receive subsidies (crowding out less efficient firms at any rate), the resulting market distortions will be minimal (Shane, 2009)[2]. Second, the strategy of picking likely winners may direct funds to particular future technologies, e.g. biotechnology (Fier and Heneric, 2005). Third, R&D activity is inherently risky (Arrow, 1962). As a result from this stochastic effect, the subsidization of R&D projects will ineluctably include failures. Public choice theory suggests that a strong political commitment is required to justify the subsidization of failed projects. Therefore, policymakers and funding authorities are induced to pick winners, i.e. to focus on projects with a high probability of success rather than funding projects with higher expected returns but a lower probability of success (Stiglitz and Wallsten, 2000). Finally, the certification of "good" projects to potential private investors might be a side-effect of a selective policy approach. Lerner (1999) argues that public funds certify the quality of their recipients and thereby attract private investors.

The suggested identification of good firms seems to be a task which can be performed rather easily in the case of already existing firms – just look at their performance in the past. However, when newly founded firms are on the policy agenda this does not work – except in the case of serial entrepreneurship. A look at a more general pattern of successful entrepreneurship is applicable here. Entrepreneurship research has identified various determinants of new venture success and thus provides guidelines for a strategy of "picking the winner" (Shane, 2009). Policymakers and funding authorities should allocate public R&D funds according to the following pre-treatment characteristics:

- *Novelty of the business idea*: The innovativeness of a start-up can be regarded as a key determinant of positive external effects, since innovative ventures commercialize knowledge and thereby contribute to diversity, increase competition, and foster economic growth (Fritsch, 2008). This is reflected by their relatively higher contribution to structural change in the long-run (Baptista and Preto, 2006). In particular, academic spin-offs which are often headed by faculty or research staff of the originating research institution provide an effective means to apply scientific research to commercial ends (Roberts, 1991; Shane, 2004).
- *Ambitions at the beginning of the first business year*: Small business managers' aspirations to expand their business activities are positively related to actual growth (Wiklund and Shepherd, 2003). Similarly, Autio (2005) finds disproportional employment

[2] However, there are still distortions arising from raising taxpayer's money to finance the subsidy as well as deadweight losses arising from screening applicants.

effects for high-expectation entrepreneurs[3]. Although these highly ambitious entrepreneurs represent only 3% to 17% of all entrepreneurs (depending on the country), they account for up to 80% of total expected jobs by all entrepreneurial activity (Autio, 2005).

- *Resource strength of the founding project*: The accumulation of knowledge as captured by founders' previous patents shows the resource-strength and the potential to innovate (Fier and Heneric, 2005; Czarnitzki et al., 2007). Additionally, the resource base of a start-up as proxied by the number of founders (single versus team start-ups) (Kamm et al., 1990; Lechler, 2001) and the size of initial capital is positively related to various performance measures (Van Praag et al., 2005).

However, a potential emphasis on probable winners might be diluted by information asymmetries and distorted incentives of policymakers, funding authorities, and applicants (Public Choice considerations). First, applicants have much better information about their projects and expectantly present their project to increase the chances of approval (adverse selection). Second, rather than pursuing the public interest, the allocation of R&D subsidies might also follow specific interests in the policy process (Hart, 2003; Stiglitz and Wallsten, 2000). The potential to focus public funds on particular industries might trigger rent-seeking activities which might be an explanation for an ongoing focus of policymakers on the manufacturing sector (Czarnitzki and Fier, 2001). In sum, information asymmetries as well as a Public Choice perspective suggest that a policy targeting of "picking the winner" might be blurred.

4. Data

4.1 Sample

The Thuringian Founder Study

Data for this study were collected within the Thuringian Founder Study (*Thüringer Gründer Studie*), an interdisciplinary project on the success and failure of innovative start-ups in the East German state of Thuringia. The database draws from the commercial register for commercial and private companies (Handelsregister, Abteilung A/B) in Thuringia and includes 2,971 start-ups in innovative industries registered between 1994 and 2006. Innovative industries, according to ZEW classification (Grupp and Legler, 2000), comprise 'advanced technology' and 'technology-oriented services'.

[3] Autio (2005) defines high-expectation entrepreneurs as those nascent entrepreneurs who aim to employ at least 20 employees within five years' time.

The survey population consists of 4,215 founders (first registered owner-managers) who registered a new entry in the Handelsregister between 1994 and 2006. This design made it possible not only to interview founders of active companies but also founders of ventures that have failed since inception. We selected a random sample from the survey population so 3,671 founders of start-ups were contacted. Due to team start-ups this corresponds to 2,604 new ventures in innovative industries. Between January and October 2008, we conducted 639 face-to-face interviews with solo entrepreneurs or with one member of a start-up team (a response rate of about 25%). The 76 start-ups that turned out not to be genuinely new (e.g., they were a new branch or new business area of an existing company) were removed. A further 13 interviews had to be deleted due to concerns over interview quality. In order to exclude any effects of the German reunification, only start-ups with a first business year later than 1993 were considered[4]. This reduced the number of valid interviews to 450.

The structured interviews were personally conducted by the members of the research project. We were supported by student research assistants, after being trained in various sessions in December 2007. On average, an interview took one and a half hours. The interviews covered a broad set of questions regarding socio-demographic and psychological data of the founder. Moreover, we asked for founder's activities along the founding process. Economic data focused on the time before the first business year and the first three business years. Retrospective data relating to events in founder's life and to the business history were collected using a modified version of the Life-History-Calendar (Belli et al., 2004, Caspi et al., 1996), which increases the validity of retrospective data.[5]

The sample of investigation

From the data of the Thuringian Founder Study, the majority of venture set ups in the sample (61.2%) reported having conducted R&D within the first three business years. Due to missing values for single variables and the exclusion of one outlier[6] we arrive at 243 R&D performing start-ups which constitute the sample of investigation in this paper. Public funds in support of R&D were given to 106 firms (43.6% of all R&D performing start-ups).

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[4] We defined the first business year as the time when accounting started either because of obligations from the commercial register or because of first revenues. This does not necessarily correspond to the date of registration in the Handelsregister.

[5] The Life-History-Calendar is a method developed by psychologists and sociologists and is based on the principles of the autobiographic memory. This means that – in a first step – we asked interviewees about the timing of well-known events (e.g. marriage, birth of children). In a second step, these events served as anchors for less well represented events (e.g. first interest in entrepreneurship).

[6] We have to discard one outlier which has a patent stock of 148 patents, almost the triple amount of the start-up with the second highest patent stock.

Additional data

For the data on the patent stock, we accessed the database of the German patent information system (DEPATIS) provided by the German Patent and Trade Mark Office. For each interviewed start-up, we looked for patent applications where the founder(s) and/or partner(s) were named as inventors. We then calculated the sum of patent applications within the last five years before the first business year. Double counts resulting from co-patenting were eliminated.

4.2 Variables

The dependent variable *R&D Subsidy* describes the take-up of R&D subsidies within the first three business years. The dummy variable is coded 1 if the respective start-up received R&D subsidies and 0 otherwise. Table 1 shows the independent variables, their definitions and hypothesized directions:

Novelty **(+)**	The *novelty of the business idea* refers to the scope of the newness of the business idea. Possible answers were no novelty (0), regional or local (1), supra-regional but national (2), European (3) or global novelty (4).
Academic Spin-off **(+)**	*Academic spin-offs* were coded as a dummy variable with 1 denoting start-ups where the business idea evolved from previous employment at a university or research institute (academic spin-off) and with 0 otherwise.
Goals **(+)**	Four items build up the variable *goals* at the beginning of the first business year. Interviewees were given four contradictory pairs with a 5 level scale in-between. They had to classify their goals at the beginning of the first business year given the following pairs: working entirely cost-covering vs. to realize much profit (1); to earn one's living vs. to become rich (2); to be a small provider vs. to become market leader (3): to generate constant revenues vs. to generate constantly rising revenues (4). The mean of these answers was build for each observation.
Team **(+)**	*Team* start-ups were defined as new ventures where more than one person was actively involved in the founding process and was intended to become an owner of the company. We code a dummy variable with 0 in the case of a single founder, and with 1 in the case of a team start-up.
Patent stock **(+)**	The *patent stock* is the sum of patent applications of founders and partners within the last five years before venture set-up.
Initial Capital **(+)**	The *amount of initial capital* at the beginning of the first business year was asked for with the help of the following table: 1,000 EUR or less (1), more than 1,000 to 10,000 EUR (2), more than 10,000 to 50,000 EUR (3), more than 50,000 to 100,000 EUR (4), more than 100,000 to 250,000 EUR (5), more than 250,000 to 500,000 EUR (6), more than 500,000 EUR (7).
Cooperative R&D	If R&D was performed in co-operation with others within the first three business years, this dummy variable is coded as 1, otherwise 0.
Year 1994-1997 Year 1998-2001 Year 2002-2006	Dummy variables that capture the time of business start, i.e. the first business year of the company when accounting started either because of obligations from the commercial register or because of first revenues.
 Nace 2………:::::.... Nace 3………:::::.... Nace 7……:::::…… Nace x……:::::……	Industry-dummies (NACE, 1 digit): Chemical industry, metalworking industry, engineering Electrical engineering, fine mechanics and optics Information and Communication Technology, R&D, Services Miscellaneous
Product	The value for the dummy variable *Product* is 1 if the start-up offered a product in the first three business years and the value is 0 in the case of service companies.

Table 1: Definition and hypothesized direction of independent variables.

Descriptive statistics of each variable and the correlation matrix can be found in table 2.

	M	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) **R&D Subsidy**	0.436	0.497	-															
(2) **Novelty**	1.794	1.688	0.279 ***	-														
(3) **Academic Spin-off**	0.173	0.379	0.256 ***	0.294 ***	-													
(4) **Goals**	3.221	0.907	0.110 *	0.311 ***	0.058	-												
(5) **Team**	0.691	0.463	0.157 **	0.095	0.258 ***	0.059	-											
(6) **Patent Stock**	1.407	4.555	0.165 **	0.322 ***	0.231 ***	0.153 **	0.086	-										
(7) **Initial Capital**	3.420	1.389	0.105	0.143 **	0.047	0.125 *	0.084	0.149 **	-									
(8) **Cooperative R&D**	0.473	0.500	0.346 ***	0.243 ***	0.221 ***	0.026	0.116 *	0.199 ***	0.059	-								
(9) **Year 1994-1997**	0.391	0.489	0.027	-0.081	-0.188 ***	-0.118 *	-0.085	-0.013	-0.065	0.051	-							
(10) **Year 1998-2001**	0.337	0.474	0.092	-0.042	0.226 ***	0.024	0.062	0.098	0.038	0.021	-0.572 ***	-						
(11) **Year 2002-2006**	0.272	0.446	-0.127 **	0.134 **	-0.034	0.104	0.027	-0.090	0.031	-0.079	-0.489 ***	-0.436 ***	-					
(12) **Nace 2**	0.263	0.441	0.039	-0.095	-0.150 **	0.048	0.015	0.065	0.160 **	0.107 *	0.134 **	-0.091	0.050	-				
(13) **Nace 3**	0.272	0.446	0.097	0.245 ***	0.088	0.134 **	0.027	0.157 **	0.086	0.181 ***	0.099	0.014	-0.123 *	-0.365 ***	-			
(14) **Nace 7**	0.374	0.485	-0.063	-0.050	0.119 *	-0.109 *	0.002	-0.116 *	-0.257 ***	-0.171 ***	-0.184 ***	0.077	0.120 *	-0.463 ***	-0.473***	-		
(15) **Nace x**	0.091	0.288	-0.104	-0.150 **	-0.106 *	-0.098	-0.069	-0.148 **	0.055	-0.155 **	-0.047	-0.013	0.065	-0.189 ***	-0.193 ***	-0.244 ***	-	
(16) **Product**	0.337	0.474	0.197 ***	0.196 ***	-0.050	0.126 **	0.025	0.118 *	0.260 ***	0.143 **	0.053	-0.068	0.014	0.186 ***	0.327 ***	-0.408 ***	-0.104	-

Note: * p<0.1; ** p<0.05; *** p<0.01; N=243

Table 2: Descriptive statistics and intercorrelations

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Novelty	0.290 *** (0.093)	0.279 *** (0.096)	0.292 *** (0.093)	0.305 *** (0.094)	0.283 *** (0.093)	0.255 *** (0.096)
Academic Spin-off	1.220 *** (0.416)	1.222 *** (0.416)	1.079 ** (0.427)	1.285 *** (0.425)	1.220 *** (0.417)	0.985 ** (0.435)
Goals		0.068 (0.165)				
Team			0.482 (0.326)			
Patent Stock				-0.033 (0.033)		
Initial Capital					0.088 (0.109)	
Cooperative R&D						1.169 *** (0.305)
Year 1994-1997	0.818 ** (0.376)	0.836 ** (0.379)	0.878 ** (0.382)	0.796 ** (0.378)	0.833 ** (0.378)	0.756 * (0.387)
Year 1998-2001	0.851 ** (0.387)	0.853 ** (0.387)	0.882 ** (0.391)	0.847 ** (0.387)	0.851 ** (0.387)	0.833 ** (0.396)
Nace 2	0.343 (0.576)	0.329 (0.577)	0.312 (0.582)	0.378 (0.579)	0.331 (0.577)	0.018 (0.605)
Nace 3	0.008 (0.596)	-0.007 (0.596)	-0.006 (0.600)	0.041 (0.597)	0.015 (0.597)	-0.327 (0.630)
Nace 7	0.170 (0.559)	0.175 (0.559)	0.172 (0.565)	0.180 (0.560)	0.214 (0.563)	0.115 (0.583)
Product	0.825 ** (0.335)	0.825 ** (0.335)	0.829 ** (0.337)	0.831 ** (0.336)	0.774 ** (0.341)	0.848 ** (0.347)
Constant	-2.053 *** (0.575)	-2.256 *** (0.759)	-2.399 *** (0.636)	-2.061 *** (0.575)	-2.345 *** (0.683)	-2.296 *** (0.601)
N	243	243	243	243	243	243
LR chi2	42.478	42.648	44.706	43.438	43.131	57.479
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000
Mc Fadden´s R²	0.128	0.128	0.134	0.130	0.130	0.173
Cox-Snell R²	0.160	0.161	0.168	0.164	0.163	0.211
Nagelkerke R²	0.215	0.216	0.225	0.219	0.218	0.282

5. Results

The results of logistic regressions are displayed in table 3. We run six different models which contain the same set of controls and the same two core independent variables *Novelty* and *Academic Spin-off*, but differ with respect to the other independent variables. In all six models we control for the period the new venture was founded, whether the start-up offered a service or a product, and for the industry. The time dummies are always significant, indicating a decline in the R&D related subsidization of start-ups since 2002. Furthermore, the significantly positive dummy variable *Product* points to a lower likelihood of service companies to receive R&D subsidies.[7] The industry dummies never show a significant coefficient, indicating that there are no sectors having been more likely to receive a R&D subsidy.

Looking at all six models, the novelty of the business idea (*Novelty*) as well as the dummy variable *Academic Spin-off* turn out to have both a positive impact on the probability of receiving R&D subsidies. Their impact is significant at the 5% and 1% level throughout. As their coefficients change only slightly between the six models, we consider this a confirmation of the robustness of our results. Our results thus indicate that R&D programs allocate funds in favor of start-ups with more innovative/novel ideas and of academic spin-offs. The focus on more innovative start-ups is likely to be driven by the expectation that they show a comparatively higher competitiveness and in consequence success. Having generated a global novelty instead of a local novelty makes a start-up less vulnerable to competitors. This, however, may be also an argument for expected higher private returns and accordingly less need to be subsidized. Therefore, we find an indication for a “picking the winner strategy”.

The case of a higher funding probability of academic spin-offs could be interpreted in the same way since basic new insights there show a high degree of novelty. Additionally, one has to take into account that supporting academic spin-offs ranks high on the policy agenda devoted to generating more economic value out of basic research in academia (Shane, 2004). However, by arguing that the step to found a new venture is much more difficult to do for a scientist in academia compared to someone having gained business experience elsewhere already, academic spin-offs can be interpreted as marginal projects – they would not come into existence without appropriate subsidization and an interpretation as a “picking the winner strategy” would not apply.

[7] This focus of policymakers and economic research on the manufacturing sector has been also pointed out by Czarnitzki and Fier (2001).

Starting with model 1 as the base model, the previously described variables only, we add the independent variable *Goal* in model 2. The variable turns out to be insignificant, indicating no impact of the founders' ambitions on the probability of being subsidized. This implies that the allocation of funds does not follow the expectations and goals of the applying entrepreneurs but looks for more hard facts. Those hard facts could be seen in the resource strength of the founding project, our third criterion. Models 3, 4 and 5 test the impact of the start-ups' resource strength as denoted by the variables *Team*, *Patent Stock* or *Initial Capital*. None of the characteristics of being a *Team* start-up, the extent of the *Patent Stock*, or the amount of *Initial Capital* exerts a significant impact on the probability of receiving R&D subsidies. Furthermore, likelihood-ratio tests[8] do not indicate any higher explanatory power of the extended models 2 to 4 in comparison with the base model (model 1). This again does not sustain our "picking the winner" hypothesis. However, the resource strength of the founding project will be partly captured by the variable *Academic Spin-off*, since academic spin-offs are mainly launched by highly qualified teams and feature a high patent stock (Shane, 2004).

In a last step, the variable *Cooperative R&D* is added (model 6). This variable has a highly significant positive impact on the probability of receiving R&D subsidies. A likelihood-ratio-test reveals that model 6 has a significant higher explanatory power than the base model. A founding project's access to external resources, as indicated by its engagement in cooperative R&D, goes along with a higher probability to receive R&D support. This can be interpreted on the one hand in terms of expecting a higher probability of success, sustaining our hypothesis. On the other hand, it would not be sustained if firm founding based on collaborative R&D indicated comparatively higher returns. If collaborative R&D was essential for a new venture, but not pursued without a subsidy, the project was merely marginal; again not validating our "picking the winner" hypothesis but rather suggesting subsidies' potential to build winners. However, the variable *Cooperative R&D* might be subject to interdependencies with the dependent variable. A considerable number of R&D support programs target cooperative R&D. Hence, cooperative R&D might be a result of the subsidy scheme, because the program criteria encourage potential applicants to engage in R&D co-operations.

[8] Likelihood-ratio tests are not reported here, but can be obtained from the authors.

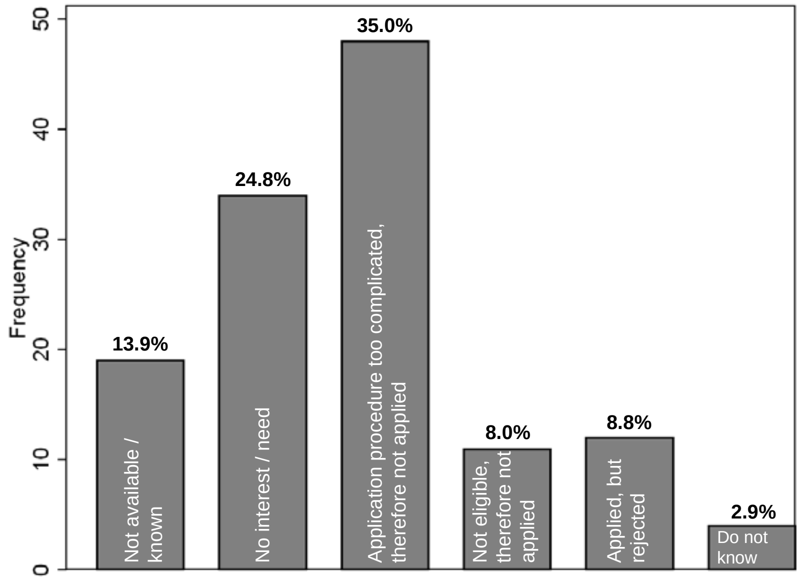
6. Discussion

When interpreting our ambiguous support for a policy strategy of "picking the winner" we, have to start by analyzing by whom the selectivity is exerted and then what this selectivity implies for policy effectiveness.

Sources of selectivity

Interpreting the positively significant coefficients of collaborative R&D, of academic spin-offs, and of start-ups selling products versus services, one has to be aware that several R&D programs exclusively focus on those criteria and consequently fund only respective projects. Since our sample contains enough new ventures not satisfying one or all of these criteria that do not receive policy support, the coefficients of collaborative R&D, of academic spin-offs, and of start-ups selling products absolutely must show up significantly positive. Hence, our positive coefficient covers two conceptually different cases of selectivity, the first being that the bias is imposed prior to announcing the tender and a second instance where the bias shows up during the selection of projects by the committees. Since both mechanisms are exerted by policymakers and/or program officials, they are interchangeably termed as administrative (Storey, 2000), agency (Wallsten, 2000) or committee selection (Storey, 2003). More tendentiously, Bassi (1984) speaks of "cream-skimming" by program administrators. However, we cannot verify whether there are well-defined allocation rules behind particular programs, because we lack data on the basis of individual funding schemes.

Moreover, not only do policymakers and program officials select beneficiaries of R&D support programs but also founders and their start-ups might self-select into the programs (Storey, 2000). Since subsidization reduces the costs of R&D, we assume that everybody would apply whose expected benefits from the R&D subsidy exceed the costs of applying. Figure 1 shows the answers of non-subsidized founders regarding the reasons why they did not make use of subsidies. The first two categories, "not available/known" and "no interest/need" (representing 38.7% of non-subsidized founders), can be subsumed as self selection of founders and might be explained by founders' (self-perceived) costs of applying for public R&D funds (e.g. time and effort spent on getting informed about funding schemes and application procedures). The other categories can be more or less regarded as committee selection. The highest fraction of non-subsidized founders (35.0%) reported that overly complicated application procedures prevented them from applying. This category, to some extent, blurs with the fourth category ("not eligible, therefore not applied") which both characterize different stages of dropping out along the information and application process. The applications of 8.8% of non-subsidized founders had been rejected, indicating clear-cut committee selection. The reasons for non-subsidization might be biased, because we only asked founders of non-subsidized start-ups, who still conducted R&D. However, we do not have data about start-ups which applied unsuccessfully and, therefore, did not conduct R&D at all – the marginal projects.



Note: The percentages do not add up to 100% due to refusals; N=137.
Fig. 1: Reasons for non-subsidization

Policy effectiveness and efficiency

The analyzed allocation of R&D subsidies does not assert whether they could effectively promote additional R&D activity. Even if there was a clear focus on "picking the winner", this approach does not promise to be the most effective and efficient. Although a selective subsidization of likely winners might minimize substitution effects, it runs the risk of enormous windfall gains: Likely winners will probably not only yield high social returns but also high private returns, rendering public policy intervention obsolete (Santarelli and Vivarelli, 2007). Furthermore, selective policy approaches coincide with deadweight losses resulting from screening and selecting procedures of eligible applicants (Parker, 2007). However, the subsidy allocation process can also mobilize co-operative innovative activity and enable learning effects for policymakers when it is organized as a contest of initiatives for self-organized co-operation in R&D (Eickelpasch and Fritsch, 2005).

The differences between subsidized and non-subsidized firms analyzed in this article constitute a selection bias. This selection bias is taken into account when matching procedures are applied to evaluate policy effectiveness[9]. These methods then facilitate causal analyses on the effectiveness and efficiency of support schemes which consider performance indicators like revenue, employment and survival. However, these effectiveness analyses focus primarily on private returns. They neglect the original rationale of the subsidization of private R&D, i.e. positive external effects. Realizing positive external effects effectively and efficiently requires the identification of projects that are privately unprofitable but socially beneficial, the very starting point of this paper. Policy strategies like “picking the winner” are simply approaches to circumvent the monumental information requirements.

7. Conclusions

This paper has drawn on new survey evidence to verify whether R&D subsidies are allocated according to a “picking the winner” approach. We argued that policymakers and program officials pursue a “picking the winner” strategy to circumvent fundamental information problems in identifying projects which yield high social returns but low private returns and thus would not be realized (to the full extent) in the absence of subsidies. As hypothesized, we find that a high degree of novelty and being an academic spin-off increases the likelihood of receiving R&D subsidies. However, other ex-ante indicators of likely winners like founder’s prior ambitions, being a team start-up, previous patent experience and the amount of initial capital do not increase the likelihood of receiving R&D subsidies.

These ambiguous results point to difficulties in precise policy targeting which, in turn, fundamentally question the massive subsidization of private R&D[10]. Widespread subsidization lacks exclusivity and thus does not allow for the certification of good projects (as suggested by Lerner (1999)). Moreover, it absorbs the demand for R&D funds and, therefore, runs the risk of hampering the development of a market for private R&D funding.

Our analysis is based on aggregate data on the receipt of R&D subsidies, i.e. we lack information on the take-up of particular schemes and we do not have information on the amount of the subsidy. Therefore, we necessarily mix up selectivity *within* and *between* single policy schemes and cannot distinguish whether selectivity is exerted by any differential extent of subsidization. Although these data limitations are a clear shortcoming of this study, the

[9] Examining the same data set with propensity score matching in a companion paper (Cantner and Kösters, 2009), we find a high impact of R&D subsidies on start-up’s employment growth and patent output within the first three business years.

[10] Additional R&D funds of 6bn Euro between 2006 and 2009 have been announced by the promotional initiative “High-Tech Strategy for Germany” (BMBF, 2006). Fostering R&D and technology-oriented start-ups is a stated aim of this initiative. The high public subsidization can be also seen in our sample: 43.6% of all R&D performing start-ups receive public R&D funds.

overall subsidy allocation should still be consistent with the pursuit of enabling R&D activity which would not be carried out in the absence of subsidies. Our aggregate data on public R&D funding thus offers unique insights into the overall subsidy allocation for a random sample. Nevertheless, it is the dispersed and continuously changing subsidy environment that impedes more precise policy insights.

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