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DO R&D SUBSIDIES AFFECT SMES' ACCESS TO EXTERNAL FINANCING?

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ABSTRACT

Many countries spend sizeable sums of public money on R&D grants to alleviate debt and equity gaps for small firms' innovation projects. In making such awards, knowledgeable government officials may certify firms to private financiers. This paper investigates whether government subsidies to R&D enhance SMEs' access to external financing due to this certification effect. Using a unique Belgian dataset of 1107 approved requests and a control group of 501 denied requests for a specific type of R&D grant, we examine the impact on small firms' external equity, short term and long term debt financing. We find that obtaining a R&D subsidy provides a positive signal about SME quality and results in better access to long-term debt.

JEL classification codes: G32 - Financing Policy; Financial Risk and Risk Management; Capital and Ownership Structure; H25 - Business Taxes and Subsidies; O38 - Technological Change; Research and Development: Government Policy

Keywords: R&D subsidies, government policy, SMEs, financial constraints, certification hypothesis, behavioural additionality

1. INTRODUCTION

Does government policy affect the rate and direction of technological evolution by SMEs? Most governments appear to think so and deploy a wide variety of instruments to foster innovation, including subsidies to R&D. These R&D grants alleviate small firms' tendency to underinvest in innovative activities. However, on top of a direct effect they may also generate a certification effect, thereby enhancing a firm's access to external finance and relaxing any potential financial constraints. For instance, Lerner (1999) found evidence that obtaining R&D grants positively impacts a firm's chances of attracting venture capital. In this paper, we examine whether government subsidies to R&D improves SMEs' access to external finance in general.

It is commonly held that small enterprises may face extensive financing constraints. Both banks and venture capitalists - the traditional private financiers for small firms - are repeatedly unwilling to provide financing, while access to public capital markets is regularly unavailable. Informational asymmetries and high levels of uncertainty are frequently advanced to explain small firm disadvantages in attracting financing (Berger and Udell, 1998).

Any concerns over asymmetric information and elevated risks are likely to be aggravated when funding applications are based upon an intended R&D investment. Volatile and intangible returns, information problems and funding providers' inability to adequately assess innovative projects cause SMEs to have poor access to capital for innovation (Carpenter and Petersen, 2002a; Freel, 2007). Moreover, the innovation assets purchased often cannot serve as collateral, thereby further exacerbating banks' perceptions of risk. As a result, one would anticipate that SMEs would be more likely to be credit-constrained for their R&D projects (Himmelberg and Petersen, 1994). Empirical research indeed reports that a great fraction of small firms refers to access to finance as a significant obstacle to innovation (Hoffman et al., 1998). Credit rationing is found to occur with respect to technology intensive firms specifically (Arrow, 1962; Westhead and Storey, 1997) and small innovative firms more generally (Freel, 1999).

A strict dependence on a market system will therefore lead to an underinvestment in innovation, relative to what is socially desirable, and would potentially hinder SMEs in exploiting their full growth potential.

Financial constraints have real impact: for example, capital market imperfections negatively affect the number of entrepreneurial start-ups and their economic viability (Bates, 1990; Holtz-Eakin et al., 1994). In the face of finance constraints for innovative projects, firms may reject or scale down the innovation project (Feldman and Kelley, 2006), thereby hampering growth in employment, sales, exports and economic welfare. Hyytinen and Toivanen (2005) provide evidence that capital market imperfections hold back SMEs' innovation and growth.

In order to resolve this market failure, many countries spend considerable sums of public money to alleviate debt and equity gaps for small firms' innovation projects. A wide range of policy schemes, such as tax shields, direct loans, interest subsidies, loan guarantees and R&D grants has been implemented (Cressy, 1996; European Commission, 2003). In theory, one would expect government grants to bring along positive effects, or 'additionality'. This may include input (e.g., increase in R&D efforts) or output additionality (e.g., increase in growth/employment/number of patents). A third category involves behavioural additionality.

Obtaining a grant may induce changes in an SME's behaviour, or may change the behaviour of other firms or institutions towards the SME. For example, by granting subsidies, knowledgeable government officials may certify firms and confer a halo effect to private investors or banks. Consequently, R&D grants address the information asymmetries that might have otherwise precluded providing financing. This information signal may be particularly strong for small firms that would otherwise have difficulty attracting the attention of potential investors (Feldman and Kelley, 2006). Studying 1 435 SBIR awardees and a matched sample, Lerner (1999) finds that R&D grants provide a positive signal about SME quality that facilitates attracting venture capital. Feldman and Kelley (2006) completed 240 interviews with firms that applied to the 1998 US Advanced Technology Program at the National Institute of Standards and Technology. They analyze whether receiving a grant increased the company's funding from other sources: private venture capital, state economic development, public venture capital programs, and other funding sources which included strategic alliances with other companies as well as other federal government R&D programs. A positive relationship is found.

In this paper, we examine whether obtaining an R&D grant facilitates SMEs' subsequent access to external financing as a consequence of this certification effect. For a unique Belgian sample of 1 107 approved requests for a specific type of R&D grant, we investigate if any positive effects on future debt or equity financing can be detected. As

Lach (2002) points out, in evaluating the effect of an R&D subsidy we need to know what the subsidized firm would have attracted in external financing had it not received the subsidy. This counterfactual information, however, is not available. We estimate the missing expected counterfactual by using a control group of 501 applications for the same subsidy that were denied. As such, in contrast to much of the research on the effect of R&D subsidies, our study reduces selection and endogeneity bias that arises since applying for an R&D grant is not a random process (Blanes and Busom, 2004; David et al., 2000; Feldman and Kelley, 2006; Klette et al., 2000).

We find strong evidence that receiving subsidies increases the likelihood that firms will raise long term debt. For short term debt, we find a smaller effect. For external equity finance, the positive effect is only found for a subsample of start-up SMEs. The certification effect of R&D grants is stronger when informational asymmetries are higher. Our results are robust to a series of alternative explanations implying that government subsidies, on top of a direct effect, generate a significant certifying effect to private financiers. It may be worthwhile for governments to consider this behavioural additionality when establishing their R&D grant policies.

Even though academics and policy makers have made considerable effort to understand and evaluate the funding environment confronting small would-be innovators, the effect of R&D grants on small firms' ability to raise external financing has attracted virtually no scrutiny. To the best of our knowledge, only Lerner (1999) and Feldman and Kelley (2006) investigate this issue. Our work adds to the literature since we examine the impact of receiving an R&D grant on both equity and debt financing, using a large sample and a unique control group of denied requests. In addition, no prior research has looked into the effect of obtaining government R&D subsidies on the firm's access to debt financing. Yet, debt markets have traditionally supplied a much larger proportion of external finance than equity markets (Esty and Megginson, 2003). Banks are the dominant external funding providers in most economies across the world (Qian and Strahan, 2007).

Belgium, like many other Continental European countries, has a bank-centered capital market, making it a well suited country of analysis.

It should be noted that the evaluation of public R&D funding is a recent important question in the literature, both on political and economic grounds. First, subsidies are a major instrument of government expenditure policy (Blanes and Busom, 2004). Second, subsidies affect the allocation of resources, income distribution and expenditure productivity, and may have an impact on sectoral and structural adjustment (IMF, 1995).

The remainder of the paper is structured as follows. Section 2 presents a brief literature review and develops our hypotheses. Section 3 provides a description of the method and sample used. The results of our study are presented in Section 4. The paper ends with a discussion of the findings and potential avenues for future research.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The standard economic rationale for the underinvestment in R&D activity is due to two types of market failure: spillovers or imperfect appropriability conditions of innovations, and financing gaps induced by asymmetric information (see David et al., 2000, and Hall, 2002, for an excellent survey on both topics).

As argued in the seminal papers of Nelson (1959) and Arrow (1962), the public-good nature and incomplete appropriability of inventive activity means that private returns will be lower than social returns. These spillovers may take several forms: innovations may for instance benefit rivals who quickly launch imitations, or consumers of the new products. Empirical support on spillovers is widespread (Grilliches, 1992, 1998; Hall, 1996; Jaffe, 1996). Consequently, due to the difficulties that firms encounter in appropriating all the benefits associated with an innovation, R&D investment is likely to be below the social optimal level (Hall, 2002; Lerner, 1999). Public policy theory calls for government intervention to compensate for the gap between the private and social returns to innovative activities so as to guarantee the socially optimal supply of R&D efforts by the private sector (Czarnitzki and Kraft, 2004; Wallsten, 2000).

Further, it is frequently shown that R&D investments are financially constrained due to informational asymmetries.

In business surveys companies repeatedly allude to the lack of external finance as a major obstacle to their investment and innovation activities (Harhoff and Körting, 1998). Financing constraints occur for various types of firms or projects in general, and for innovative projects in specific (Arrow, 1962; Carpenter and Petersen, 2002b; Himmelberg and Petersen, 1994; Kamien and Schwartz, 1978; Spence, 1979). For R&D, the innovator commonly has superior information about the nature and economic potential of the project than prospective financiers. As a result, the lemon's premium for R&D will be particularly high because investors have more difficulty distinguishing good projects from bad (Akerlof, 1970; Leland and Pyle, 1977). In summary, informational asymmetries may make raising debt or equity for R&D very expensive or even preclude it completely (Greenwald et al., 1984; Myers and Majluf, 1984). Thus, a second rationale for public subsidies lies in the fact that they may convey information to other potential financiers.

These problems are particularly important for small businesses. A number of studies (Jewkes et al., 1958; Mansfield et al., 1977) suggest that spillover problems are worse among smaller firms, which are regularly incapable of defending successfully their intangible assets or extracting most of the rents in the product market. Next, several empirical papers report evidence that financing constraints have a greater impact on small firms' investment (Berger and Udell, 1998; Carpenter and Petersen, 2002b; Hall, 1992). This is partly due to the fact that agency and asymmetric information problems are generally more pronounced for small firms (Ennew and Binks, 1995). The focus of this work is on financial-market reasons for underinvestment in R&D that persist even in the absence of externality-induced underinvestment.

Government intervention could alleviate underinvestment by small firms in innovative activities. Investment in R&D below the optimal level is extremely costly, firstly in itself, and secondly because innovations generate substantial external effects on technological change, economic welfare and employment (Storey and Tether, 1998a). Technological development is acknowledged to be one of the main determinants of economic growth. Nowadays, almost all OECD countries offer some sort of grants or subsidy schemes to stimulate private R&D activity (Storey and Tether, 1998b). Nevertheless, even though market failure is widely accepted as a feature of R&D, it is a priori not clear whether public support will meet its objective.

Ideally, government subsidization of R&D should invoke additionality effects (Görg and Strobl, 2005). A large academic literature has evaluated the success of many government R&D policies.

Klette et al. (2000) and David et al. (2000) surveyed the literature dealing with public R&D subsidies and input additionality. Macro-economic studies usually identify a complementary relationship between public and private R&D expenditure, whereas studies on the firm level are not able to confirm this effect (Czarnitski and Fier, 2001). Another part of the literature has assessed the effectiveness of various financial assistance schemes by taking different output measures into account, including the impact on technology use (Wallsten, 2000), productivity and efficiency (Bergström, 2000; Harrison and Robinson, 2001), survival probabilities (Jarmin, 1999) and employment performance (Girma et al., 2003). As noted by Girma et al. (2003), the evidence is mixed. Subsidies are often ineffective and costly due to crowding out effects and since government involvement may be distorted by the desire of interest groups or politicians to maximize their own utility (IMF, 1995).

However, government support may also result in behavioural additionality (Buisseret et al., 1995); it may change an SME's behaviour, or it may affect the behaviour of others towards the SME. Actions related to governmental agencies, like approving new products, granting patents or awarding subsidies, may serve as an information signal to other investors (Narayanan et al., 2000). Lerner (1999) finds for a sample of US firms that obtaining SBIR grants provides a positive signal about the SME's quality which facilitates raising venture capital. In granting an award, knowledgeable government officials may certify firms to private investors and deal with the information problems that might have otherwise prohibited attracting financing. Specifically, a government agency with a reputation for elevated standards and scientific integrity that judges a risky R&D project to be worthy of a pecuniary investment certifies that the technology has merit. Furthermore, when the agency's assessment is linked to the commercialization potential, private investors may consider the award winning project as more valuable than other high risk research projects (Feldman and Kelley, 2006). Thus, government funding may confer a halo effect, enhancing the firm's chances of attracting external debt and equity financing.

Feldman and Kelley (2006) indeed find that receipt of R&D grants increases the funding from other sources. The main research question we address in this study, therefore, is whether government subsidies increase a firm's access to external equity and debt financing through a process of certification.

Numerous papers have illustrated the existence and importance of certification effects in various areas of corporate finance. In the context of IPOs, hiring a reputable accounting firm (Beatty, 1989; Titman and Trueman, 1986), a prestigious underwriter (Booth and Smith, 1986; Carter and Manaster, 1990) and having VC backing (Barry et al., 1990; Megginson and Weiss, 1991) or a reputable alliance partner (Stuart et al., 1999) all serve as strong signals that the firm going public is of high quality. James (1987) and Lummer and McConnell (1989) provide evidence of certification generated by bank loan announcements and renewals; other examples include credit ratings (Boot et al., 2006; Sufi, 2007), relationship banks (Bharath et al., 2007) and the percentage lead arrangers hold in loan syndication (Dahiya et al., 2003; Dennis and Mullineaux, 2000; Gatti et al., 2007).

The arguments presented above lead to the following hypothesis.

Hypothesis 1: Receiving government R&D subsidies increases SMEs' access to external financing through a process of certification.

Furthermore, the impact of receiving a subsidy may differ between debt and equity. Pecking order theories (Myers and Majluf, 1984) clearly illustrate that the role of information asymmetry is most significant for equity, which will result in a considerable lemon's premium when issuing equity to new, outside shareholders. Therefore, one might expect that the impact of certification is strongest for attracting equity. Lerner (1999) and Feldman and Kelley (2006) indeed find that R&D grants provide a positive signal about SME quality that facilitates attracting a particular source of new equity, namely venture capital.

Hypothesis 2a: The positive impact of the certification effect generated by receiving an R&D subsidy is stronger for equity financing than for debt financing.

On the other hand, it is well established that venture capitalists, as specialized financial intermediaries, are experts in information collection and processing, and thus may mitigate the substantial information problems surrounding SMEs' innovative projects (Gompers and Lerner, 1999). For banks, reducing information asymmetry is much harder and judging SMEs' high tech investments might be challenging as it requires a profound understanding of how the firm and its markets operate. As a result, the assessment of future cash flows of R&D projects is often unfeasible (Binks and Ennew, 1996). High tech SMEs typically complain with banks of their limited competency in correctly evaluating their business potential and about the resulting excessive amount of warranties required. Smaller firms suffer most from these problems (Giudici and Paleari, 2000; Storey and Tether, 1998a). These elements would predict a stronger positive signalling effect of the grant receipt for debt financing.

Hypothesis 2b: The positive impact of the certification effect generated by receiving an R&D subsidy is stronger for debt financing than for equity financing.

Finally, we expect a differential effect depending on the maturity of the debt provided. From the perspective of a bank, offering long term debt is more risky. Banks, therefore, will only consider granting long-term debt when they have favourable information about the lender.

Diamond (1991, 1993) argues that short-term financing makes it more difficult for borrowers to defraud creditors as it limits the period during which firms can exploit their creditors without defaulting. A series of short-term loans permits bankers to retain greater control because of the option to stop rolling over the short term loans. Creditors can review the firm's decisions more regularly and adapt the loan terms before sufficient losses have accumulated to make default by the borrower optimal. Thus, short term debt acts as a disciplining device.

The threat of liquidation and the continuous scrutiny of the firm may lead to a greater level of efficiency and a reduction in wasteful activities by managers (Jensen, 1986; Rajan, 1992). Moreover, long term debt results in greater distortions in managers' risk preferences than does short term debt. When investment is financed through debt, this creates an incentive problem as the project's profits need to be split between shareholders and debtholders. Shareholders may underinvest and pass up valuable projects if they do

not capture enough of the return. Short term debt can mitigate this conflict of interest (Myers, 1977).

Consequently, we put forward the following hypothesis.

Hypothesis 3: The positive impact of the certification effect generated by receiving an R&D subsidy is stronger for long term debt financing than for short term debt financing.

3. DATA, METHODS AND RESULTS

3.1 Data

3.1.1 Empirical Setting: IWT-Flanders' SME Innovation Program

The empirical evidence of this paper is based on a database containing detailed data of subsidies granted by the Institute for the Promotion of Innovation by Science and Technology in Flanders[1] (IWT-Flanders). IWT-Flanders was established in 1991 by the Flemish government as a regional public institution to provide R&D and innovation support in Flanders. IWT has several financial tools and an annual budget of €262 million (in 2006) available to support projects.

[1] Flanders is the Dutch speaking part of Belgium and the largest region of the country.

In addition to direct funding, a variety of services is provided to the local industry in the field of technology transfer, partner search, information about international subsidy programs, etc. IWT also has an important co-ordination mission, aiming at a strong co-operation between all organizations in Flanders offering technological innovation services to companies.

IWT-Flanders has various programs aimed at providing financial support for research and development in the private sector. Although SMEs may have opportunities to attract R&D grants from other government related institutions as well, IWT-Flanders is by far the most important provider of this type of subsidies in Belgium. In this study, we examine the impact of IWT-Flanders' SME innovation program on SMEs' access to external financing sources. This program targets all SMEs established in Flanders who want to prepare an innovation initiative that can generate economic added value. In 2004, 240 projects received funding within this program for a total of €13.43 million. There exist two types of subsidies within this SME program: innovation studies and innovation projects. The main goal of an innovation study is to increase knowledge in the area of a technical/scientific problem or idea. The duration of these studies is between 3 and 12 months. Companies can apply for funding for 6 different types of innovation studies. The main goal of an innovation project is to develop technological knowledge and to implement it, for example, by building a prototype. This should result in new or improved products, processes and services. The duration of a project is between 6 and 24 months. IWT-Flanders uses different criteria to evaluate applications for subsidies. The first criterion is the extent of technological innovation and knowledge acquisition and the quality of the execution. The second criterion is the commercialization potential and the economic value added for Flanders. A third criterion is the financial viability of the firm requesting a subsidy. In general, the subsidy will cover a certain percentage of the eligible costs. On average, the support rate is 50%. The maximum subsidy is €250 000.

We obtained a unique dataset from IWT-Flanders on subsidies requested and subsidies granted within the SME innovation program over the period 1995-2004. In total, 1 608 projects were submitted by 1 185 different companies (see Table 1).

It is clear from this table that the number of subsidies increased substantially from 2001 onwards, while the approval rate declined somewhat. Overall, almost 70% of the requests were approved. The number of subsidies for innovation studies and innovation projects is equally distributed even though there is some variation from year to year. In evaluating the effect of an R&D subsidy, it is important to know what the subsidized firm would have attracted in external financing had it not received the subsidy (Lach, 2002). In the analyses, therefore, we also include those firms that submitted a request for a subsidy but were subsequently declined.

Insert Table 1 About Here

For each firm that requested a subsidy we collected financial statement data for a period of maximum 10 years through Belfirst, a commercial database provided by Bureau Van Dijk. Belfirst contains financial statement data of *all* public and private Belgian companies. All Belgian companies (with limited liability of the shareholders), irrespective of their size, have to file detailed financial statement data with the National Bank of Belgium. Both companies starting up within the time frame of this study and firms disappearing from the database, because they failed or were taken over, are included. Therefore, there is no survivorship bias in our study. By combining the IWT dataset with the financial accounts provided by Belfirst, our final sample contains data for 6 822 firm years.

3.1.2 Variables

Dependent variables. In this study, the dependent variables indicate whether a firm uses a specific type of financing in a given year. We distinguish between external equity financing and short term and long term financial debt. Firms are coded as using short term financial debt if there is a net increase of outstanding financial debt with a maturity of less than or equal to one year which exceeds 5% of total assets (*short term debt*).

This 5% cut-off point is consistent with previous studies and guarantees that the focus of the analyses is on relatively substantial financing events (de Haan and Hinloopen, 2003; Hovakimian et al., 2001; Marsh, 1982; Van Acker et al, 2008).[2] Similarly, firms are coded as using long term financial debt if there is a net increase of outstanding financial debt with a maturity of more than one year which exceeds 5% of total assets (*long term debt*). Firms are coded as raising external equity financing when there is a net increase in external equity of at least 5% of total assets (*external equity*). Equity can be raised either from existing or new shareholders.

Independent variables. Our first independent variable indicates whether a firm received a subsidy in a certain year (*subsidy_received*). As the effect of receiving a subsidy on attracting financing may only materialize in the year after the subsidy was received, this variable is coded 1 both in the year the subsidy was received and the year after the subsidy was received.[3] Otherwise this variable is coded 0. Our second independent variable indicates whether a firm has applied for a subsidy but was declined funding (*subsidy_rejected*). Again, this variable takes on the value 1 in the year the subsidy was requested and subsequently declined and the year after.

Control variables. We include a wide set of control variables. These variables are lagged one year in order to avoid problems of reverse causality. Where appropriate, our control variables are scaled by total assets for standardization. Furthermore, variables are calculated using book values. First of all, we control for the need of external finance by measuring the amount of internal finance available within the firm. Following the pecking order theory, managers prefer to fund new investment with internally generated funds rather than debt, but prefer debt to external equity financing (Donaldson, 1961; Myers and Majluf, 1984). As proxies for the amount of internal finance we use the amount of liquid assets, the dividend ratio and the cash flow ratio (De Haan and Hinloopen, 2003). The amount of liquid assets is measured by the total amount of liquid assets as a percentage of total assets (*liquidity*). Dividends are measured by dividing the total amount of dividends by total assets (*dividend ratio*).

The higher this ratio, the less financing will be available internally. Cash flow generation is proxied by dividing EBITDA by total assets (*cash flow ratio*). The higher

[2] We tested the effect of using different cut-off points for each type of financing event in order to check the robustness of the results. The results were similar when using a cut-off point in the range of 3% to 10%.
[3] We also tested the effect of receiving a subsidy on attracting financing two years and three years after the subsidy was granted. Our results were never significant however.

this variable, the more cash will be available internally and the less likely firms will have to attract outside funding. We also control for firm solvency by including the firm's financial debt to total assets ratio (*leverage*). Following the traditional static trade-off theory, the higher the leverage, the less likely firms will be able to attract additional debt financing as the potential costs of bankruptcy will increase (Harris and Raviv, 1991). Furthermore, we control for potential agency problems between inside managers and outside investors. Agency costs are particularly prevalent in a setting characterized by considerable growth options. Firms generally engage in research and development to generate growth options (Titman and Wessels, 1988). Consequently, we use the ratio of intangible to total assets (*intangible assets*) as a proxy for agency costs. Further, we include the ratio of tangible to total assets (*tangible assets*) as firms with more tangible assets can more easily provide collateral in order to attract debt financing (Hovakimian et al., 2001). In order to control for size, we include the natural logarithm of a firm's total assets (*firm size*). Larger firms can more easily attract outside funding as there will be less informational asymmetry for outside investors. Further, their cash flows are less volatile and, therefore, the probability and expected costs of bankruptcy will be lower (Hovakimian et al., 2001). Lastly, we include year dummies to control for time effects. As we employ fixed effects in the analyses, we control for time independent unobserved heterogeneity at the firm level. Section 3.2.4 will introduce some additional control variables that we use in our robustness checks.

3.1.3 Descriptives

Table 2 provides an overview of the number of financing events in each year. These figures clearly illustrate that long-term debt is the most popular funding source followed by short term debt financing. External equity finance is less popular as a financing source. This is in line with previous research that has shown that firms follow a pecking order when looking for funding (Myers, 1984; Myers and Majluf, 1984). The percentage of firms making use of a certain financing source is relatively stable over the different years.

Insert Table 2 About Here

Table 3 provides descriptive statistics of the independent and control variables used in the analyses. On average, 7.6% of the firms included in the sample received a subsidy in a given year. Further, on average 3.7% of the firms requested a subsidy in a given year that was subsequently rejected.

The mean size of a subsidy is slightly more than €50 000, whereas the median subsidy equals €30 000. Average firm total assets are about €3 million. The financial ratios indicate that most firms generate internal finance through their ongoing activities. For example, the average cash flow ratio amounts to 12%. Mean leverage is quite high and equals almost 70%. Intangible assets make up only a small percentage of the total amount of assets in the average firm.

Insert Table 3 About Here

3.2 Results

3.2.1 Hypothesis Testing Procedure

Since the dependent variable is a binary outcome and we have longitudinal data, we employ a conditional fixed effect logit panel model to analyze the effect of receiving a subsidy on attracting financing. A fixed effects model makes it possible to control for all the unobservable characteristics of the firm that are stable over time. The general model testing our hypothesis takes the following form:

$$\text{Financing event}_t = f(\text{subsidy\_received}_{t/t-1}, \text{subsidy\_rejected}_{t/t-1}, \text{control variables}_{t-1}) \quad (1)$$

In each regression we lose a number of observations since the dependent variable does not always vary within a firm. For example, some firms never raised external equity and therefore drop out of the equation. The number of observations thus fluctuates among the different regressions. Table 4 indicates that most independent and control variables are not strongly correlated with each other.

All correlations between the variables used in the regressions are below 0.60. VIFs were found not to exceed 2, well within the acceptable guideline of 10 (Cohen et al., 2003).

Insert Table 4 About Here

3.2.2 The Impact of Subsidies on Funding Decisions

The main results are reported in Table 5. All the models are statistically significant. The dependent variable in each of the models is a binary variable equal to one if the firm attracted a specific type of financing in that particular year, and otherwise equal to zero.

Model 1 is a baseline model that includes the effect of our control variables on attracting long term debt. Most of the control variables have the expected sign. Surprisingly, a higher amount of tangible assets results in a lower probability of using long term debt financing. In model 2, the effect of subsidies is introduced. The positive coefficient for receiving a subsidy suggests that firms who are granted a subsidy are more likely to attract long term debt. The economic effect is considerable: receiving a subsidy increases the probability of receiving long term debt by 32%.

Model 3 analyzes the effect of our control variables on receiving short term financial debt. In model 4, we add the effect of receiving subsidies. The coefficient of receiving a subsidy is marginally significant. This indicates that obtaining a subsidy may enhance a firm's ability to attract short-term debt. Receiving a subsidy increases the likelihood of attracting short term debt by 21%.

Model 5 examines the effect of our control variables on obtaining external equity. In model 6, the effect of applying for and receiving a subsidy is included. None of these variables is significantly related to the use of external equity as a funding source. At first sight, this result seems to contrast with Lerner (1999) who finds a positive impact of receiving a grant on a firm’s ability to attract venture capital, and would tend to support Hypothesis 2b.

However, in our sample external equity is typically attracted from the current shareholders, who are insiders not subject to information problems. Therefore, it is straightforward that we find a stronger impact of the certification effect generated by receiving an R&D subsidy for (outsider) debt financing than for (insider) equity financing. Unfortunately, our data do not allow us to fine tune our analysis by explicitly distinguishing between equity attracted from existing or new shareholders. Thus, we observe the relationship predicted in Hypothesis 2b, but the underlying motivation would be different: equity providers are usually insiders whereas banks are outsiders to the firm. Given our dataset, we cannot tell whether the certification effect differs between equity or debt provided by outsiders.

It should also be noted that all models in Table 5 indicate that the coefficient of applying for but not receiving a R&D subsidy is never significant. This can be explained since this negative signal may not be revealed by the firm.

To summarize Table 5, receiving subsidies increases the likelihood that firms will raise long term and short term debt. Both effects are economically significant but the impact on long term debt financing is more substantial. There is no effect of getting subsidies on raising external equity finance.

Insert Table 5 About Here

3.2.3 Information Asymmetry and the Impact of Subsidies on Funding Decisions

Berger and Udell (1998) and Carpenter and Petersen (2002a) argue that information problems are frequently more important for small and young companies, and for high tech businesses. The signal that receiving a subsidy communicates to external financiers is likely to have a greater impact when there is more asymmetric information and uncertainty regarding the quality of the underlying firm.

Therefore, we include an interaction term between receiving a subsidy and whether or not the firm is a start-up company i.e. a firm younger than two years, which is the case for 8.3% of the firms in our sample.[4] Start-up companies have no track record yet and hence there will be more uncertainty regarding their quality. Further, the likelihood of attracting outside funding will depend on the strength of the signal. The impact of receiving a subsidy for an innovation project is likely to be higher than that of an innovation study. After all, an innovation study does not automatically lead to the development of a new product or service whereas innovation projects need to result in something more material such as a prototype. Moreover, projects run for a longer period of time and involve higher amounts. The strength of the signal of receiving a subsidy for an innovation project is therefore likely to be higher than that of an innovation study.

In Table 6 we examine these issues by introducing an interaction effect between receiving a subsidy and a dummy indicating whether the firm is a start-up or not, and between receiving a subsidy and a dummy reflecting the type of subsidy. In model 1 we look at the effect of the interaction variables on receiving long term financial debt. The interaction term between the starter dummy and receiving a subsidy is not significant. The interaction variable between type of subsidy and receiving a subsidy has the expected sign and is significant. This indicates that innovation projects are more likely to lead to long term debt increases. In model 2, in which we look at the effect of subsidies on attracting short term debt, none of the interaction terms is significant even though they have the expected sign. In model 3, the dependent variable indicates whether a firm was able to attract external equity finance. The positive coefficient for the interaction term between the starter dummy and receiving a subsidy suggests that the effect of receiving a subsidy on attracting external equity finance is stronger for start-up firms in line with the signalling hypothesis. The effect is marginally significant.

To summarize Table 6, we find evidence that the impact of receiving a subsidy on attracting outside funding is more important for start-up firms which are characterized by higher levels of informational asymmetry and for innovation project subsidies which provide a stronger signal.

[4] We also used a cut-off point of three years. The results are qualitatively similar.

Our finding that the positive impact of receiving an R&D grant is stronger for firms that are more likely to suffer from information problems provides additional support for the certification hypothesis.

Insert Table 6 About Here

3.2.4 Testing the Robustness of the Certification Hypothesis

In order to test the robustness of our results, we extend our analysis with a number of additional control variables.

One alternative argument why firms are more likely to attract external funding when they receive a subsidy is because their balance sheet is strengthened (Lerner, 1999). After all, a subsidy increases the solvency position of a firm. Subsidies, therefore, provide a buffer function and hence attracting outside funding might be facilitated. Following this alternative explanation, the larger the size of the subsidy, the more likely firms will be able to attract outside funding. By contrast, the certification hypothesis suggests that there may not be a positive relationship between the amount of subsidies and the likelihood of raising external funding (Lerner, 1999). In order to test this alternative explanation, we include the relative size of the subsidy, calculated by dividing the subsidy amount by total assets in the year the grant was received (*relative size subsidy)*, in the regression analyses. The mean value of this variable equals 4.44%. Table 7 reports that none of the interaction terms is significant, therefore lending support to the certification hypothesis. Note, however, that the effect of receiving a subsidy on attracting short term debt is still positive but no longer significant.

Insert Table 7 About Here

Further, receiving a subsidy automatically creates a funding need as the subsidy covers only a certain percentage of the total amount needed and, therefore, additional financing is necessary. In order to deal with this potential problem of spurious correlation, we interact our dummy for receiving a subsidy with the percentage of the project or study not covered by the subsidy *(percentage project not funded by subsidy).* On average, 49.37% of the funds asked for will not be provided. Our results are reported in Table 8. As expected, the significantly positive coefficients of the interaction terms designate that a larger percentage of the project not covered by the subsidy results in a higher probability of attracting both short and long term debt as well as equity. Model 1 illustrates that the main effect of receiving a subsidy is still positive and significant indicating that irrespective of the funding need not covered by the subsidy, firms are more likely to attract additional long term debt financing. A similar result can be observed in model 2 in which we look at the impact of receiving a subsidy on attracting short term debt. Both the main effect and the interaction effect are marginally significant.

Insert Table 8 about here

Finally, the finding that firms which receive a subsidy are more likely to attract additional funding might be due to the fact that those firms that receive a subsidy are inherently of higher quality and, therefore, irrespective of receiving a subsidy, have better chances to receive funding from external sources. One criterion IWT-Flanders uses to evaluate the overall quality of a project is the financial health of the firm applying for a subsidy (IWT, 2008). One way to assess a firm`s financial viability is to calculate the probability of financial distress. Our proxy for the probability of financial distress is the OJD-score, which is similar to the Altman Z-statistic, but adapted to the Belgian context *(financial health)* (Altman, 1968; Altman and Narayanan, 1997; Ooghe et al., 1995). A higher score indicates a lower risk of failure. Table 9 reports the results. Note that the number of observations drops considerably as the financial health variable could only be calculated for a subsample of firms for which the financial records were complete.

Not surprisingly, financially healthier firms are more likely to attract both equity and short and long term debt. Our main effect of receiving a subsidy on attracting long

term debt remains unchanged. The effect of receiving a subsidy on raising short term debt disappears however.

Insert Table 9 about here

In summary, Table 7, 8 and 9 indicate that the results presented in Table 5 and Section 3.2.2 are robust to a series of alternative explanations. In line with the certification hypothesis, Table 6 provides evidence that the effect of R&D grants is stronger when informational asymmetries are higher. Therefore, our findings confirm that receiving government R&D subsidies increases SMEs' access to external financing through a process of certification (*Hypothesis 1*). The impact of the signal is stronger for long term than for short term debt financing (*Hypothesis 3*). All our analyses consistently indicate that receiving subsidies increases the likelihood of raising long term debt whereas most of our models find a significant though smaller effect on attracting short term debt. Finally, the effect is stronger for debt financing than for equity financing, as put forward in *Hypothesis 2b*. However, the reasons why we find this differs from our theoretical motivation. Therefore, we cannot confirm *Hypothesis 2b* in the strict sense as our dataset does not allow explicitly distinguishing between equity provided by insiders or outsiders.

4. DISCUSSION AND CONCLUSION

In this paper, we examine whether obtaining an R&D grant provides a positive certification effect that facilitates SMEs' subsequent access to debt and equity financing. We use a unique Belgian dataset of 1 107 approved requests and a control group of 501 denied requests for a specific type of R&D grant. Thus, in contrast to much of the research on the effect of R&D subsidies, our study reduces selection and endogeneity bias that arises since firms self-select into applying for an R&D grant.

As Feldman and Kelley (2006) argue, collecting data on all SMEs that applied for a subsidy and comparing winners and non-winners is consistent with a quasi-experimental program evaluation design. This permits to empirically test whether the government program meets its objectives and to identify how the program might be optimized. It further enables governments to examine the broader prospects of their program, e.g. regarding innovation and economic growth, in an unbiased way.

Few papers have analyzed the effect of R&D grants on small firms' ability to attract external financing. Our work adds to the literature since we examine the impact of receiving an R&D grant on both equity and debt financing, using a large and unique sample. Studying the effects of subsidies is important as they are a major instrument of government expenditure policy and affect the allocation of resources, income distribution and expenditure productivity (IMF, 1995). This paper provides new insights in the effects generated by R&D subsidies.

Our empirical evidence shows that obtaining an R&D grant provides a positive certification effect that facilitates SMEs' subsequent access to financing. Receiving subsidies increases the likelihood of raising long term debt. We find a positive but smaller effect for short term debt. For external equity finance, a positive effect is found for start-up SMEs. The certification effect of R&D grants is stronger in case of higher asymmetric information. Our results are robust to a number of alternative explanations. We thus provide strong support for the signaling hypothesis, which entails that public R&D subsidies, on top of a direct effect, generate a significant certifying effect to private financiers. As adequate access to external finance for SMEs' innovative investments is crucial for the success of small businesses and economic growth, governments should consider this when establishing their R&D grant policies.

Alternative explanations for firms that obtained a government subsidy to have greater success at raising subsequent financing exist. First, firms that receive public grants may just have superior R&D projects. Second, the government subsidy may raise the project's return above a reasonable hurdle rate for other financiers (Feldman and Kelley, 2006).

Yet, one would expect that if the main effect of receiving public subsidies is to improve a firm's solvency, there should be a positive relationship between the amount of the subsidy received and the likelihood of attracting external financing. By contrast, the certification hypothesis suggests that there may not be such a relationship (Lerner, 1999).

Our study is subject to various limitations. First, due to lack of data, we examine the impact of getting an IWT-Flanders grant on a firm's ability to attract external financing without controlling for any other government grants the firm may have received. The IWT-Flanders R&D grants, however, are the most important subsidy for SMEs that want to pursue innovative activities. We therefore feel that the resulting bias will be small. Second, endogeneity problems may potentially bias our results. Does receiving a subsidy increase the likelihood of attracting external financing, or does a larger need for financing result in firms obtaining subsidies? However, we have attempted to eliminate this problem in various ways. We used lagged control variables in our analysis. Next, we included a sample of firms that requested the same subsidy but were denied. These firms are expected to have a similar requirement for financing. Finally, we incorporated several variables in our analysis that explicitly control for the firm's external financing need.

Despite the major role of small firms within an economy, the large amounts spent on government subsidies and academics' interest in interactions between governments and (small) firms, the public subsidization of small firms has attracted modest analysis (Lerner, 1999). Furthermore, there is little quantitative assessment of the effectiveness of public subsidy policies (Lach, 2002).

Obviously, this presents many potential avenues for further research. More work is needed on the determinants of applying for and receiving grants. This is important as it is otherwise hard to accurately evaluate the impact of public subsidies. Regarding input and output additionality of subsidies, the empirical evidence is rather mixed, therefore calling for studies that use large and complete datasets, containing information about all applicants for a particular type of subsidy. A more extensive investigation of behavioural effects generated by obtaining subsidies and their impact on a firm's ability to attract future financing would be interesting as well.

For instance, a detailed analysis for the various types of financing would prove useful. One could for instance distinguish between equity raised from existing or new shareholders; venture capital or business angel financing; various types of bank debt; etc. A further investigation of which firm, financier or general market characteristics affect the certification effect would also be valuable. We leave this for future research.

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TABLE 1

Distribution of the Sample by Year and Type of Subsidy

Year	Requested		Approved		Approval rate	Innovation studies		Innovation projects	
	N	%	N	%	%	N	%	N	%
1995	68	3.6	48	3.9	70.6	9	18.8	39	81.3
1996	76	4.0	62	5.0	81.6	28	45.2	34	54.8
1997	87	4.6	60	4.9	69.0	31	51.7	29	48.3
1998	70	3.7	54	4.4	77.1	24	44.4	30	55.6
1999	61	3.2	45	3.7	73.8	23	51.1	22	48.9
2000	68	3.6	49	4.0	72.1	23	46.9	26	53.1
2001	192	10.2	111	9.0	57.8	61	55.0	50	45.0
2002	318	16.8	232	18.8	73.0	120	51.7	112	48.3
2003	319	16.9	206	16.7	64.6	101	49.0	105	51.0
2004	349	18.5	240	19.5	68.8	130	54.2	110	45.8
Total	**1 608**	**100.0**	**1 107**	**100.0**	**69.2**	**550**	**49.7**	**557**	**50.3**

TABLE 2

Financing events

Year	N	Long term debt		Short term debt		External equity	
		N	%	N	%	N	%
1996	450	67	14.89	71	15.78	16	3.56
1997	541	93	17.19	80	14.79	26	4.81
1998	594	113	19.02	96	16.16	26	4.38
1999	630	125	19.84	106	16.83	38	6.03
2000	666	97	14.56	108	16.22	31	4.65
2001	730	114	15.62	83	11.37	38	5.21
2002	813	104	12.79	108	13.28	30	3.69
2003	839	120	14.30	129	15.38	32	3.81
2004	855	106	12.40	121	14.15	36	4.21
Total	**6118**	**939**	**15.35**	**902**	**14.74**	**273**	**4.46**

TABLE 3

Descriptive Statistics

	N	MEAN	S. D.	Median	Min.	Max.
Subsidy_received	6 822	0.08	0.26	0.00	0.00	1.00
Subsidy_rejected	6 82	0.04	0.19	0.00	0.00	1.00
Subsidy amount [a]	95	51.45	47.79	30.00	2.40	242.16
Total assets [a]	6 82	3312.13	4109.45	1722.00	1.00	26945.12
Liquidity (%)	6 82	8.86	11.87	4.77	0.00	100.00
Dividend ratio (%)	6 82	1.01	4.65	0.00	0.00	130.00
Cashflow ratio (%)	6 82	12.78	18.20	12.98	-199.88	95.65
Leverage (%)	6 82	68.91	27.17	72.26	0.00	299.00
Intangible assets (%)	6 82	2.13	6.95	0.00	0.00	69.50
Tangible assets (%)	6 82	24.96	19.54	0.21	20.52	99.53
Relative size subsidy (%)	95	4.44	9.46	1.59	0.03	144.28
Percentage project not funded by subsidy (%)	95	49.37	13.58	40.00	2.00	75.00
Financial health	1991	0.68	1.79	0.71	-24.00	5.58

[a] The amounts are expressed in €1 000.

TABLE 4

Pearson Correlations[a]

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Subsidy_received	1.00												
2. Subsidy_rejected	-0.10*	1.00											
3. Subsidy amount	-0.01		1.00										
4. Firm size [a]	0.02	-0.03*	0.16*	1.00									
5. Liquidity (%)	0.00	0.03*	0.01	-0.23*	1.00								
6. Dividend ratio (%)	0.00	-0.01	0.00	0.08*	0.10*	1.00							
7. Cashflow ratio (%)	-0.03*	-0.03*	-0.03*	0.03*	0.05*	0.17*	1.00						
8. Leverage (%)	-0.02*	0.02	0.00	-0.10*	-0.17*	-0.05*	-0.18*	1.00					
9. Intangible assets (%)	0.04*	0.04*	0.06*	-0.07*	-0.06*	-0.04*	-0.16*	0.06*	1.00				
10. Tangible assets (%)	-0.02	0.00	-0.10*	-0.02*	-0.19*	-0.07*	0.15*	0.17*	-0.11*	1.00			
11. Relative size subsidy (%)	0.01	-0.04*	0.27*	-0.40*	0.11*	-0.03*	0.00	0.03*	0.07*	-0.04*	1.00		
12. Percentage project not funded by subsidy (%)	-0.24*	0.32*	0.48*	-0.04*	0.04*	0.01	0.02	0.02	0.01	-0.01	-0.04*	1.00	
13. Financial health	-0.03	-0.04	-0.11*	0.07*	0.21*	0.12*	0.54*	-0.51*	-0.23*	-0.01	-0.12*	0.03	1.00

[a] n=6 822
* p<0.05

TABLE 5

Conditional Fixed Effect Logit Model: External Financing Events Following Subsidies[ab]

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Dependent Variables	**Long term debt**		**Long term debt**		**Short term debt**		**Short term debt**		**External equity finance**		**External equity finance**	
Subsidy_received $_{t / t-1}$			0.28**	0.11			0.19*	0.11			0.20	0.18
Subsidy_rejected $_{t / t-1}$			0.21	0.18			0.02	0.19			0.12	0.30
Liquidity$_{t-1}$	1.09**	0.51	1.10**	0.52	-1.15*	0.62	-1.13*	0.62	-0.16	0.73	-0.20	0.73
Dividend ratio$_{t-1}$	1.69*	0.93	1.74*	0.93	1.54*	0.92	1.52	0.92	-24.74*	13.78	-25.01*	13.85
Cashflow ratio$_{t-1}$	-0.61*	0.33	-0.65**	0.33	-0.36	0.33	-0.39	0.33	-0.08	0.32	-0.10	0.32
Leverage$_{t-1}$	-1.03***	0.30	-1.03***	0.30	-0.47*	0.28	-0.47*	0.28	1.44***	0.30	1.45***	0.30
Intangible assets$_{t-1}$	-0.76	0.85	-0.85	0.86	-0.44	0.86	-0.52	0.86	1.39*	0.81	1.31	0.82
Tangible assets$_{t-1}$	-2.16***	0.42	-2.18***	0.42	0.69*	0.42	0.68	0.42	-0.55	0.63	-0.61	0.63
Firm size$_{t-1}$	1.21***	0.12	1.22***	0.12	0.53***	0.11	0.54***	0.11	0.42***	0.13	0.42***	0.13
Number of observations	4 425		4 551		3 914		3 914		1 656		1 656	
Number of groups	714		714		630		630		300		300	
Log likelihood	-1 503.78		-1 500.13		-1 428.68		-1 427.23		-509.28		-508.58	
P-value of log likelihood test	<.0001		<.0001		<.0001		<.0001		<.0001		<.0001	

[a] Dependent variable equals 1 if financing event occurs, 0 otherwise.
[b] Year dummies are not reported here.
* p<0.10, **p<0.05, ***p<0.01

TABLE 6

Conditional Fixed Effect Logit Model: External Financing Events Following Subsidies: Testing Interaction Effects for Type of Firm and Type of Subsidy[ab]

	Model 1		Model 2		Model 3	
Dependent Variables	**Long term debt**		**Short term debt**		**External equity finance**	
Subsidy_received $_{t / t-1}$	0.07	0.16	0.10	0.17	-0.02	0.29
Subsidy_received $_{t / t-1}$ * Starter	-0.01	0.36	0.45	0.41	0.83*	0.44
Subsidy_received $_{t / t-1}$ * Type subsidy	0.44**	0.22	0.09	0.22	0.03	0.35
Subsidy_rejected $_{t / t-1}$	0.21	0.18	0.02	0.19	0.09	0.30
Liquidity$_{t-1}$	1.09**	0.52	-1.14*	0.62	-0.30	0.73
Dividend ratio$_{t-1}$	1.70*	0.93	1.52	0.92	-24.92*	13.75
Cashflow ratio$_{t-1}$	-0.67**	0.33	-0.39	0.33	-0.09	0.33
Leverage$_{t-1}$	-1.05***	0.30	-0.46*	0.28	1.50***	0.31
Intangible assets$_{t-1}$	-0.87	0.86	-0.58	0.86	1.38*	0.82
Tangible assets$_{t-1}$	-2.18***	0.42	0.65	0.42	-0.67	0.63
Firm size$_{t-1}$	1.22***	0.12	0.55***	0.11	0.44***	0.13
Number of observations	4 425		3 914		1 656	
Number of groups	714		630		300	
Log likelihood	-1 498.10		-1 426.60		-506.78	
P-value of log likelihood test	<.0001		<.0001		<.0001	

[a] Dependent variable equals 1 if financing event occurs, 0 otherwise.
[b] Year dummies are not reported here.
* p<0.10, **p<0.05, ***p<0.01

TABLE 7

Conditional Fixed Effect Logit Model: External Financing Events Following Subsidies: Testing Interaction Effects for Size of Subsidy[ab]

	Model 1		Model 2		Model 3	
Dependent Variables	**Long term debt**		**Short term debt**		**External equity finance**	
Subsidy_received $_{t / t-1}$	0.27*	0.12	0.09	0.12	0.06	0.19
Subsidy_received $_{t / t-1}$* Relative size subsidy	0.44	1.24	2.03	1.29	2.13	1.21
Subsidy_rejected $_{t / t-1}$	0.27	0.22	0.11	0.24	0.47	0.37
Liquidity$_{t-1}$	1.01*	0.51	-1.42*	0.64	0.60	0.65
Dividend ratio$_{t-1}$	1.58*	0.92	1.35	0.98	-32.00	15.70
Cashflow ratio$_{t-1}$	-0.49	0.33	-0.21	0.32	-0.42	0.33
Leverage$_{t-1}$	-0.90**	0.29	-0.36	0.27	1.22	0.28
Intangible assets$_{t-1}$	-0.48	0.84	-0.87	0.89	1.69	0.86
Tangible assets$_{t-1}$	-2.16***	0.43	0.79*	0.43	-0.27	0.61
Firm size$_{t-1}$	1.04***	0.11	0.51***	0.10	0.26	0.12
Number of observations	4 551		3 998		1 753	
Number of groups	728		639		314	
Log likelihood	-1 558.14		-1 455.63		-542.84	
P-value of log likelihood test	<.0001		<.0001		<.0001	

[a] Dependent variable equals 1 if financing event occurs, 0 otherwise.
[b] Year dummies are not reported here.
* p<0.10, **p<0.05, ***p<0.01

TABLE 8

Conditional Fixed Effect Logit Model: External Financing Events Following Subsidies: Controlling for Financing Need Created by Receiving Subsidy[ab]

	Model 1		Model 2		Model 3	
Dependent Variables	**Long term debt**		**Short term debt**		**External equity finance**	
Subsidy_received $_{t / t-1}$	0.29**	0.11	0.19*	0.11	0.18	0.18
Subsidy_received $_{t / t-1}$ * Percentage project not funded by subsidy	4.91***	0.80	1.28*	0.71	3.61***	0.88
Subsidy_rejected $_{t / t-1}$	0.15	0.18	0.01	0.19	0.01	0.30
Liquidity$_{t-1}$	1.16**	0.53	-1.17*	0.62	-0.33	0.76
Dividend ratio$_{t-1}$	1.92**	0.93	1.53*	0.92	-24.30*	13.86
Cashflow ratio$_{t-1}$	-0.55	0.34	-0.37	0.33	-0.15	0.34
Leverage$_{t-1}$	-1.03***	0.30	-0.47*	0.28	1.41***	0.31
Intangible assets$_{t-1}$	-0.68	0.87	-0.48	0.86	1.21	0.86
Tangible assets$_{t-1}$	-2.14***	0.43	0.68	0.42	-0.50	0.64
Firm size$_{t-1}$	1.44***	0.12	0.60***	0.11	0.59***	0.15
Number of observations	4 425		3 914		1 656	
Number of groups	714		630		300	
Log likelihood	-1 477.61		-1 425.64		-498.47	
P-value of log likelihood test	<.0001		<.0001		<.0001	

[a] Dependent variable equals 1 if financing event occurs, 0 otherwise.
[b] Year dummies are not reported here.
* p<0.10, **p<0.05, ***p<0.01

TABLE 9

Conditional Fixed Effect Logit Model: External Financing Events Following Subsidies: Controlling for Firm Quality[ab]

	Model 1		Model 2		Model 3	
Dependent Variables	**Long term debt**		**Short term debt**		**External equity finance**	
Subsidy_received $_{t / t-1}$	0.71**	0.27	-0.20	0.24	-0.61	0.51
Subsidy_rejected $_{t / t-1}$	0.05	0.52	0.12*	0.39	-0.27	0.91
Financial health	0.67**	0.31	0.49	0.28	0.35*	0.19
Liquidity$_{t-1}$	-2.98	2.22	-1.39	2.43	-1.58	3.40
Dividend ratio$_{t-1}$	4.49**	2.27	1.22	2.09	-11.28	11.11
Cashflow ratio$_{t-1}$	-1.70	1.35	-1.48	1.18	-2.69*	1.38
Leverage$_{t-1}$	-0.56	1.34	0.70	1.30	5.96***	1.47
Intangible assets$_{t-1}$	2.82	4.08	-2.56	3.84	10.19***	3.55
Tangible assets$_{t-1}$	-3.21**	1.39	1.08	1.15	-3.48	2.29
Firm size$_{t-1}$	2.53***	0.48	1.27***	0.37	2.09***	0.70
Number of observations	817		999		357	
Number of groups	144		172		67	
Log likelihood	-249.82		-361.15		-86.39	
P-value of log likelihood test	<.0001		0.4152		<.0001	

[a] Dependent variable equals 1 if financing event occurs, 0 otherwise.
[b] Year dummies are not reported here.
* p<0.10, **p<0.05, ***p<0.01