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Do Financial Constraints Hold Back Innovation and Growth?

Evidence on the Role of Public Policy*

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Abstract

This paper provides evidence that capital market imperfections hold back innovation and growth, and that public policy can complement capital markets. We deliver the evidence by studying the effects of government funding on the behavior of SMEs in Finland. By adapting the methodology recently proposed by Rajan and Zingales (1998) to firm-level data, we show that government funding disproportionately helps firms from industries that are dependent on external finance. We demonstrate that the result is economically significant and robust to a variety of tests.

JEL: E50, G21, G24, G32

Keywords: corporate finance, financial constraints, innovation, firm growth, subsidies

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1 Introduction

Does enterprise lead and finance follow, as Joan Robinson (1952) and others after her have argued? Or is it the other way around? The extent to which imperfections in capital markets restrain investment and growth has been the objective of intensive research both at the firm (see Hubbard 1998 for a survey), industry (Rajan and Zingales 1998, RZ henceforth) and country level (King and Levine, 1993). This strand of research, and its complement, the research studying the effects of public policy on firm performance (see, e.g., Lerner 1999, and Wallsten 2000 who study the US SBIR program but reach opposite conclusions, and Lach 2002 and Jaffe 2002)[1], have been hampered by a number of problems in trying to establish the causality between finance and firm growth. Although the two literatures have so far developed relatively independently from each other, the objective of this paper is to provide evidence on the question of causality by borrowing insights from both. To deliver the evidence we study the effects of public policy (measured by government funding) on the behavior of privately owned, small and medium sized enterprises (SMEs) in Finland.[2]

Governments around the globe seem to express downright skepticism on Joan Robinson's and others' conclusion, as they have been keen to provide funding to SMEs. This seems to imply that governments think that where government

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[1] See also David, Hall and Toole (2000), and Klette, Møen and Griliches (2000), for surveys.

[2] A skeptical reader might ask what's different or interesting about Finland. In our (obviously not objective) view, Finland is different and interesting for a good reason. Finland is currently considered one of the most competitive countries in the world both by World Economic Forum (WEF 2001) and International Institute of Management Development (IMD 2002), not least because of the perceived 'innovativeness' of its business sector and 'efficiency' of its government. In particular, Finland's basic, technological and scientific infrastructure as well as its government institutions and programs, including 'public sector contracts', 'government subsidies to firms', and 'educational system', rank high in the well-known international comparisons of WEF, IMD and those of Global Entrepreneurship Monitor (GEM 2001). These comparisons suggest that the efforts of the Finnish government are perceived as an important element of the recent economic development in Finland.

finance leads, innovation and growth follow (see, e.g., OECD 2000). It is indeed a long-standing view that imperfections in capital markets create a wedge between the cost of internal and external finance to SMEs (Hubbard 1998, Lerner 1999, Carpenter and Petersen 2002) and that the wider the wedge, the more likely that SMEs dependent on external finance fail to pursue some innovations and growth potential. The existence of this 'funding cap' is a primary rationale for the provision of government funding to SMEs (for a differing view, see de Meza and Webb 2000, and de Meza 2002).

This paper's analysis tests this positive view of the role of active public policy in capital markets. We argue that if there are economically significant imperfections in capital markets and if 'government finance leads' (i.e. if it successfully complements capital markets), government funding should *disproportionately* help innovation (R&D) and growth of firms in industries that are dependent on external finance. It is this hypothesis that we develop and test in this paper.

In a recent paper, RZ (1998) made an important methodological contribution by creating a way to identify industries' technological demand for external finance (by measuring it in the US). They then estimate industry-level growth equations on data from other countries and include industry and country fixed effects, and an interaction term between an industry's technological demand for external finance and a measure of a country's financial development.[3] RZ find that after controlling for industry and country fixed effects, the coefficient of the interaction term is positive and statistically significant. Their result suggests that

[3] Recently Cetorelli and Gampera (2001) have extended RZ's framework to examine the effects of banking market structure on growth. See also Carlin and Mayer (2002) who build on RZ's framework to evaluate the relationship between industrial activity and the structure of countries' financial and legal systems

industries that are relatively more in need of external finance develop disproportionately faster in countries with better-developed capital markets.

We build on RZ's methodology and amend it in two ways. First, in place of their financial development -variable, we use a measure of the regional availability of government funding to SMEs within a country. They argue that financial development liberates firms from the drudgery of generating funds internally by helping firms raise capital from sources external to the firms at a reasonable cost. We think that government funding should lead to the same outcome, if it successfully augments capital markets. Second, we shift the focus to the effects of cross-regional, between-industry differences on a firm-level variable. By focusing on firm-level performance we can correct for region and industry characteristics. Importantly, we can simultaneously address the problem of reverse causality, which has been an important concern in the studies on finance and growth (see RZ 1998), and selection effects, which have been an important concern in the literature on government funding and firm performance (see Wallsten 2000).

We apply the amended methodology to recently collected firm-level data on Finnish SMEs that allow us to disaggregate SME funding by its sources, including external sources and the government. Using these data, we identify an industry's need for external finance from data on SMEs operating in the metropolitan Helsinki area that is the financial center and capital of Finland. Under the assumption that capital markets in Helsinki are relatively frictionless, this method allows us to identify an industry's technological demand for external financing. Under the further assumption that such technological demand carries over to other geographical areas in Finland, we examine whether the availability of government funding (outside the metropolitan Helsinki area) especially helps firms in industries that are technologically dependent on external finance.

The findings of this paper suggest that SMEs face an upward-sloping capital supply curve and hence that the market for SME finance is imperfect. The evidence is consistent with the view that financial constraints hold back innovation and growth, and the hypothesis that government funding can alleviate capital market imperfections. Beyond these conclusions, our results have no implications for public policy. In particular, one cannot draw conclusions about the welfare effects of government funding (cf. de Meza and Webb 1987, 2000 and de Meza 2002).

The paper is organized as follows. Section 2 discusses sources of capital market imperfections and various motives for providing government funding to SMEs. Section 3 explains our empirical approach, and section 4 describes the data. In this section, the main sources of government funding in Finland are also briefly described. Section 5 presents the regression results and investigates the robustness of our findings. Section 6 summarizes the paper.

2 Theoretical Background

2.1 Why Do Capital Market Imperfections Matter?

To understand why capital market imperfections might constrain the growth and 'innovativeness' of firms, consider a simple model of firm level investment (see, e.g., David et al. 2000) and growth (Carpenter and Petersen 2002). Figure 1 illustrates the main elements of the model. The horizontal axis measures both R&D investment and/or the growth of sales.[4] The vertical axis measures both the (pri-

[4] Following the 'percentage of sales approach' we assume that the ratio of assets used to achieve a given level of sales is constant (see Higgins 1977, Demirkgüç-Kunt and Maksimovic 1998, 2002). The assumption implies that the growth of sales is proportional to the change in assets, allowing us to measure sales growth on the horizontal axis rather than the change in assets as in Carpenter and Petersen (2002).

vate) marginal rate of return on investment and expansion as well as the marginal cost of capital.

The marginal cost of capital schedule, MCC, reflects the opportunity cost of investment and expansion. It is horizontal to the extent a firm has internal funds available but becomes upward sloping at some level of R&D investment and expansion. Standard textbook considerations about asymmetric information, adverse selection and moral hazard suggest that the marginal cost of financing is an increasing function of the amount raised. The MCC schedule captures the idea that in the presence of capital market imperfections, the firm's increased use of external financing eventually pushes the marginal cost of capital upwards. In perfect capital markets, the MCC schedule would be horizontal.

The marginal rate of return schedule, MRR, slops downwards, as it ranks the R&D projects and expansion possibilities of firms in descending order of expected return. The MRR schedule for growth could be more elastic than the MRR schedule for investment (Carpenter and Petersen 2002).

[Insert Figure 1 here]

In Figure 1, the firm's profit maximizing levels of R&D investment (expansion) are found at *A* and *B*, where *A* refers to a firm facing imperfect and *B* to a firm facing perfect capital markets. It is evident that a firm facing a more elastic MCC schedule invests more in R&D (pursues more growth). The model thus predicts that SMEs that are dependent on external finance are more likely to fail to pursue some innovations and growth potential than SMEs that are not.[5]

[5] Especially growth-oriented, technology-intensive SMEs may face a steeply upward sloping MCC schedule because the profitability of growth opportunities is unknown and because R&D projects are highly uncertain investments in untapped market niches and in tacit knowledge that becomes embedded in the human capital of employees (see, e.g., Hall 2002). These tend to worsen the adverse selection problem and increase the lemons premium (Myers and Majluf 1984). They also create scope for moral hazard problems, especially because agency and contracting costs may be a characteristic feature of R&D projects (Holmström 1989) and because it is difficult, if not impos-

2.2 Why Subsidize SMEs?

Economic theory suggests various rationales for governments to provide (subsidized) funding to SMEs, especially to technology intensive SMEs (see e.g. Lerner, 1999). First, public finance theory posits that if SMEs are a unique source of new ideas and growth that generate positive externalities to other industries and firms, supporting them is appropriate. For example, because the social return from the SMEs' R&D expenditures may exceed their private returns due to 'knowledge' spillovers (Griliches 1992, Lach 2002), firms will tend to underinvest in R&D. Second, capital market imperfections may constrain investment and growth of SMEs.

Figure 2 illustrates the rationale for providing government funding to SMEs facing capital market imperfections. Holding the MRR schedule constant, awarding government funding to an SME has two effects on the MCC schedule. They both depend on whether the firm is dependent on external finance or not. First, the award of government funding has a direct effect by shifting the MCC to the right, because it permits the undertaking of additional projects using capital that has a lower marginal cost than at the pre-award equilibrium. Second, the award may have an indirect effect (as suggested by Lerner's (1999) results) as it may convey information about the quality of the firm both to the equity holders of the firm and to other (potential) investors. This reduces informational asymmetries and lowers the cost of internal and external funds, implying both a downward shift in the MCC schedule (the effect on the required rate of return by current owners and

sible, to contract for a delivery of a specific innovation (Aghion and Tirole 1994). Finally, technology-intensive small businesses may find it difficult to convey the quality of their ventures to the providers of external finance due to appropriability problems and the confidential nature of R&D projects (Anton and Yao 1994, Bhattacharya and Chiesa 1995).

other corporate insiders) and a change in the slope of the upward sloping part of the schedule (the effect on the required rate of return by corporate outsiders).

[Insert Figure 2 here]

Figure 2 shows the first of these two effects. The direct effect is larger for firms positioned on the upward sloping part of the MCC schedule, i.e., for firms dependent on external finance, than for firms positioned on the horizontal part. When the MCC schedule shifts to right, the position of a firm who is originally on the horizontal part (at point *C*) does not change, whereas those firms that initially are on the upward sloping part of the MCC schedule (such as point *D*) increase their R&D (growth) investments (to point D^*).[6]

There are thus reasons to think that the effects of government funding should vary with the elasticity of the marginal cost of capital schedule that firms face. The hypothesis put forward by the model is that if there are significant imperfections in capital markets, government funding should *disproportionately* help firms in industries that are (more) dependent on external finance. These firms are more likely to face a less elastic marginal cost of capital schedule than firms that are less dependent on external finance. This is the distinctive channel on which the test of this paper focuses.

3 The Empirical Approach

To test our hypothesis we estimate several variants of the following basic model:

$$\begin{aligned} Y_i = {} & \alpha + \beta \cdot (\mathit{External\ dependence}_j \cdot \mathit{Government\ \ funding}_a) \\ & + \Phi_1 \cdot \mathit{Industry\ dummies}_j + \Phi_2 \cdot \mathit{Area\ dummies}_a + \Phi_3 \cdot \mathit{Controls}_i \qquad (1) \\ & + \mathit{Error}_i \end{aligned}$$

[6] Provided that the downward shift in the MCC schedule is moderate compared to the change in the schedule's slope, also the indirect effect works to the same direction as the direct effect.

In (1), subscript i refers to firm, j to industry and a to area; α and β are parameters, and uppercase coefficients Φ_k (k = 1, 2, 3) indicate vectors of parameters.

The dependent variable is a measure of firm i's investments in R&D or its growth (we define the various measures in section 4.1). The independent variable of primary interest is the interaction term between an industry ($External\ dependence_j$) and an area ($Government\ funding_a$) characteristic. If we can measure industry j's dependence on external finance and the amount of government funding available in area a, then - provided that we correct for area and industry effects - we should find that the coefficient estimate for the interaction is positive in the presence of capital market imperfections. To correct for area and industry specific effects, we include $Industry\ dummies_j$ and $Area\ dummies_a$. The vector of $Controls_i$ (described in detail below) is included to control for a number of firm specific effects that potentially affect the dependent variable(s).

Model (1) differs from that of RZ in two ways, as already mentioned in the Introduction. First, in place of RZ's financial development -variable, we use a measure of the local availability of government funding to SMEs.[7] If it successfully augments capital markets, government funding should help firms grow by liberating firms from the drudgery of generating funds internally. Second, we shift the focus to the effects of cross-regional, between industry differences on a firm-level variable. In RZ's model, the dependent variable is measured in industry j of area (country) a, whereas our dependent variable refers to firm i from industry j and area a. Together with the inclusion of industry and area fixed effects this

[7] Unlike RZ's financial development -variable that varies across countries, our measure of the availability of government funding only varies within a country. This allows us to abstract from the problem of country-specific omitted variables.

means that $Error_i$ measures firm-level deviations (those not controlled for by the vector of firm-level $Controls_i$) from the industry-area mean.

RZ's methodology and our modifications to it allow us to simultaneously address a number of econometric issues that arise in standard firm-level analyses of the effects of government funding on firm performance in which some measure of firms' performance is regressed on a measure of government funding (the subsidy) awarded to the firm:

- *Reverse causality and selection:* Receiving government funding may be endogenous to a firm's activities: e.g., firms that do more R&D could be more likely to receive government funding. This may either result in a selectivity problem that may bias upward econometric estimates of the effect of government funding on firm R&D in standard firm-level regressions (David et al. 2000, Klette et al. 2000, Wallsten 2000) or indicate reverse causality. Our specification controls for the selectivity problem because the interaction term is measured at industry and area level, *not* at the level of individual firms. Recall, in particular, that the error term in equation (1) measures the firm-level deviation from the area-industry mean of R&D or growth. It is hard to imagine a channel through which the availability of government funding in area *a* or the external dependence of industry *j* would be correlated with the deviation in R&D expenditures or growth of firm *i* from its industry-area mean. Thus, should we find a positive coefficient for the interaction term, reverse causality is unlikely to explain it.
- *Omitted variables:* Omitted latent variables that are correlated with both R&D or growth decisions and government funding could give arise to endogeneity (David et al. 2000, and Klette et al. 2000). Because the in-

dustry and area dummies capture first-order effects, i.e., the effects of potentially omitted industry and area regressors, our analysis of the interaction term should be relatively immune to criticism about an omitted variable bias.

- *Identification:* Because government funding may shift MRR and MCC schedules simultaneously (David et al. 2000), it may be difficult to say whether government funding matters because it alleviates capital market imperfections or because it opens up additional R&D and growth opportunities. Our framework should be able to deal with this issue for two reasons. First, we analyze government funding, not public contracts that are expected to assist a public agency in better fulfilling its mission objectives. As David et al. (2000) argue, government funding is less likely to have an effect on the MRR schedule than public contracts. Second, and more importantly, by looking at interaction effects rather than direct effects (as usually is done), we reduce the possibility that government funding shifts the MRR schedule. The only effects, if any, of government funding that are identified are those that arise because there is within region variation in external dependence across industries.
- *Measurement error:* One of the most difficult tasks in RZ's approach is measuring industry *j*'s technological dependence on external finance. If it is measured inaccurately, measurement error might be a cause of concern to us. However, we have no *a priori* reason to believe that the industry level measurement error would be correlated with the deviation in R&D expenditures or growth of firm *i* from its industry-area mean. Moreover, had we a bad proxy for the technological dependence on external finance, we would presumably be biased against finding any statistically signifi-

cant effects for the interaction term. And, finally, to the extent that there is systematic variation in the industry level measurement error, the industry dummies should capture the first-order effects of that. These same considerations apply also to measuring the amount of government funding available in area *a*.

4 The Data

The empirical evidence of this paper is based on new data originating from a recently conducted primary survey. It resulted in a dataset that covers 724 SMEs from all major sectors of the Finnish economy.[8] In what follows we develop our measures of i) innovativeness and growth, ii) dependence on external finance, and iii) government funding. The data are described in detail thereafter.

4.1 Measures of Innovativeness and Firm Growth

We measure (investments in) innovativeness as the R&D expenditure of firm *i*, (denoted $R\&D_i$). Because $R\&D_i$ is a source of future technological improvements and a manifestation of systematic search for inventions and innovations, the variable should be useful when studying whether government funding matters for firms' investments in innovativeness. We could also view $R\&D_i$ as a measure of long-term growth opportunities and future expansion, as R&D investments are a means to acquire corporate growth opportunities.

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[8] The survey was administrated by the Research Institute of the Finnish Economy (ETLA) and its subsidiary Etlatieto Ltd. It was conducted between December 2001 and January 2002. Only farm (agricultural), financial, and real-estate sectors are fully excluded. The data only cover SMEs that are not proprietorships, partnerships, or subsidiaries. A detailed description of the survey, data and the Finnish SME finance is presented in Hyytinen ja Pajarinen (2002), available at www.etla.fi. For recent developments in the Finnish financial system, see Hyytinen, Kuosa and Takalo (2003).

The second dependent variable is the average sales growth rate over the next three years, as projected by the entrepreneurs themselves (denoted $GROWTH_i$).[9] It is a measure of mid-term growth opportunities.

4.2 Measures of Dependence on External Finance

Unlike Carlin and Mayer (2002) and Cetorelli and Gambera (2001), we do not have the option of using RZ's estimates of external dependence for manufacturing industries. In our view, it would not be prudent to assume that the patterns of external finance that RZ identify using large listed US firms would also apply to the Finnish SME sector. For example, firms in the RZ data are at a much later stage in their lifecycle than the firms in our data. The option is also precluded because we have only very few, if any, observations for many of RZ's manufacturing industries.

There are two problems that we need to overcome before we can construct our own estimates for external dependence. First, like RZ, we do not have data on actual use of external financing at industry level. Even if data on actual use of external financing were available by industry, it would not be useable because it would reflect the equilibrium between the demand for external finance and supply. Because our test rests on the assumption that government funding matters because of market failure in capital markets, we cannot identify an industry's dependence on external financing by simply computing it for each industry using a selected measure.

Second, our data are based on a survey that includes only few items from financial statements. This fact is a mixed blessing for us. On the one hand, it implies that we cannot use the same measure for external dependence as RZ. More-

[9] The variable is based on Question 11 of the survey, in which entrepreneurs were asked: "What is your average annual target rate of sales growth for the next three years?".

over, because our data consists of a cross-section, we would not be able to smooth temporal fluctuations.[10] On the other hand, the data is rich in other details, including the sources of equity (ownership) and debt.

We overcome the first problem in the same way as RZ do. We assume that there is a technological reason why some industries rely more on external finance than others and that these technological differences persist across different geographical areas. Provided that the differences persist, we can identify an industry's need for external finance from data on SMEs operating in the metropolitan Helsinki area under the assumption that capital markets in Helsinki are relatively frictionless. If they are, the actual amount of external funds raised by an SME residing the Helsinki metropolitan area equals its desired amount.

While we are not claiming that the capital markets in Helsinki are as perfect as the US capital markets are, the assumption is not inconsistent with the facts. First, Helsinki is the financial center and capital of Finland where the only stock exchange resides and where all major deposit banks, finance companies, venture capital firms as well as investment banks have their headquarters. Second, almost all foreign financial institutions that are present in Finland also have their offices in Helsinki. Finland and particularly the Helsinki metropolitan area have also attracted a non-negligible amount of foreign capital, including cross-border venture capital, since long-term capital movements were liberalized in 1993. Third, venture capital activity is concentrated to southern Finland, as 65% of all Finnish venture capital investments in 2000 were made in firms residing there. Fourth, household and corporate wealth, which are a potential source of initial finance to start-

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[10] To the extent that an industry's technological dependence on external finance *changes* as it emerges, matures and dies (like industries typically do), we would probably like to measure the degree of dependence for industry j that is currently prevailing. In this sense, having just one cross-section is not as problematic as it may first sound.

ups, angel finance and trade credit, are also concentrated in the Helsinki metropolitan area. Finally, even if the supply of capital was not perfectly elastic in the metropolitan Helsinki area, the methodology provides a reasonable measure of the *relative* demand for funds by different industries under the weaker assumption that the elasticity of the supply curve does not change substantially in the cross-section of industries (RZ, p. 564). As we already discussed earlier, also the inclusion of industry dummies into the regression and our focus on the interaction term alleviate the concerns that an industry level measurement error might give a raise to.

In order to overcome the second problem, we measure dependence on external finance in four different ways. First, we utilize our survey questions (and the information on firms' balance sheets available to us) to calculate the fraction of total debt and equity that is attributable to corporate outsiders, i.e., to investors that belong neither to the management nor the personnel of the firm. This fraction, denoted $EXDEPOUT_i$, is computed as the sum of outside equity and credit supplied by corporate outsiders. Outside equity consists of the fraction of total shareholders' equity not owned by the management or personnel of a firm.[11] Outside loan financing consists of credit supplied by financial institutions (such as banks, finance firms, other domestic financial institutions), non-financial businesses (trade credit, loans from other firms) and government.

Second, we estimate a firm's dependence on external finance using a financial planning model (called also the 'percentage of sales' approach; see Higgins

[11] Because shareholders' equity consists mainly of share capital and retained earnings and because outsiders would have been entitled to receive retained earnings as dividends in proportion to their ownership in the firm, we assume that the part of the retained earnings that can be attributed to outside owners on the basis of their ownership represents capital infusions by outsiders.

1977, Demirkgüç-Kunt and Maksimovic 1998, 2002). Under certain assumptions, the financial planning model allows us to compute the 'excess growth' made possible by external finance. The measure, denoted $EXDEPSG_i$, is defined as a dummy set to one if the difference between a firm's realized sales growth rate, ΔS_i, and its maximum sustainable growth, SG_i, is positive. The maximum sustainable growth rate assumes that the firm does not pay dividends and that it obtains enough short-term and long-term credit to maintain a constant ratio of debt to equity. It is computed as $SG_i = ROE_i/(1-ROE_i)$, where ROE_i is defined as the ratio of profit (loss) for the fiscal period to shareholders' equity. Whilst this measure is attractive because it is based on a standard model, and because it has been extensively used before, it does have the drawback that it does not take into account the long-term nature of R&D investments. We expect it to perform less well in the R&D than in the growth regressions, as the latter are explicitly taking a mid-term view, consistent with this measure of financial dependence.

The remaining two of our four measures for dependence for external finance are profitability-based. The third measure, denoted $EXDEPLOSS_i$, classifies firm *i* as dependent on external finance if its return on assets was negative in the last fiscal year. The fourth one, denoted $EXDEPPROF_i$, classifies firm *i* as dependent on external finance if the entrepreneur answered in the survey that her firm's current profitability is *not* better than it has been over the last three years on average.[12]

To aggregate $EXDEPOUT_i$, $EXDEPSG_i$, $EXDEPLOSS_i$, and $EXDEPPROF_i$ across companies in the metropolitan Helsinki region we calculate industry averages.[13] The resulting industry-level variables (denoted with subscript *j*, not *i*), provide us with four alternative measures for industry *j*'s need for external finance. In other words, *External dependence*$_j$ is a generic measure, taking four different forms: $External\ dependence_j \in \{EXDEPOUT_j, EXDEPSG_j, EXDEPLOSS_j, EXDEPPROF_j\}$. Under the assumption that capital markets in Helsinki are relatively frictionless, the first two measure a technological reason why some industries rely more on external finance than others. The latter two are measures for 'technological profitability', and adverse changes to it. While these measures have the problem of being based on an accounting definition of profitability, they should capture the fact that for some industries relying on internal financing may be next to impossible due to low current *industry* profitability, or due to a recent adverse change in it. What is important is that capital market imperfections should not affect the costs of capital in the metropolitan Helsinki area and thereby bias our measures for (typically hard-to-observe) industry profitability.

We present descriptive statistics for the measures of external dependence both at the firm-level and industry-level in section 4.4, where the data are described.

[12] The variable is based on Question 20 in the survey. In the question, entrepreneurs were asked: "Is the current profitability of your firm better than the firm's profitability has been over the last three years on average?".

[13] We group the firms into 14 broad industry categories based on two- and three-digit SIC-like industry codes. We end up with 14 industries, because we need to have industries for which there are firms operating within the metropolitan Helsinki area (so that we can estimate industry *j*'s dependence for external finance) and for which there are firms operating outside the metropolitan Helsinki area (so that we can estimate equation (1)). The industries are listed in section 4.4, where the data are described.

4.3 Measures of Government Funding

Ideally, the availability of government funding should be measured with the ease at which SMEs, especially those suffering from capital market imperfections, obtain finance from various government sources. There is little agreement on how this kind of availability is appropriately measured and, typically, even less data available.

To develop a measure for the regional availability of government funding, we begin by estimating the amount of government funding received by each SME in our sample from all the agencies providing public SME support in Finland. The National Technology Agency (Tekes), Finnvera plc (a specialised financing company owned entirely by the Finnish state), and the Finnish National Fund for Research and Development (Sitra), are the most prominent sources of public support to firms in Finland. Tekes finances R&D projects of companies and universities and its funds are awarded from state budget via the Ministry of Trade and Industry. It grants loans and capital loans, which are not gratuitous (i.e. they are repayable and priced at a below-market interest rate), as well as pure R&D subsidies, which are gratuitous (i.e. they are not repayable). Sitra provides government venture capital funding for early stage technology companies and for commercialization of innovations. It uses equity and equity-linked instruments, which are not gratuitous (i.e. capital is injected only in exchange for a ownership stake in the company). Through its nationwide branch network, Finnvera offers various financing services, such as subsidized loans and guarantees, to promote the domestic operations and internationalization of Finnish SMEs. Some of its financial services are gratuitous (guarantees) while some are not (loans). Of these agencies, Tekes and Finnvera explicitly take the location of the firm into account in making their decisions. In addition to Tekes, Sitra and Finnvera, there are 15 Regional

Employment and Economic Development Centres ('TE Centres') that provide public support, both financial and non-financial, to SMEs. The financial support that TE Centres provide is mainly awarded from state budget via the Ministry of Labour. They all are gratuitous. Finally, some government funding to SMEs is provided through Finnish Industry Investment (FII) Ltd, a government-owned fund of funds, which also invests directly in (larger) Finnish firms, as well as through relatively small regional, semi-governmental and municipal -owned venture capital firms. Financing provided by these organizations is typically non-gratuitous.

The survey data allows us to compute for each firm in the sample the fraction of total debt and equity that is attributable to any of the above described government agencies providing public SME support and R&D finance in Finland. We denote the fraction $GOVFUN_i$. The measure captures only the extent to which firm *i* relies on government funding that is not gratuitous, i.e. that is either repayable or that is provided only in exchange for an ownership stake and is thus recorded in their balance sheets. We address this issue and other characteristics of $GOVFUN_i$ below.

In similar vein to RZ's financial development variable, we measure government funding regionally. To aggregate $GOVFUN_i$ geographically, we compute area averages of it within each of the 15 TE Centres. TE Centres together cover the entire Finland and naturally, the areas in which individual TE Centres are active do not overlap.[14] Aggregation provides us with a measure for the amount of governmental funding available in area *a*, $GOVFUN_a$.

[14] The TE Centres are the natural unit of analysis, because their primary function is the provision of public support, both financial and non-financial, to local economies and especially to firms. The Business Departments of TE Centres advise start-ups, provide services to promote internationalization of firms, encourage firms to adopt new technologies and supply capital to

It is important to emphasize the nature and limitations of $GOVFUN_a$:

- $GOVFUN_a$ does not account for government funding that is not recorded in the balance sheet of firms. Examples of such government funding include subsidies (aid) that are recognized as revenue when received and that effectively are gratuitous. While we do not have data on the *amount* of such subsidies, the survey data include qualitative information on them. We can therefore address the limitation by showing that an omitted subsidy variable is not driving our results (see section 5.2);
- Previous analyses, including Lichtenberg (1988) and Wallsten (2000), have used government funds 'potentially awardable' to firms as an instrument for a firm-level subsidy variable like $GOVFUN_i$ when estimating the effects of government funding on firm performance. Our $GOVFUN_a$ is similar in nature to the instrument. However, firms may do more R&D or pursue stronger growth (by running down current cash holdings and using short-term credit etc.) in areas where there is a lot of 'potentially awardable' government funds around, *anticipating* that they can rely on government funding in future if needed. The exclusion restriction used in the previous analyses is therefore not totally unproblematic, because $GOVFUN_a$ can, similarly to financial development in RZ, be an important determinant of R&D and growth decisions, especially to firms in industries that are more dependent on external finance. The benefit of the definition of $GOVFUN_a$ is, from our point of view, that it

zation of firms, encourage firms to adopt new technologies and supply capital to partially finance firm's investment and development projects. By design, the geographical distribution of TE Centres reflects the geographical distribution of the relevant local capital markets better than that of municipalities or provinces. While TE Centres are a preferred regional unit of ours, we show in section 5.2 that our results are robust to using an alternative geographical division.

captures this kind of (previously overlooked) indirect effects (not unlike the financial development -variable in RZ).[15]

- By relying on $GOVFUN_a$ we only observe the equilibrium between the demand for government funding and its supply in each TE Centre. In areas where capital market imperfections are more severe, firms are keener to rely on government funding. $GOVFUN_a$ also provides us with information about the regional supply of government funding because the more government funding is available, the easier it is for SMEs to obtain some. Whichever of these is the more important source of variation, $GOVFUN_a$ is relatively more important for firms in industries that are more dependent on external finance. If there were no variation cross TE Centres in capital market conditions, the measure for government funding would only reflect variation in the regional supply of government funding. Similarly, if there were no variation in the regional supply, our measure would only reflect variation in capital market conditions cross TE Centres. In other words, even if there was no deliberate public policy to allocate different amounts of funding to different regions, we can proceed with our tests as long as there is variation in the data.

Finally, we need to emphasize the assumption that the capital markets for SMEs are at least partly local. While a growing number of studies support the assumption (Lerner 1995, Petersen and Rajan 2001), it is a potential source of bias. A violation of this assumption creates a bias against finding any statistically significant effects.

4.4 Descriptive Statistics

We present firm-level summary statistics in Table 1. A first thing to note is that the number of observations for an explanatory variable may exceed the number observations for the dependent variables. The reason is that we lack data on $R\&D_i$ for some firms for which we have data on $GROWTH_i$, and vice versa. The mean of $R\&D_i$ is 0.11 millions of euro, while that of $GROWTH_i$ is as high as 19%.[16] There is more variation in $R\&D_i$ than in $GROWTH_i$, and the maximum of both variables is very large relative to the mean. Although not shown in the table, 38% of the 618 $R\&D_i$ observations are zero. The corresponding number for $GROWTH_i$ is 27%. We explicitly allow for the possibility that R&D expenditures or expected growth is zero by using a censored regression (Tobit) model.[17]

Table 1 also reports descriptive statistics for $EXDEPOUT_i$, $EXDEPSG_i$, $EXDEPLOSS_i$, and $EXDEPPROF_i$, as well as $GOVFUN_i$, measured here at the firm-level. What the table reveals is that on average, 40% of the total funds of SMEs can be attributed to outside investors; 36% of firms have grown using external finance, i.e. faster than the maximum sustainable growth rate; 10% of the firms are making losses; and the profitability of every third firm is currently lower than or the same as it has been during the past three years. Finally, on average, 7% of the total funds of SMEs can be attributed to government sources.

[15] We address the potential limitation of model (1) that it does not include the firm-level $GOVFUN_i$ in the estimating equation by showing that our results remain intact even if it is included. The results of this robustness test are presented in section 5.2.

[16] Median of $R\&D_i$ and $GROWTH_i$ are .008 million euros and 10%.

[17] No firm reported a negative expected growth. We treat this as a reporting bias: it is likely that some of the firms that report zero expected growth actually expect negative growth, but were reluctant to answer so. Our framework allows for such a possibility.

As Table 1 reveals, the data also include several firm-level control variables. Firms in our sample are on average 16 years old (AGE_i), and have 17 employees (EMP_i). The current CEOs have managed the firm nine years on average ($CEOAGE_i$), and 29% of them have a university degree ($CEOEDUC_i$). 69% of firms have a strong principal, controlling, owner ($PRINSOWN_i$); in 96% of firms the combined ownership of the three largest shareholders exceeds 50% ($CONOWN_i$); four per cent have foreign shareholders ($FOREOWN_i$); and in 88% of firms, board members ownership exceeds 50% ($BOARDOWN_i$). The average number of board members ($BOARD_i$) is 2.85, and that of firm's executives and other personnel on the board ($BOARDINS_i$) is 1.76. The CEO is the chairman of the board ($CEOCHAIR_i$) in half of the firms. 44% of firms have made a product innovation during the last three years ($INPROD_i$), and 30% have made a process innovation during the last three years ($INPROC_i$). Every eighth firm has patents ($PATENT_i$), and 22% have intangible assets ($INTANG_i$ = dummy set to 1 if the entrepreneur evaluates that his/her firm owns other intangible assets than patents). The firms in the sample seem to be what we would expect for a group of small, high-tech firms.[18]

[Insert Table 1 here]

In Table 2 we continue our analysis of firm-level data. The table reports the correlation coefficients between the dependent variables, the measures for exter-

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[18] Finally, Table 1 reports descriptive statistics for three variables that will be used to evaluate the robustness of our results. The variables are $AUDIT_i$ (= dummy set to 1 if firm is audited by one of the internationally recognized 'Big Five' accounting firms), $LOANDEN_i$ (= dummy set to 1 if firm's loan applications has been turned down because of lack of collateral and/or guarantees during the last two years) and $AWARD_i$ (= dummy set to 1 if firm has during the last fiscal year or prior to it received gratuitous government awards of any kind (or if it has loans guaranteed by a governmental agency) that are not recorded in the balance sheet).

nal dependence and government funding. The correlation between $R\&D_i$ and $GROWTH_i$ is 0.80 and significant at the 1% level. This suggests that R&D firms have more growth opportunities, which is what we expected to find. The measures of external dependence are also highly correlated with each other; the only exception is the zero correlation between $EXDEPPROF_i$ and $EXTDEPOUT_i$. The dependent variables and the measures for external dependence correlate positively with each other; five out of the eight correlations are statistically significant. Because growth-oriented and R&D-intensive firms are on average likely to be dependent on external finance, these findings lend credence to our measures of financial dependence. Finally, $GOVFUN_i$ is positively correlated (at the 1 % level) both with the dependent variables as well as the measures for external dependence; the only exception is the correlation with $EXDEPPROF_i$, which is next to zero. The positive correlations are precisely what one would expect to find if there are positive selection effects (Wallsten 2000) and if government awards tended to be allocated to firms that are dependent on external finance.

[Insert Table 2 here]

Table 3 reports the external dependence for each of our industries, as measured using data on SMEs residing in the metropolitan Helsinki area. The table shows that according to $EXDEPOUT_j$, '*ICT services, excluding software*' is the most and '*Services n.e.c.*' the least dependent industry on external finance. The ranking of the industries naturally varies with the measure used. The measures are, however, positively correlated. While not reported in the table, the largest correlation (between $EXDEPSG_j$ and $EXDEPLOSS_j$) is 0.52, while the smallest one (between $EXDEPOUT_j$ and $EXDEPSG_j$) is 0.12. Note, finally, that $EXDEPLOSS_j$ has more variation cross industries than the other three measures.

[Insert Table 3 here]

Finally, Table 4 reports the average reliance by firms on government funding for each TE Centre. The table shows that in a TE Centre situated in '*Kainuu*' firms rely most (on average 17%) and in '*Uusimaa*' and in '*Pohjanmaa*' least (to be precise, on average 4.0% and 4.2%, respectively) on government funding. These patterns are remarkably intuitive, because '*Uusimaa*' includes the metropolitan Helsinki area and because '*Kainuu*' lies in North-Eastern Finland (located nearby the Russian border) and suffers from a shrinking economy and high unemployment. The mean of $GOVFUN_a$ cross TE Centres is 8%.

[Insert Table 4 here]

5 Empirical Results

5.1 Basic Results

In Table 5 we report the results of Tobit regressions of equation (1), obtained using the four different measures of external dependence (one column each), and using our two dependent variables ($R\&D_i$ in Panel A, $GROWTH_i$ in Panel B). Besides the interaction term, the specification also includes industry and area dummies, AGE_i, EMP_i and their squares. Since we use data from the Helsinki metropolitan area to identify dependence on external finance, we drop SMEs residing in that area from all regressions.[19]

[Insert Table 5 here]

In the first column the measure for external dependence is $EXDEPOUT_j$. We find that the coefficient for the interaction term is positive and statistically

[19] This means that we 'lose' in total 165 firm-observations. We have also run the regressions reported in Table 5 including these firms with a Helsinki dummy variable for the excluded firms and the product of the interaction term and the Helsinki dummy. The results do not differ from those reported here.

significant at the 5% level in the R&D and at the 10% level in the growth equation. As the second column shows, when our measure for external dependence is $EXDEPSG_j$, the interaction term is significant at standard levels only in the growth equation. As we discussed earlier, this measure of financial dependence does not take into account the long-term nature of R&D, and was therefore expected to perform less well in the R&D equation. In column three, external dependence is measured using $EXDEPLOSS_j$. The interaction term carries a highly significant positive coefficient in both equations. Finally, in column four, external dependence is measured using $EXDEPPROF_j$. Again, the interaction terms' coefficients are positive and highly significant. These results suggest that the R&D investments and perceived growth prospects of firms that operate in industries that are dependent on external financing are disproportionately positively affected by the availability of government funding in their area. This is evidence both for imperfections in (local) capital markets, as well as for positive (additionality) effects of government funding.

Table 5 also reveals that $R\&D_i$ and $GROWTH_i$ are initially directly related to the size of the SME, as measured by EMP_i, but begin to decrease with size after a threshold. AGE_i has a non-linear effect only on $GROWTH_i$.

Table 6 repeats the exercise but now the results are based on an extended specification with 14 additional firm characteristics. We lose 28 observations compared to Table 5. Whilst the extended vector of firm characteristics allows us further to control for the characteristics of firms, this does come at the price of possible endogeneity problems. Our main interest is however in the coefficient of the interaction term, not in the coefficients of the firm characteristics. It is promising to note that the results do not change; even the point estimates are very close to those in Table 5. Our results on capital market imperfections and effects of government financing are not driven by omitted firm level characteristics.

[Insert Table 6 here]

It is of some independent interest to observe that $CEOEDUC_i$, $BOARD_i$, $PATENT_i$ and $INTANG_i$ have a statistically significant positive correlation with $R\&D_i$, while $BOARDINS_i$ correlates negatively with it. These qualitative results are similar in the $GROWTH_i$ regression, with the exception that correlation with $CEOEDUC_i$ is not statistically significant. These findings are what one would expect, though the positive correlation with board size is a bit surprising. The other firm-level control variables do not obtain statistically significant coefficients in either equation.

5.2 Economic Significance of Results

Are the documented effects economically significant? To address the question, we display in Table 7 a set of marginal effects evaluated at the means of the independent variables for the models reported in Table 6 (i.e. using the full set of firm-level control variables and the four measures for external dependence). The marginal effects are presented for the expected value of the dependent variable conditional on being uncensored, the unconditional expected value of the dependent variable, and the probability of being uncensored.

To begin with, consider the marginal effects reported in Panel A for the interaction term that is based on $EXDEPOUT_j$. If there was a two percentage point (half the cross area standard deviation) increase in government funding in the area where a firm resides, then in an industry where, say, every fifth euro is attributable to outside financiers, i) the firm would, on average, invest about 0.05 million euros more in R&D ($0.2*0.02*11.460 \approx 0.046$), ii) the firm would, provided that it already does R&D, invest about 0.04 million euros more in R&D ($0.2*0.02*9.005 \approx 0.036$) on the top it is currently investing, and iii) the probability of the firm doing R&D would be around 5% higher ($0.2*0.02*13.374 \approx 0.053$). Given that the unconditional mean R&D in the estimation sample is 0.10 million euros, the mean R&D conditional on doing R&D is 0.15 million euros and the probability of being censored is 0.35, the effects are economically not negligible. The effects are of similar magnitude for the other measures of external dependence and for the growth equation.

[Insert Table 7 here]

What the reported marginal effects also illustrate is that government funding *disproportionately* helps firms in industries that are *more* dependent on external finance. For example, in an area where every thirtieth euro of the total debt and equity is attributable to government agencies, the *differential* in the probability of doing R&D is about 5 percentage points ($(0.33-0.2)*0.03*13.374 \approx 0.052$) between firms in industries where every third euro is attributable to outside financiers and firms in industries where every fifth euro is attributable to outside financiers. The corresponding differential in the probability of becoming a growth firm is nearly four percentage points ($(0.33-0.2)*0.03*9.415 \approx 0.036$).

5.3 Robustness Tests

Are the documented effects statistically robust? To address this question, we conduct a number of robustness tests. We have run the tests using the full vector of firm level control variables. To save space, we only report the coefficients of the interaction variable in most of what follows.

A. Varying the Measure of External Dependence

Our results have so far been shown to hold for four different measures of external dependence. We undertake an additional robustness check to make sure that our measures of external dependence are reasonable. In Table 8, external dependence is measured in relative terms, i.e., on the basis of the ranking of the industries that the industry means imply. The highest rank indicates the strongest dependence on external finance. The use of the ranking is motivated by the qualitative nature of our basic hypothesis suggesting that if capital markets are imperfect, firms in industries that are *more* dependent on external financing will invest relatively more in R&D and are relatively more growth-oriented had they more government funding around. As the table shows, the interaction variables remain positive and the patterns of statistical significance are similar to those in Table 6.

[Insert Table 8 here]

B. Varying the Measure of Government Funding

It is reasonable to ask whether the results depend on how we measure the reliance by firms on government funding. In what follows, we run three tests to show that the results are not sensitive to the choice of this measure.

First, we measure the availability of government funding in relative terms, i.e., on the basis of the ranking of TE Centres that the area means imply. Specifically, we compute for each TE Centre the mean fraction of total debt and equity attributable to governmental sources (as before) and then assign a ranking to each TE Centre according to the means, with the highest rank indicating the heaviest reliance on government funding. As above, the use of the ranking is motivated by the qualitative nature of our basic hypothesis suggesting that if capital markets are imperfect, firms in industries that are more dependent on external financing will invest relatively more in R&D and are relatively more growth-oriented had they *more* government funding around.

Second, as we already discussed, one limitation of the measure is that it does not include gratuitous government awards that are not recorded in the balance sheet of firms. To address the limitation, we include $AWARD_i$ (= dummy set to 1 if firm has during the last fiscal year or prior to it received gratuitous government awards of any kind (or if it has loans guaranteed by a government agency) that are not recorded in the balance sheet) to the regressions reported in Table 5 and 6. We expect the dummy variable to be endogenous due to positive or negative selection bias.[20] Despite the possible bias, we include the dummy to illustrate that our results are not driven by an omitted award variable.

Third, because model (1) does not include the firm-level subsidy variable ($GOVFUN_i$), a skeptical reader might think that we have so far demonstrated nothing but an omitted $GOVFUN_i$ problem. To show that this is not the case, we repeat the above exercise by including it to the regressions. We expect $GOVFUN_i$ to be endogenous due to positive selection bias.

Tables 9-11 report the results for the three tests. Table 9 shows that the results are robust to using the alternative, rank-based definition for the availability of government funding. The regressions with $AWARD_i$, reported in Table 10, show that the interaction term is positive and significant as before and that the dummy obtains a positive coefficient that is never statistically significant. Finally, the regressions with $GOVFUN_i$, reported in Table 11, show that the interaction

[20] The positive selection bias may arise if firms apply for awards because they have discovered promising projects. Similarly, the chance of the firm winning an award may also increase with the amount of R&D it does and the growth options it has. However, because the dummy also captures government employment subsidies, negative selection bias may also arise.

term is positive and significant as before. The firm-level $GOVFUN_i$ always obtains a positive coefficient that is statistically significant in the growth but not in R&D equation. We conclude that an omitted subsidy variable is not driving the results.

[Insert Tables 9-11 here]

As a final robustness check of how to measure government funding, we address the concern that we cannot be sure that the geographical distribution of TE Centres truly reflects the geographical distribution of the relevant local capital markets. We therefore re-run the basic regressions using Finnish regions instead of TE Centres.[21] Although not reported, we found few, if any, changes in the results.

C. Do Capital Market Imperfections Drive the Results?

We have claimed that government funding disproportionately helps firms in industries that are dependent on external finance *because* capital markets are imperfect. The aim of our final robustness test is to deliver evidence supporting this claim. To derive a proper test, we make a new prediction: Holding other things constant, firms in industries that are more prone to suffer from capital market imperfections will invest relatively more in R&D and are relatively more growth-oriented, the more they have government funding around. We test this prediction using the following modified version of model (1):

$$\begin{aligned} Y_i = {} & \alpha + \beta \cdot (Market\ imperfection_j \cdot Government\ \ funding_a) \\ & + \Phi_1 \cdot Industry\ dummies_j + \Phi_2 \cdot Area\ dummies_a + \Phi_3 \cdot Controls_i \\ & + Error_i \end{aligned} \qquad (2)$$

[21] Finland consists of 20 ‘regions’, which are kind of small provinces. While the geographical distribution of regions resembles that of TE Centres, there are some differences. They stem from the fact that regions outnumber TE Centres and TE Centres are a governmental organization whereas regions are more like coalitions of municipalities.

In model (2), $Market\ imperfection_j$ has replaced $External\ dependence_j$. The new industry level -variable measures the extent to which an industry is prone to suffer from capital market imperfections. We compute it for each industry using data on SMEs residing *outside* the metropolitan Helsinki area. Two alternative measures are used. The first one is based on industry average of $AUDIT_i$ (dummy set to 1 if firm is audited by one of the internationally recognized 'Big Five' accounting firms; see Table 1 for descriptive statistics). The justification for this measure is that the use of such auditors should be more prevalent in industries that have a higher need to demonstrate their creditworthiness to outsiders, i.e., the measure should be correlated with an industry's difficulties in attracting outside financing (see, e.g., Titman and Trueman 1986 and Core 2001).[22] The second measure is the industry average of $LOANDEN_i$ (= dummy set to 1 if a firm's loan application has been turned down because of lack of collateral and/or guarantees during the last two years; see Table 1 for descriptive statistics).[23] This measure aims to capture industry specific difficulties in attracting outside debt finance.

We reran the regressions reported in Table 5 using these two measures of $Market\ imperfection_j$ and report the results in Table 12. In all cases, the coefficient of the interaction term is positive and significant. It remains so even if we include (firm-level) $AUDIT_i$ or $LOANDEN_i$ in the estimation equation. We have also rerun the regressions reported in Table 12 using the full set of explanatory vari-

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[22] High quality disclosure may be especially important for firms with high growth options because for them standard disclosure is of too low quality and alleviates information asymmetry only to a limited extent (see, e.g., Core 2001). Because of the costs of high quality disclosure, such as the premium charged by the internationally recognized auditors, the firms that choose the high quality disclosure (e.g., a prestigious auditor) are, in equilibrium, those with favorable information about the firm's future and its growth opportunities (see Titman and Trueman 1986 for a formal model).

[23] In the survey, entrepreneurs were asked: "Has your firm's application for a loan been turned down by a bank or some other credit institution because of lack of collateral (or guarantees) during the last two years?" The question was asked in two parts, first suggesting lack of collateral (Question 30) and then lack of guarantees (Question 31) as the reason for denial.

ables (as in Table 6); the results were almost identical to those reported in Table 12. The results suggest that firms in industries that are more prone to suffer from capital market imperfections will invest relatively more in R&D and are relatively more growth-oriented, the more they have government funding around.

[Insert Table 12]

D. Additional Robustness Tests

Because of the censored nature of our dependent variables, we have (until now) employed the old and well-known Tobit maximum likelihood estimator when estimating model (1). While very widely used, this estimator entails a rather stringent distributional assumption (normality) and relies on the error terms being homoskedastic. If these assumptions are violated, the maximum likelihood estimator will not provide consistent estimates. We tackle this potential problem in a number of ways. First, we estimate our basic model using OLS and the full vector of firm-level control variables. Despite the potential inconsistency of this estimator in the presence of censoring, it provides us with a first check of the potential problems with the Tobit model. There is, in fact, evidence that miss-specifying the errors as being normally distributed and using the maximum likelihood method may result in more biased estimates than ignoring the censoring problem entirely and using OLS (Chay and Powell 2001; see also Chay and Honore 1998). Second, we log-transform the dependent variable and re-estimate the basic model both using OLS and the Tobit maximum likelihood estimator. This way of transforming the dependent variable is a means to account for the non-normality of the errors also when the dependent variable is censored (see Maddala 1983, pp. 190-192, for a discussion). Third, we estimate a version of our model using the censored least absolute deviations (CLAD) estimation method proposed by Powell

(1984). This estimator both accounts for censoring and permits non-normal, heteroscedastic and asymmetric errors.

We perform each of the above-described robustness tests for our two dependent variables and the four different measures of external dependence. We therefore obtain over thirty new estimates for the interaction term, on which our analysis focuses. The results of the tests can be summarized as follows:

- When the basic model is estimated by OLS, the coefficient of the interaction term is positive and statistically significant at better than the 10% level in each of the eight regressions we run. In five of these regressions, it is significant at the 5% level.
- When the dependent variables are log-transformed and the estimation method is OLS, the coefficient of the interaction term is positive and statistically significant at better than the 10% level in seven out of the eight cases and at better than the 5% level in six out of the eight cases. With the log-transformed dependent variables and the Tobit estimator, the same pattern of statistical significance holds.
- It turns out that we cannot resort to Powell's CLAD estimator without a cost. The cost arises because the objective function that the estimator solves (minimizes) is not convex and because the problems that this non-convexity give rise to are likely to increase with the number of regressors (see also Buchinsky and Hahn 1998). In our case, the estimator fails to converge when we try to estimate our basic model, both with the smaller set (cf. Table 5) and full vector (cf. Table 6) of firm-level control variables. To apply the estimator, we proceed as follows. We only consider the small set of firm-level controls. We first estimate the model using the Tobit estimator *without* industry and area dummies to check how our re-

sults change if they are not controlled for. It turns out that in all cases, the coefficient of the interaction term *decreases*, but remains clearly positive. In fact, its statistical significance *increases* in all eight regressions we run: the term is now significant at the 5% level in *all* cases and at better than the 1% level in seven out of the eight regressions. When then we apply Powell's CLAD estimator to this "trimmed" model and bootstrap the standard errors, we find that the size of the coefficient of the interaction term decreases further in both R&D and growth equations. However, the term is positive and significant at better than the 10% level in six out of the eight regressions.

Taken together, the foregoing tests show that our results are driven neither by the normality nor homoskedasticity assumption.

As a final robustness test, we investigate whether "biotechnology-related" SMEs are driving our results. Biotechnology firms are typically R&D intensive and growth-oriented, and dependent on external finance. In Finland, they are also clustered on certain geographical areas (see the Academy of Finland 2002). The reason we investigate the effects of this group of SMEs on our results is that a closer look at the unconditional R&D and growth distributions revealed that "biotechnology-related" SMEs are clearly more R&D-intensive and growth-oriented than other SMEs in our sample.[24] Given that the Finnish government has through various agencies and means invested heavily in such firms since the early 1990s, it is of interest to include a dummy for SMEs in biotechnology business in our basic regression models (cf. Tables 5 and 6). Doing so does not change the basic results: the interaction remains statistically significant. The dummy obtains, however, a positive and in most cases statistically significant coefficient. This finding indicates that the "biotechnology-related" SMEs are very R&D intensive and growth-oriented even after controlling for their age, size and other characteristics.

E. Summary of Robustness Tests

We have shown that our results are robust to a variety of alternative definitions of key variables and to including (possibly endogenous) firm-level subsidy variables in the estimating equation. We also provided supporting evidence for the claim that government funding disproportionately helps firms in industries that are dependent on external finance because capital markets are imperfect. The results hold also when we allow for non-normal, heteroscedastic and asymmetric errors when estimating our censored regression model.

Overall, the results support the view that the growth and innovativeness of small firms is constrained by access to external finance, and that government funding is able to alleviate these constraints.

6 Conclusions

The hypothesis put forward and tested in this paper is that if there are economically significant imperfections in capital markets, government funding should *disproportionately* help firms in industries that are dependent on external finance. We deliver evidence supporting the hypothesis by studying the effects of government funding on the R&D investments and growth orientation of SMEs in Finland.

We adapt the methodology put forward by Rajan and Zingales (1998). First, in place of their financial development -variable, we use a measure of the avail-

[24] We cannot identify "biotechnology-related" SMEs using the standard industry classifications. However, the survey on which our data is based included a question about whether the respondent firm is in "biotechnology business".

ability of government funding to privately owned SMEs. We also shift the focus to the effects of cross-regional, between industry differences on a firm-level variable. Finally, we identify industries' technological demand for external finance, but using data on SMEs in the metropolitan Helsinki area that has the most developed capital market within Finland.

Our analysis shows that firms in industries that are more dependent on external financing invest relatively more in R&D and are relatively more growth-oriented when they have more government funding (potentially) available. The result is robust to a number of tests. We also demonstrate that the effects are economically significant.

The findings of this paper suggest that SMEs face an upward-sloping capital supply curve and hence that the market for SME finance is imperfect. The evidence is consistent with the view that financial constraints hold back innovation and growth, and the hypothesis that government funding can alleviate capital market imperfections. The latter finding is of special policy interest, not only because it contributes to the recent research studying the effects of public policy on firm performance but also because it qualifies the picture portrayed by the recent papers of La Porta, Lopez-de-Silanes and Shleifer (2002) and Sapienza (2003) on the effects of government ownership of financial institutions. While these papers have convincingly shown that the government ownership of financial institutions leads to misallocation of capital that can be detrimental to economic growth, our findings suggest that the type of government involvement may matter. Beyond these conclusions, our results have no implications for public policy. In particular, one cannot draw conclusions about the welfare effects of government funding (cf. de Meza and Webb 1987, 2000 and de Meza 2002). Measuring these remains a challenging topic for future research.

So, to conclude, does enterprise lead and finance follow? Our answer to this long-standing question is ‘no’, as for Finnish SMEs it seems to be the other way around.

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Figure 1 The Effect of Financial Market Imperfections

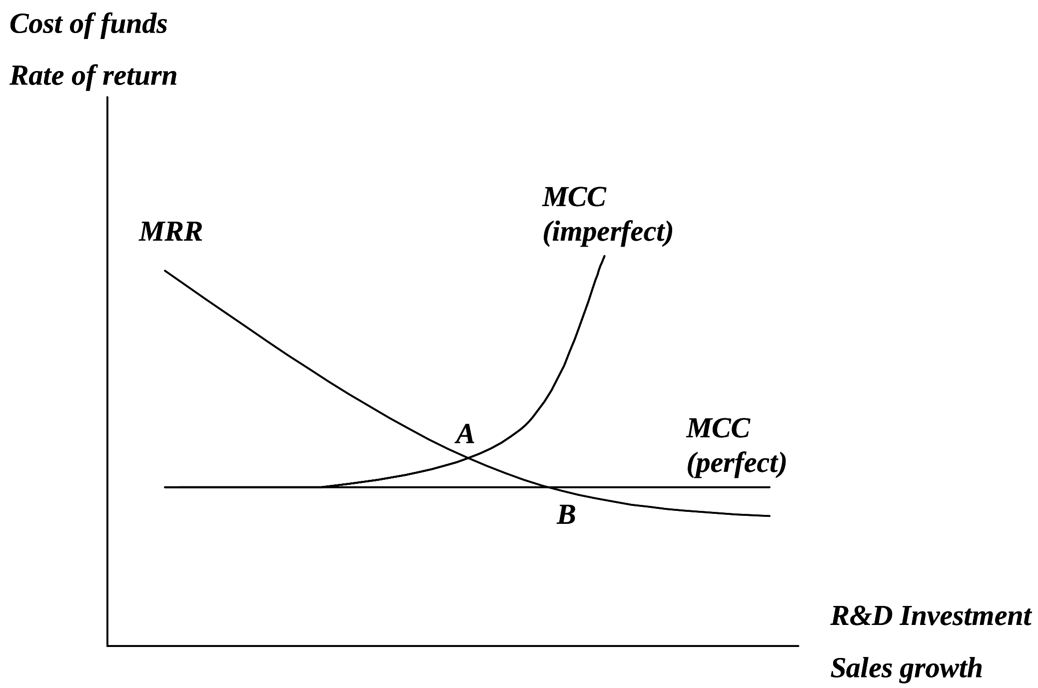

Figure 2 The (Direct) Effect of Shifting the MCC Schedule

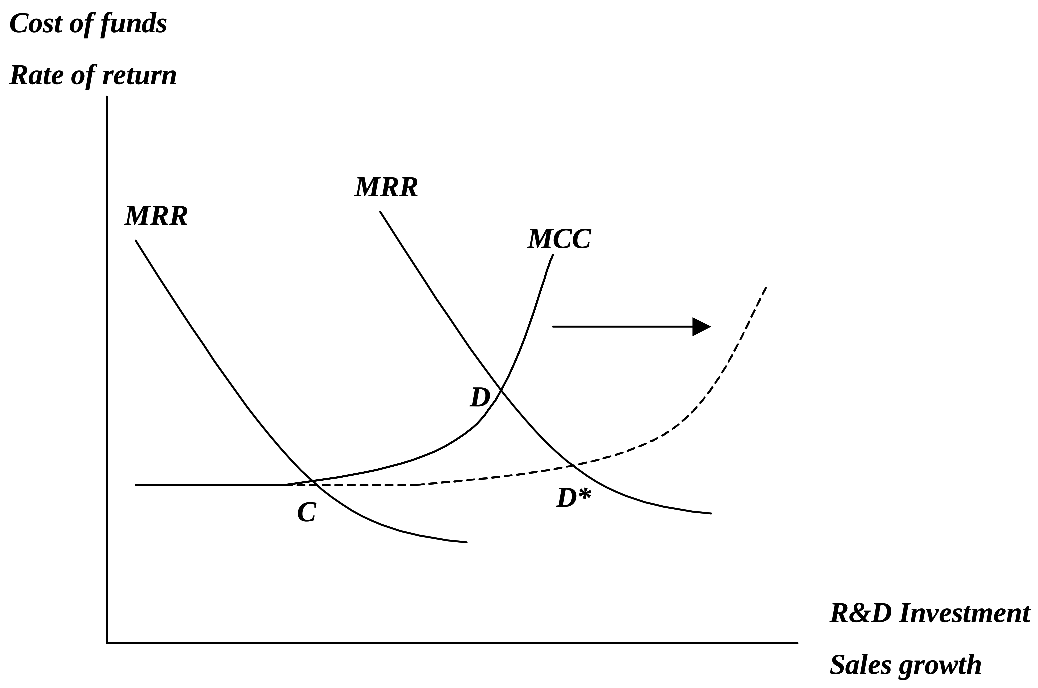

Table 1 Firm-level Descriptive Statistics

	Obs	Mean	Std. Dev.	Min	Max
$R\&D_i$	618	0.11	0.69	0.00	15.47
$GROWTH_i$	675	0.19	0.49	0.00	10.00
$EXDEPOUT_i$	723	0.40	0.34	0	1
$EXDEPSG_i$	646	0.36	0.48	0	1
$EXDEPLOSS_i$	724	0.10	0.31	0	1
$EXDEPPROF_i$	675	0.33	0.47	0	1
$GOVFUN_i$	715	0.07	0.16	0	1
AGE_i	723	15.92	16.69	0	118
EMP_i	724	17.16	26.60	1	230
$CEOAGE_i$	706	9.34	7.07	0	42
$CEOEDUC_i$	709	0.29	0.45	0	1
$PRINSOWN_i$	724	0.69	0.46	0	1
$SHAREAGR_i$	712	0.24	0.43	0	1
$CONCOWN_i$	723	0.96	0.21	0	1
$FOREOWN_i$	724	0.04	0.20	0	1
$BOARDOWN_i$	723	0.88	0.33	0	1
$BOARD_i$	723	2.85	1.49	0	12
$BOARDINS_i$	723	1.76	1.03	0	8
$CEOCHAIR_i$	722	0.50	0.50	0	1
$INPROD_i$	720	0.44	0.50	0	1
$INPROC_i$	716	0.30	0.46	0	1
$PATENT_i$	723	0.12	0.33	0	1
$INTANG_i$	722	0.22	0.41	0	1
$LOANDEN_i$	724	0.05	0.21	0	1
$AUDIT_i$	721	0.24	0.43	0	1
$AWARD_i$	724	0.45	0.50	0	1

Notes: This table reports firm-level descriptive statistics (number of observations, mean, standard deviation, minimum and maximum). The number of observations for an explanatory variable may exceed the number observations for the dependent variables, because we lack data on $R\&D_i$ for some firms for which we have data on $GROWTH_i$, and vice versa. All the information is obtained from a primary survey administrated by the Research Institute of the Finnish Economy (ETLA) and its subsidiary Etlatieto Ltd between December 2001 and January 2002. The survey covered SMEs that are not proprietorships, partnerships, or subsidiaries and that are not from farm, financial, or real-estate sectors.

Table 2 Selected Firm-level Correlations

	$R\&D_i$	$GROWTH_i$	$EXDEPOUT_i$	$EXDEPLOSS_i$	$EXDEPSG_i$	$EXDEPPROF_i$	$GOVFUN_i$
$R\&D_i$	1.00						
	618						
$GROWTH_i$	0.80	1.00					
	(0.00)						
	569	675					
$EXDEPOUT_i$	0.03	0.05	1.00				
	(0.49)	(0.23)					
	617	674	723				
$EXDEPLOSS_i$	0.17	0.25	0.19	1.00			
	(0.00)	(0.00)	(0.00)				
	618	675	723	724			
$EXDEPSG_i$	0.09	0.20	0.16	0.40	1.00		
	(0.03)	(0.00)	(0.00)	(0.00)			
	553	610	646	646	646		
$EXDEPPROF_i$	0.08	0.05	0.00	0.19	0.09	1.00	
	(0.05)	(0.26)	(0.97)	(0.00)	(0.03)		
	577	631	674	675	607	675	
$GOVFUN_i$	0.18	0.28	0.38	0.21	0.24	-0.02	1.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.69)	
	611	669	715	715	640	667	715

Notes: This table reports firm-level pairwise correlations (coefficient of correlation, p-value and number of observations) for dependent variables and selected firm-level variables measuring external dependence and government funding. The number of observations vary, because we lack data on *$R\&D_i$* for some firms for which we have data on *$GROWTH_i$*, and vice versa. All the information is obtained from a primary survey administrated by the Research Institute of the Finnish Economy (ETLA) and its subsidiary Etlatieto Ltd between December 2001 and January 2002. The survey covered SMEs that are not proprietorships, partnerships, or subsidiaries and that are not from farm, financial, or real-estate sectors.

Table 3 Industry-level Descriptive Statistics for External Dependence

PANEL A	Means			
	$EXDEPOUT_j$	$EXDEPSG_j$	$EXDEPLOSS_j$	$EXDEPPROF_j$
ICT services, excluding software	0.49	0.33	0.14	0.29
R&D services	0.49	0.38	0.22	0.75
Wood-processing and chemicals	0.46	0.50	0.50	0.67
Printing and publishing	0.46	0.67	0.20	0.50
Mechanical engineering	0.46	0.22	0.00	0.20
Trade and transport	0.40	0.29	0.04	0.36
Electrical engineering n.e.c.	0.40	0.00	0.00	0.50
Food, beverages, textiles	0.37	0.33	0.00	0.50
Scientific instruments	0.34	0.60	0.00	0.20
ICT manufacturing n.e.c.	0.32	0.36	0.00	0.31
Computers	0.31	0.60	0.29	0.57
Software	0.27	0.43	0.21	0.43
Metals, construction, energy supply	0.18	0.25	0.00	0.33
Services n.e.c.	0.16	0.26	0.05	0.35

PANEL B	Summary statistics			
	Mean	Std. Dev.	Min	Max
$EXDEPOUT_j$	0.37	0.11	0.16	0.49
$EXDEPSG_j$	0.37	0.18	0.00	0.67
$EXDEPLOSS_j$	0.12	0.15	0.00	0.50
$EXDEPPROF_j$	0.43	0.17	0.20	0.75

Notes: n.e.c = not elsewhere cited. Panel A of this table reports the mean of the four measures of external dependence for 14 industries (defined using two-level SIC-like industry codes), measured using data on SMEs residing in the metropolitan Helsinki area. Panel B of the table reports summary statistics for the four measures. All the information is obtained from a primary survey administrated by the Research Institute of the Finnish Economy (ETLA) and its subsidiary Etlatieto Ltd between December 2001 and January 2002. The survey covered SMEs that are not proprietorships, partnerships, or subsidiaries and that are not from farm, financial, or real-estate sectors.

Table 4 TE Centre-level Descriptive Statistics for Government Funding

PANEL A	Mean $GOVFUN_a$
Kainuu	0.17
Pohjois-Pohjanmaa	0.12
Etelä-Savo	0.11
Varsinais-Suomi	0.11
Keski-Suomi	0.11
Pohjois-Karjala	0.10
Pohjois-Savo	0.09
Lappi	0.06
Häme	0.06
Etelä-Pohjanmaa	0.05
Satakunta	0.05
Pirkanmaa	0.04
Kaakkois-Suomi	0.04
Pohjanmaa	0.04
Uusimaa	0.04

PANEL B	Summary statistics			
	Mean	Std. Dev.	Min	Max
$GOVFUN_a$	0.08	0.04	0.04	0.17

Notes: n.e.c = not elsewhere cited. Panel A of this table reports the mean of government funding for 15 TE Centres, measured using data on SMEs residing in each TE-Centre. Panel B of the table reports summary statistics for the measure. All the information is obtained from a primary survey administrated by the Research Institute of the Finnish Economy (ETLA) and its subsidiary Etlatieto Ltd between December 2001 and January 2002. The survey covered SMEs that are not proprietorships, partnerships, or subsidiaries and that are not from farm, financial, or real-estate sectors.

Table 5 R&D and Firm Growth Regressions

PANEL A	Dependent variable: $R\&D_i$							
	(1)		(2)		(3)		(4)	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
$GOVFUN_a$ *								
$EXDEPOUT_j$	26.88	2.04	-		-		-	
$EXDEPSG_j$	-		13.02	1.54	-		-	
$EXDEPLOSS_j$	-		-		29.73	3.46	-	
$EXDEPPROF_j$	-		-		-		22.21	2.41
AGE_i	-8.5E-03	-1.11	-7.7E-03	-1.01	-6.9E-03	-0.91	-7.4E-03	-0.96
AGE^2_i	3.7E-05	0.43	3.0E-05	0.35	2.0E-05	0.24	2.4E-05	0.29
EMP_i	0.02	5.29	0.02	5.13	0.02	5.24	0.02	5.25
EMP^2_i	-1.0E-04	-3.49	-1.0E-04	-3.44	-1.0E-04	-3.45	-1.0E-04	-3.50
Ind. dummies	Yes		Yes		Yes		Yes	
Area dummies	Yes		Yes		Yes		Yes	
Observations	476		476		476		476	
Censored obs.	173		173		173		173	
Log likelihood	-472.28		-473.19		-468.43		-471.49	
LR Chi^2	82.14		80.33		89.84		83.73	
degr. of freedom	32		32		32		32	
significance	0.00		0.00		0.00		0.00	
R^2_{pseudo}	0.08		0.08		0.09		0.08	

PANEL B	Dependent variable: $GROWTH_i$							
	(1)		(2)		(3)		(4)	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
$GOVFUN_a$ *								
$EXDEPOUT_j$	12.22	1.80	-		-		-	
$EXDEPSG_j$	-		10.39	2.20	-		-	
$EXDEPLOSS_j$	-		-		19.93	4.15	-	
$EXDEPPROF_j$	-		-		-		14.83	2.89
AGE_i	-0.01	-3.30	-0.01	-3.19	-0.01	-3.06	-0.01	-3.21
AGE^2_i	1.1E-04	2.28	1.1E-04	2.19	9.8E-05	2.05	1.1E-04	2.19
EMP_i	8.2E-03	3.58	7.8E-03	3.43	7.9E-03	3.53	7.9E-03	3.51
EMP^2_i	-4.1E-05	-2.74	-4.0E-05	-2.68	-3.9E-05	-2.68	-4.0E-05	-2.74
Ind. dummies	Yes		Yes		Yes		Yes	
Area dummies	Yes		Yes		Yes		Yes	
Observations	519		519		519		519	
Censored obs.	97		97		97		97	
Log likelihood	-398.09		-397.30		-391.28		-395.56	
LR Chi^2	69.45		71.04		83.07		74.51	
degr. of freedom	32		32		32		32	
significance	0.00		0.00		0.00		0.00	
R^2_{pseudo}	0.08		0.08		0.10		0.09	

Notes: This table reports Tobit regressions of the model: $Y_i = \alpha + \beta(\textit{External dependence}_j \cdot \textit{Government funding}_a) + \Phi_1 \cdot \textit{Industry dummies}_j + \Phi_2 \cdot \textit{Area dummies}_a + \Phi_3 \cdot \textit{Controls}_i + \textit{Error}_i$. In Panel A, the dependent variable is R&D in millions of euros. In Panel B, it is the average sales growth rate over the next three years, as projected by the entrepreneurs themselves. The coefficients corresponding to rows $EXDEPOUT_j$, $EXDEPSG_j$, $EXDEPLOSS_j$, and $EXDEPPROF_j$ are those of the interaction term because we are not able to identify any direct effects of these variables because of the inclusion of industry and area specific dummies (coefficients are for brevity not reported). Since we use data from the Helsinki metropolitan area to identify dependence on external finance, we have dropped SMEs residing in that area from the regressions.

Table 6 R&D and Firm Growth Regressions with Further Firm-level Controls

PANEL A	Dependent variable: $R\&D_i$							
	(1)		(2)		(3)		(4)	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
$GOVFUN_a$ *								
$EXDEPOUT_j$	29.26	2.15	-		-		-	
$EXDEPSG_j$	-		10.98	1.29	-		-	
$EXDEPLOSS_j$	-		-		31.83	3.57	-	
$EXDEPPROF_j$	-		-		-		24.92	2.60
AGE_i	-0.01	-1.21	-9.7E-03	-1.04	-9.7E-03	-1.05	-0.01	-1.08
$AGE\text{^}2_i$	3.8E-05	0.37	2.4E-05	0.23	2.2E-05	0.22	2.6E-05	0.26
EMP_i	0.02	4.28	0.02	4.09	0.02	4.26	0.02	4.25
$EMP\text{^}2_i$	-9.2E-05	-2.98	-9.1E-05	-2.93	-9.1E-05	-2.98	-9.4E-05	-3.04
$CEOAGE_i$	-5.9E-04	-0.07	-1.5E-03	-0.18	-4.9E-04	-0.06	-4.6E-04	-0.06
$CEOEDUC_i$	0.23	2.01	0.23	2.01	0.21	1.86	0.23	1.98
$PRINSOWN_i$	-0.03	-0.29	-0.02	-0.18	-0.01	-0.12	-0.02	-0.15
$SHAREAGR_i$	-0.15	-1.26	-0.15	-1.28	-0.15	-1.27	-0.13	-1.12
$CONCOWN_i$	0.07	0.26	0.07	0.26	0.08	0.27	0.10	0.34
$FOREOWN_i$	-0.10	-0.39	-0.09	-0.35	-0.06	-0.22	-0.09	-0.37
$BOARDOWN_i$	0.15	0.81	0.12	0.65	0.12	0.64	0.12	0.64
$BOARD_i$	0.12	2.94	0.12	2.98	0.12	3.08	0.13	3.16
$BOARDINS_i$	-0.13	-2.39	-0.12	-2.13	-0.13	-2.32	-0.12	-2.26
$CEOCHAIR_i$	-0.01	-0.11	-0.01	-0.10	7.1E-03	0.06	0.01	0.13
$INPROD_i$	0.13	1.22	0.11	1.04	0.14	1.35	0.17	1.54
$INPROC_i$	0.09	0.84	0.09	0.89	0.05	0.45	0.05	0.50
$PATENT_i$	0.38	2.69	0.39	2.73	0.35	2.54	0.35	2.50
$INTANG_i$	0.26	2.17	0.25	2.12	0.27	2.32	0.25	2.10
Ind. dummies	Yes		Yes		Yes		Yes	
Area dummies	Yes		Yes		Yes		Yes	
Observations	448		448		448		448	
Censored obs.	157		157		157		157	
Log likelihood	-431.36		-432.85		-427.39		-430.31	
LR Chi^2	124.32		121.34		132.25		126.41	
degr. of freedom	46		46		46		46	
significance	0.00		0.00		0.00		0.00	
R^2_{pseudo}	0.13		0.12		0.13		0.13	

PANEL B	Dependent variable: $GROWTH_i$							
	(1)		(2)		(3)		(4)	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
$GOVFUN_a$ *								
$EXDEPOUT_j$	12.39	1.80	-		-		-	
$EXDEPSG_j$	-		9.94	2.10	-		-	
$EXDEPLOSS_j$	-		-		20.99	4.28	-	
$EXDEPPROF_j$	-		-		-		16.17	3.10
AGE_i	-0.01	-2.61	-0.01	-2.45	-0.01	-2.40	-0.01	-2.51
$AGE\text{^}2_i$	8.5E-05	1.56	7.7E-05	1.43	7.2E-05	1.35	7.8E-05	1.45
EMP_i	5.6E-03	2.27	5.0E-03	2.07	5.5E-03	2.31	5.4E-03	2.22
$EMP\text{^}2_i$	-2.9E-05	-1.87	-2.7E-05	-1.76	-2.8E-05	-1.86	-2.9E-05	-1.89
$CEOAGE_i$	-5.5E-03	-1.23	-6.0E-03	-1.35	-5.8E-03	-1.34	-5.5E-03	-1.26
$CEOEDUC_i$	0.09	1.36	0.08	1.31	0.08	1.24	0.09	1.39
$PRINSOWN_i$	8.5E-03	0.13	0.02	0.26	0.01	0.23	0.01	0.20
$SHAREAGR_i$	-0.06	-0.91	-0.06	-0.97	-0.06	-0.93	-0.05	-0.70
$CONCOWN_i$	0.03	0.20	0.03	0.21	0.03	0.19	0.04	0.26
$FOREOWN_i$	-0.16	-1.13	-0.15	-1.04	-0.12	-0.88	-0.15	-1.05
$BOARDOWN_i$	0.10	1.04	0.09	0.88	0.08	0.83	0.08	0.82
$BOARD_i$	0.06	2.54	0.06	2.49	0.06	2.58	0.06	2.70
$BOARDINS_i$	-0.05	-1.84	-0.05	-1.61	-0.05	-1.77	-0.05	-1.84
$CEOCHAIR_i$	-0.03	-0.53	-0.04	-0.64	-0.02	-0.39	-0.03	-0.41
$INPROD_i$	-0.02	-0.26	-0.02	-0.42	5.3E-04	0.01	4.2E-03	0.07
$INPROC_i$	-3.3E-03	-0.06	-3.4E-03	-0.06	-0.04	-0.69	-0.03	-0.59
$PATENT_i$	0.31	3.82	0.32	3.87	0.29	3.60	0.29	3.54
$INTANG_i$	0.13	1.87	0.13	1.93	0.14	2.06	0.13	1.87
Ind. dummies	Yes		Yes		Yes		Yes	
Area dummies	Yes		Yes		Yes		Yes	
Observations	491		491		491		491	
Censored obs.	90		90		90		90	
Log likelihood	-363.28		-362.72		-356.00		-360.17	
LR Chi^2	109.06		110.18		123.63		115.28	
degr. of freedom	46		46		46		46	
significance	0.00		0.00		0.00		0.00	
R^2_{pseudo}	0.13		0.13		0.15		0.14	

Notes: see Table 5.

Table 7 Marginal Effects

PANEL A	Dependent variable: $R\&D_i$		
	Marginal effects at the means of explanatory variables		
	Unconditional expected value	Conditional on being uncensored	Probability uncensored
$GOVFUN_a$ *			
$EXDEPOUT_j$	11.46	9.00	13.37
$EXDEPSG_j$	4.31	3.39	5.01
$EXDEPLOSS_j$	12.49	9.80	14.76
$EXDEPPROF_j$	9.78	7.68	11.45
	Unconditional mean value	Mean conditional on being uncensored	Probability uncensored
$R\&D_i$	0.10	0.15	0.65
PANEL B	Dependent variable: $GROWTH_i$		
	Marginal effects at the means of explanatory variables		
	Unconditional expected value	Conditional on being uncensored	Probability uncensored
$GOVFUN_a$ x			
$EXDEPOUT_j$	7.10	5.02	9.42
$EXDEPSG_j$	5.71	4.04	7.58
$EXDEPLOSS_j$	12.11	8.56	16.25
$EXDEPPROF_j$	9.29	6.57	12.38
	Unconditional mean value	Mean conditional on being uncensored	Probability uncensored
$GROWTH_i$	0.18	0.21	0.82

Notes: This table reports the marginal effects of the Tobit regressions for the models that include area and industry fixed effects and the full vector of control variables (reported in Table 6): In Panel A, the dependent variable is R&D in millions of euros. In Panel B, it is the average sales growth rate over the next three years, as projected by the entrepreneurs themselves. The marginal effects have been evaluated at the means of the explanatory variables. The unconditional mean, mean conditional on being uncensored and probability uncensored of the dependent variables refer to the estimating sample.

Table 8 Robustness: Rank-based External Dependence

	Dependent variable:			
	$R\&D_i$		$GROWTH_i$	
	Coeff.	t-stat.	Coeff.	t-stat.
$GOVFUN_a$ *				
$EXDEPOUT_j$	0.96	2.49	0.42	2.11
$EXDEPSG_j$	0.62	1.59	0.56	2.65
$EXDEPLOSS_j$	1.52	3.05	1.04	3.76
$EXDEPPROF_j$	1.00	2.22	0.64	2.58

Notes: This table reports a modified version of the basic regressions that include area and industry fixed effects and the full vector of control variables (reported in Table 6): In Panel A, the dependent variable is R&D in millions of euros. In Panel B, it is the average sales growth rate over the next three years, as projected by the entrepreneurs themselves. The modification is that the four measures for external dependence are based on the ranking of the industries that the industry averages imply.

Table 9 Robustness: Rank-based Government Funding

	Dependent variable:			
	$R\&D_i$		$GROWTH_i$	
	Coeff.	t-stat.	Coeff.	t-stat.
$GOVFUN_a$ *				
$EXDEPOUT_j$	0.24	2.33	0.10	1.98
$EXDEPSG_j$	0.08	1.22	0.10	1.98
$EXDEPLOSS_j$	0.22	3.46	0.15	4.24
$EXDEPPROF_j$	0.19	2.64	0.13	3.26

Notes: This table reports a modified version of the basic regressions that include area and industry fixed effects and the full vector of control variables (reported in Table 6): In Panel A, the dependent variable is R&D in millions of euros. In Panel B, it is the average sales growth rate over the next three years, as projected by the entrepreneurs themselves. The modification is that the measure for government funding is based on the ranking of the TE Centres that the area averages imply.

Table 10 Robustness: The inclusion of *AWARD$_i$*

PANEL A	Dependent variable: R&D$_i$							
	(1)		(2)		(3)		(4)	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
GOVFUN$_a$ *								
EXDEPOUT$_j$	29.68	2.17	-		-		-	
EXDEPSG$_j$	-		11.21	1.31	-		-	
EXDEPLOSS$_j$	-		-		32.70	3.65	-	
EXDEPPROF$_j$	-		-		-		25.25	2.63
AWARD$_i$	0.07	0.70	0.07	0.66	0.10	0.96	0.07	0.73

PANEL B	Dependent variable: GROWTH$_i$							
	(1)		(2)		(3)		(4)	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
GOVFUN$_a$ *								
EXDEPOUT$_j$	12.47	1.82	-		-		-	
EXDEPSG$_j$	-		10.19	2.15	-		-	
EXDEPLOSS$_j$	-		-		21.19	4.32	-	
EXDEPPROF$_j$	-		-		-		16.22	3.11
AWARD$_i$	0.06	1.01	0.06	1.09	0.06	1.15	0.06	1.03

Notes: This table reports a modified version of the basic regressions that include area and industry fixed effects and the full vector of control variables (reported in Table 6): In Panel A, the dependent variable is R&D in millions of euros. In Panel B, it is the average sales growth rate over the next three years, as projected by the entrepreneurs themselves. The modification is that a new variable *AWARD$_i$* (= dummy set to 1 if firm has during the last fiscal year or prior to it received gratuitous government awards of any kind (or if it has loans guaranteed by a government agency) that are not recorded in the balance sheet) is included in the model.

Table 11 Robustness: The inclusion of *GOVFUN$_i$*

PANEL A	Dependent variable: R&D$_i$							
	(1)		(2)		(3)		(4)	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
GOVFUN$_a$ *								
EXDEPOUT$_j$	31.04	2.23	-		-		-	
EXDEPSG$_j$	-		10.92	1.26	-		-	
EXDEPLOSS$_j$	-		-		31.63	3.54	-	
EXDEPPROF$_j$	-		-		-		25.37	2.62
GOVFUN$_i$	0.50	1.70	0.48	1.64	0.46	1.61	0.49	1.68

PANEL B	Dependent variable: GROWTH$_i$							
	(1)		(2)		(3)		(4)	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
GOVFUN$_a$ *								
EXDEPOUT$_j$	13.54	1.95	-		-		-	
EXDEPSG$_j$	-		9.31	1.97	-		-	
EXDEPLOSS$_j$	-		-		20.96	4.32	-	
EXDEPPROF$_j$	-		-		-		16.56	3.18
GOVFUN$_i$	0.58	3.58	0.57	3.50	0.58	3.63	0.59	3.66

Notes: This table reports a modified version of the basic regressions that include area and industry fixed effects and the full vector of control variables (reported in Table 6): In Panel A, the dependent variable is R&D in millions of euros. In Panel B, it is the average sales growth rate over the next three years, as projected by the entrepreneurs themselves. The modification is that a new variable *GOVFUN$_i$* (=the fraction of total debt and equity, as recorded in firms' balance sheets, that is attributable to the government agencies that provide public SME support and R&D finance in Finland) is included in the model.

Table 12 Robustness: Capital Market Imperfection

PANEL A	Dependent variable: $R\&D_i$							
	(1)		(2)		(3)		(4)	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
$GOVFUN_a$ *								
$AUDIT_j$	49.82	2.27	-		48.46	2.21	-	
$LOANDEN_j$	-		76.99	2.35	-		77.43	2.36
$AUDIT_i$	-		-		0.18	1.69	-	
$LOANDEN_i$	-		-		-		-0.15	-0.71
AGE_i	-8.6E-03	-1.13	-7.6E-03	-1.00	-7.4E-03	-0.96	-7.9E-03	-1.04
AGE^2_i	3.8E-05	0.44	2.8E-05	0.33	2.7E-05	0.31	3.1E-05	0.36
EMP_i	0.02	5.30	0.02	5.23	0.02	4.82	0.02	5.27
EMP^2_i	-1.0E-04	-3.50	-1.0E-04	-3.49	-9.5E-05	-3.22	-1.0E-04	-3.54
Ind. dummies	Yes		Yes		Yes		Yes	
Area dummies	Yes		Yes		Yes		Yes	
Observations	476		476		475		476	
Censored obs.	173		173		173		173	
Log likelihood	-471.79		-471.62		-469.39		-471.36	
LR Chi^2	83.12		83.47		86.10		83.98	
degr. of freedom	32		32		33		33	
significance	0.00		0.00		0.00		0.00	
R^2_{pseudo}	0.08		0.08		0.08		0.08	

PANEL B	Dependent variable: $GROWTH_i$							
	(1)		(2)		(3)		(4)	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
$GOVFUN_a$ *								
$AUDIT_j$	37.00	3.02	-		35.33	2.89	-	
$LOANDEN_j$	-		43.67	2.42	-		43.64	2.42
$AUDIT_i$	-		-		0.12	2.02	-	
$LOANDEN_i$	-		-		-		0.04	0.37
AGE_i	-0.01	-3.26	-0.01	-3.25	-0.01	-3.12	-0.01	-3.23
AGE^2_i	1.1E-04	2.28	1.1E-04	2.24	1.0E-04	2.17	1.1E-04	2.22
EMP_i	8.0E-03	3.55	7.9E-03	3.46	7.1E-03	3.06	7.8E-03	3.44
EMP^2_i	-3.9E-05	-2.64	-4.0E-05	-2.70	-3.5E-05	-2.39	-4.0E-05	-2.68
Ind. dummies	Yes		Yes		Yes		Yes	
Area dummies	Yes		Yes		Yes		Yes	
Observations	519		519		517		519	
Censored obs.	97		97		96		97	
Log likelihood	-395.19		-396.79		-391.87		-396.72	
LR Chi^2	75.25		72.06		79.53		72.20	
degr. of freedom	32		32		33		33	
significance	0.00		0.00		0.00		0.00	
R^2_{pseudo}	0.09		0.08		0.09		0.08	

Notes: This table reports a modified version of the basic regressions that include area and industry fixed effects and the full vector of control variables (reported in Table 6): In Panel A, the dependent variable is R&D in millions of euros. In Panel B, it is the average sales growth rate over the next three years, as projected by the entrepreneurs themselves. The modification is that *Market Imperfection*$_j$ replaces *External Dependence*$_j$. The new industry level -variable measures the extent to which an industry is prone to suffer from capital market imperfections. We compute it for each industry using data on SMEs residing outside the metropolitan Helsinki area. It is based on industry average of *AUDIT*$_i$ (dummy set to 1 if firm is audited by one of the internationally recognized 'Big Five' accounting firms) or *LOANDEN*$_i$ (= dummy set to 1 if a firm's loan application has been turned down because of lack of collateral and/or guarantees during the last two years). SMEs residing in the metropolitan Helsinki area have been dropped from the regressions.