How Important is Equity Finance for R&D Activity? - Evidence from German Small and Medium-Sized Enterprises

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Abstract

This paper analyses the importance of equity finance for the R&D activity of SMEs. Based on a survey of German companies, we find that a higher equity ratio is conducive to more R&D for young but not for old companies. Equity is a constraining factor for young companies which have to rely on the original equity investment of their owners since they have not yet accumulated retained earnings. The importance of equity is confirmed with information on loan applications. Innovative companies have a higher probability for failed loan negotiations. The negotiations of young companies are more likely to fail because the bank makes no offer. We use instrumental variables to control for reverse causality.

JEL classification: G 32, O 32

Keywords: R&D activity, equity finance, small and medium-sized enterprises

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1 Introduction

The innovative activity of companies plays a vital part for the growth of economies. New developments benefit consumers by offering a greater choice of products and services. Although large companies spend a high share of the total R&D expenditure of the private sector, small and medium-sized companies (SMEs) are also important players in the innovation process. In 2004, companies with less than 500 employees contributed to 12.5% to the R&D expenditures of the German private sector (Stifterverband (2005)). On the one hand, small companies face disadvantages because they cannot exploit scale economies and are restricted in the types of financing they can raise for their R&D activities. On the other hand, some characteristics of SMEs even facilitate the implementation of R&D projects (Acs and Audretsch (1990)). Managers may know more about the technology, there may be an entrepreneurial spirit more favourable to risk taking, and researchers may encounter fewer bureaucratic hurdles (Scherer (1991); Link and Bozeman (1991)).

The literature on differences in R&D activity between companies has so far mostly concentrated on the influence of size (see, for example, Scherer (1965)). So far, the importance of different financial resources for the R&D activity has been neglected. Young, innovative companies have only a limited choice between different types of financing. Bank loans are not a fitting form of finance for R&D projects due to the high risk inherent in such endeavours (Himmelberg and Petersen (1994)). Venture capital financing is a more appropriate form. However, the VC market in Germany is not well developed. In the year 2004 only 844 companies received venture capital financing. The total volume of these investments was Euro 2.7 billion (BVK (2005)).[1] Private companies therefore have to rely mostly on the equity investment of their owners.

The purpose of this paper is to provide an analysis of whether the equity capital available to small and medium-sized enterprises affects their R&D activity using a representative survey of German companies from KfW Bankengruppe (formerly Kreditanstalt für Wiederaufbau). We test the hypothesis that companies with a higher equity ratio will engage more in R&D activities, measured alternatively as the probability of pursuing R&D and as the

[1]The statistics of the German Private Equity and Venture Capital Association (BVK) are the most comprehensive information available. According to the BVK they cover 90% of the volume of the German VC market (Krahnen and Schmidt (2004)).

R&D intensity (ratio of R&D expenditures to sales). We differentiate between young and old companies. Young companies depend more on the original investment of their owners, since they have had less time to accumulate past profits. They also face more severe problems in obtaining external financing. In order to control for reverse causality we use alternatively the lag of the equity ratio and the credit rating of the company as instruments.

So far, the literature is mainly concerned with the direction of causality from R&D activity to the capital structure and focuses primarily on listed companies (see Hall (2002) for a literature survey). Listed companies have the ability to adjust their capital structure according to the costs of both equity and debt finance. Aghion et al. (2004) find lower leverage for listed UK companies with R&D activity together with an increase in leverage in the R&D intensity. Carpenter and Petersen (2002) document low use of debt for US high-tech companies prior to IPO. For young and unlisted companies the situation is different. They are often confronted with a lack of financial resources. Their financial structure is not only influenced by relative prices but also by the availability of financing. Here the company-specific probability of bankruptcy will play a significant role for the access to finance. Hyytinen and Pajarinen (2005) study the determinants of leverage for a sample of small, unlisted Finnish companies. The authors document especially low leverage for companies in the ICT sector with high R&D intensity.

The other direction of causality has so far found scant attention. Singh and Faircloth (2005) document for their sample of large, listed US companies a negative influence of leverage on R&D intensity. The authors restrict their sample to companies with minimum positive R&D expenditure. Since listed companies can increase their equity base through a seasoned public offering, the analysis of public companies cannot shed light on the question whether some companies are restricted in their R&D activity through constraints in the availability of equity capital.

A less closely related literature studies the influence of financial constraints on the investment behaviour of companies.[2] Companies are said to be financially constrained if they face higher costs of external than internal finance. Our focus is not so much the relative cost of different alternatives of financing, it is rather an investigation of the necessary capital

[2]Fazzari et al. (1988) look at investment in general. Harhoff (1998), Bond et al. (1999), Himmelberg and Petersen (1994) and Czarnitzki (2002) consider investment in R&D.

structure for R&D activity.

This paper is organized as follows. Section 2 describes the data set. Section 3 describes the financing of German SMEs. Section 4 presents the empirical results. Section 5 concludes.

2 Data

The analysis is based on the KfW-Mittelstandspanel, a panel survey of German small and medium-sized companies conducted by KfW Bankengruppe, Frankfurt, Germany. In addition to basic company characteristics, this data set includes information on the financial structure of companies and their innovative activities. Small and medium-sized companies are defined as companies with less than Euro 500 million turnover. There is no minimum number of employees required for the inclusion into the panel.[3] The survey covers both the manufacturing and the service sector. Companies from the banking and insurance industries are excluded from the analysis.

The selection of the companies into the survey took place via a stratified random sample procedure. The stratification is done according to six size groups (up to 4 employees, 5-9, 10-19, 20-49, 50-99 and 100 or more employees), five industries (manufacturing, construction, retail, wholesale and services), region (Western versus Eastern Germany) and participation in a government support programme for SMEs conducted by KfW Bankengruppe.[4] The government programmes are based on either support for bank loans or equity capital. We use unweighted regression procedures controlling for the stratification variables.

Information on 5,870 companies from the first wave collected in 2003 is used for the main part of the analysis. The section on loan demand and supply draws on a combination with the second wave of 2004. Unfortunately, a panel analysis is not possible, since the second wave did not ask about the R&D intensity. Information on the credit rating of the companies is merged to the survey from the company data base of Creditreform, Germany's largest credit rating agency.

Descriptive statistics for the variables are provided in Table 1. The average number of

[3]We do not impose a minimum size requirement for the analysis because even the smallest companies report substantive innovative activity. 10% of companies without employees have positive R&D expenditures.

[4]The programmes mainly support the investment activities of existing and newly founded companies.

employees measured in full-time equivalents is below 50, since only small and medium-sized companies are covered. The age of the companies has a wide dispersion with an average of 32 years. The equity ratio, defined as book value of equity capital divided by total assets, has an average value of 21%.[5] The R&D intensity, defined as R&D expenditures divided by sales, has a mean of 2.2%. 26% of companies report R&D activity.

Table 1: Descriptive Statistics

Variable	**Mean**	**Median**	**Stdev.**	**Min**	**Max**
Number of employees	47.6	19	82.0	0	948
Company age (in years)	31.6	13	37.4	1	410
Equity ratio	21.2	15	21.4	-90	100
R&D intensity	2.2	0	6.9	0	99
Probability for R&D activity	0.26	0	0.44	0	1

Source: KfW-Mittelstandspanel, wave of 2003. All values refer to the year 2002.

3 The Financing Situation of SMEs

3.1 Comparing Companies With and Without R&D Activity

In order to get a better understanding of the financing conditions of small and medium-sized companies, we investigate whether there are structural differences between companies with and without R&D activity. Table 2 shows descriptive statistics for both company types. A striking difference is the larger size of R&D performing companies, which is reflected in almost double the number of employees.[6] There are no differences with respect to company age – both mean and median are almost identical.

The financing choices display marked differences illustrating a higher need for equity

[5]Companies with negative equity values are included in the sample. Liabilities can exceed the assets of a company, if repeated losses eat up the equity capital. The company is not closed, if creditors believe that loans can be repaid with future profits.

[6]The size difference cannot be explained with companies being larger in industries that typically perform more R&D. The difference still exists after controlling for industry effects.

capital for innovative companies. The equity ratio is more than 2 percentage points higher for companies with positive R&D activity. A difference that is statistically significant at the 1% level. In addition, owners of companies with R&D activity need to commit to a substantially higher investment volume. Equity per owner has a mean of Euro 1,015,000 for companies with and of Euro 552,000 for companies without R&D activity. In order to raise enough equity, companies can rely on the contributions of several owners. Mean and median of the number of owners are higher for innovative companies. Both the differences in equity per owner and in the number of owners are significant to the 1% level.

Table 2: Company Characteristics According to R&D Activity

	Mean			**Median**	
Variable	R&D	no R&D	Sig. lev. of diff.	R&D	no R&D
Number of employees	70.0	39.5	1%	34.5	15
Company age (in years)	32.0	31.5	66%	13	13
Equity ratio	23.1	20.5	1%	18	14
Equity per owner (in '000 EUR)	1,015	552	1%	233	100
No of owners	1.96	1.69	1%	2	1

Source: KfW-Mittelstandspanel, wave of 2003. All values refer to the year 2002.

3.2 Access to Bank Financing

This subsection will convey an impression of which types of companies face particular difficulties in obtaining external finance. We use information on the outcome of loan applications that was asked in the second wave of the survey from companies with positive investment activity in the year 2003. It refers to experience with loan applications in this year.

Table 3 column (1) shows results of a probit regression with the dependent variable equal to one if the company applied for a loan in the year 2003. The dummy for young companies is set equal to one for all companies up to and including the age of 10 years. R&D activity, age and size have no influence on this decision. The only significant explanatory variable is the equity ratio. However, its influence is rather small. An increase in the equity ratio by

one standard deviation (20%) decreases the probability of a loan application by 2 percentage points. There is no indication that companies with R&D activity have a lower demand for bank loans. However, it is possible that some owners expect a loan denial and do not apply for this reason.

Table 3: Credit Demand and Supply - Probit Regressions

	(1)	(2)	(3)
Dep. variable	Loan application	Negotiations failed	No loan offer
Dummy R&D activity	0.003	0.070*	0.047
	(0.028)	(0.039)	(0.060)
Dummy young company	-0.012	0.051	0.141***
	(0.027)	(0.037)	(0.054)
Dummy R&D * Dummy young	0.020	-0.058	-0.060
	(0.047)	(0.064)	(0.100)
Equity ratio	-0.001**	-0.003***	-0.002
	(0.001)	(0.001)	(0.001)
No of employees	0.000	-0.000	-0.001***
	(0.000)	(0.000)	(0.000)
No of observations	2,132	1,425	658
Log likelihood	-1,256	-942	-407
Mean of dependent variable	0.71	0.46	0.50

Note: *, **, *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively. Marginal effects are reported. For dummy variables the effect is calculated for a change from 0 to 1. Robust standard errors are in parentheses. All regressions contain industry dummies comparable to the 3-digit SIC level, a dummy for limited liability, for participating in a government support programme and for Eastern German companies.

The probit regression in column (2) only considers companies with loan applications and identifies the characteristics that lead to a higher probability of failed negotiations. Negotiations can either fail because the bank makes no loan offer or because the offer is rejected by the company. Of the companies which applied, 46% were unsuccessful. An important determinant for a failed negotiation is R&D activity. It increases the probability of a failure by 7 percentage points. Also, companies with a higher equity ratio find it easier to obtain a loan because they are less likely to default.

There are several reasons why R&D activities are difficult to finance with bank loans.[7] R&D projects often promise high returns if successful but have a significant probability of failure. In the case of failure the bank may lose its capital. Furthermore, there are severe problems of asymmetric information. Borrowers typically know more about the success probability of R&D projects than banks. Also, banks may find it difficult to ascertain that R&D projects are implemented as originally agreed. Lastly, R&D projects often provide little collateral value. A high share of R&D expenditures consists of wages for researchers and assets have often a small resale value because they are company-specific. The low collateral value of R&D projects is especially severe for young companies, since they are less diversified. They do not have tangible assets from other business activities to pledge.[8]

Finally, in column (3) we investigate in more detail why negotiations failed. The dependent variable is coded with one if the bank made no loan offer and with zero if the company received an offer but declined it. Both reasons have an equal probability of 50%. It is interesting that especially young companies have difficulties in obtaining an offer. Banks are more reluctant to lend to young companies because they have a higher probability of bankruptcy. The products of young companies are sometimes not yet proven in the market, they still need to establish a customer base and are often restricted to one product, which gives them little diversification. Furthermore, their creditworthiness is more difficult to establish since they have not yet established a track record with the bank. Of the other regressors, only the size of the company has an independent effect. For larger companies it is less likely that they don't receive a loan offer. By implication, they have a higher probability of declining themselves an offer by the bank. The equity ratio has an insignificant effect. One could expect that companies with weak equity capitalization have a higher probability of not receiving a loan offer. However, they may also receive an offer with a high interest rate or with stringent collateral requirements that the company judges as unattractive.

[7]See Himmelberg and Petersen (1994) for a more detailed discussion of financing R&D activities with bank loans.

[8]Collateral is an important instrument used by banks to make lending less risky. In their sample of bank loans extended by five large German banks, Elsas and Krahnen (2002) find that 71% of the loans are collateralized and 31.5% of the total credit volume is covered by collateral. Lehmann et al. (2004) report average collateral coverage of 61% for Western Germany and 53% for Eastern Germany.

4 The Importance of Equity Finance for R&D Activity

4.1 Estimates Without Instruments

For the empirical analysis we employ first the Tobit model. It takes account of the fact that many companies report zero values of R&D expenditure. In the Tobit model regressors have the same influence on the probability of doing a positive amount of R&D and on the R&D intensity itself. This restriction is lifted in the second model. The hurdle model (see Cragg (1971)) consists of two parts. The first is a probit model for the probability of doing R&D; the second is a Tobit model restricted to companies with positive R&D. The separation into two parts allows for more flexibility. If there are differences either in the size of the influence of explanatory variables or in their significance, the hurdle model makes them transparent.[9]

In Table 4 we present the results of the Tobit and the hurdle model without using an instrument for the equity ratio. Columns (1) and (2) contain the results for the Tobit regressions without and with interaction term for the age of the company. Equity has a positive and significant coefficient in the first regression. When we use the interaction term, it becomes clear that equity is only important for the R&D activity of young companies.[10]

In columns (3) to (6) we show the results of the hurdle model. A higher equity ratio increases the probability of R&D if we take all companies together. By splitting according to company age, we see that this effect was driven by the young companies. A one standard deviation increase in the equity ratio increases the probability for R&D activity by 1.7 percentage points. This is a moderate increase given the average probability for R&D activity of 26% in the sample. The additional control variables show that the probability for R&D is increasing in size, decreasing in age and higher for companies with limited liability.

Columns (5) and (6) contain results on the R&D intensity. There is no influence of the equity ratio on the R&D intensity without differentiating according to age. When separating between young and old companies, the equity ratio has a significant influence for the former

[9]The Heckman selection model is not appropriate here. For companies without R&D activity the R&D intensity is known to be zero and therefore not missing. Furthermore, the R&D intensity can only have non-negative values, whereas the main equation of the Heckman model disregards this restriction (Wooldridge (2002)).

[10]The sample contains 1,873 companies up to the age of 10 years (32% of the total).

Table 4: Regression Results Without Instruments

	(1)	(2)	(3)	(4)	(5)	(6)
	Tobit		Hurdle model			
Dep. variable	R&D intensity, R&D ≥ 0		Prob. of R&D		R&D intensity, R&D > 0	
Equity ratio	0.036**	0.007	0.002**	0.001	0.019	-0.011
	(0.014)	(0.014)	(0.001)	(0.001)	(0.016)	(0.015)
Equity ratio * Dummy young		0.076***		0.003*		0.085***
		(0.024)		(0.001)		(0.029)
No of employees	0.026***	0.028***	0.004***	0.004***	-0.026***	-0.024***
	(0.007)	(0.007)	(0.001)	(0.001)	(0.005)	(0.005)
Square no of employees	-0.000**	-0.000***	-0.000***	-0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	-0.074***	-0.051***	-0.004***	-0.003**	-0.073***	-0.045***
	(0.015)	(0.015)	(0.001)	(0.001)	(0.014)	(0.013)
Square age	0.000***	0.000*	0.000*	0.000	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dummy support programme	-0.106	-0.096	0.047	0.048	-1.160*	-1.156*
	(0.585)	(0.583)	(0.041)	(0.041)	(0.595)	(0.591)
Dummy limited liability	5.024***	5.078***	0.335***	0.337***	0.657	0.734
	(0.798)	(0.798)	(0.051)	(0.051)	(0.793)	(0.793)
Dummy Eastern Germany	-0.866	-0.752	-0.061	-0.057	0.061	0.109
	(0.590)	(0.591)	(0.041)	(0.042)	(0.567)	(0.565)
No of observations	5,870	5,870	5,870	5,870	1,521	1,521
Pseudo R squared	-7,803	-7,796	-2,750	-2,748	-5,729	-5,721
Marginal Effect (ME) equity ratio	0.0073	0.0015	0.0007	0.0004	0.011	-0.006
ME interaction young		0.015		0.0008		0.048
ME * sd equity ratio	0.157	0.032	0.015	0.009	0.217	-0.129
ME interaction young * sd equity ratio		0.334		0.017		0.980
Mean dep. variable	2.17	2.17	0.26	0.26	8.37	8.37

Note: Dummy young equals one for companies up and including the age of 10 years. Dummy support programme equals one for companies that participated in government programmes to support financing. Dummy Eastern Germany equals one for companies located in the Eastern part of Germany. All regressions contain industry dummies comparable to the 3-digit SIC level. Robust standard errors are in parentheses. *, **, *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

group. An increase of the equity ratio by one standard deviation increases the R&D intensity by almost one percentage point. Compared to the average R&D intensity of innovative companies in the sample of 8.4% the influence of equity is quite substantial. In addition, the results show a decrease of R&D intensity in size and age.

Overall, we find that the equity ratio has no significant influence on the R&D activity of old companies. Both companies with and without R&D activity have had several years to increase their equity capital through the retention of profits. Therefore it is possible that equity capital is no restriction any more for R&D activity.

4.2 Estimates With Instruments

The estimates of the previous section can be influenced by reverse causality. Not only can equity capital be a prerequisite for R&D activity, it is also possible that companies with R&D activity select a capital structure with a higher proportion of equity, since bank capital can be more expensive for riskier companies.

In order to separate the effect of the equity ratio on the R&D activity, we use instruments. The first instrument is the lag of the equity ratio. This instrument introduces a time difference between the capital structure and the decision on the R&D activity. The result of the first-stage regression is reported in column (1) of Table 5. The large coefficient of the lagged value of the equity ratio suggests that the variable has a high degree of persistence. The influence of reverse causality may therefore not completely be eliminated. In separate regressions we use a second instrument, the credit rating of the company. It takes on values of 600 for the best and 100 for the weakest rating. The average of the rating is at 463 with a median at 474. The credit rating is obtained from the German credit rating agency Creditreform. The rating considers financial standing, reliability in paying bills, order situation, company size and industry risk as main components. The evaluations at Creditreform have shown that the rating predicts the probability of default on trade credit well. Since banks prefer to lend to good risks, the rating gives also an indication on how easy a company will find it to obtain bank loans. Although the credit rating includes many company characteristics, it does not include any information on the R&D activity of the company. It is therefore a suitable instrument for the equity ratio. The regression in column (2) shows a positive relationship between the credit rating and the equity ratio that is significant at the 1% level.

Table 5: First Stage Regression Results

	(1)		(2)	
Dep. variable	Equity ratio in 2002			
Equity ratio in 2001	0.912***	(0.010)		
Credit rating			0.032***	(0.005)
No of employees	0.003	(0.003)	-0.018**	(0.007)
Square no of employees	-0.000	(0.000)	0.000***	(0.000)
Age	0.005	(0.006)	0.085***	(0.018)
Square age	-0.000	(0.000)	-0.000***	(0.000)
Dummy support programme	-0.312	(0.248)	-4.785***	(0.670)
Dummy limited liability	0.123	(0.278)	-2.019**	(0.870)
Dummy Eastern Germany	-0.049	(0.246)	1.706**	(0.717)
No of observations	5,743		4,456	
R squared	0.84		0.04	

Note: Dummy support programme equals one for companies that participated in government programmes to support financing. Dummy Eastern Germany equals one for companies located in the Eastern part of Germany. All regressions contain industry dummies comparable to the 3-digit SIC level. Robust standard errors are in parentheses. *, **, *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

Next we discuss the regression results obtained with instruments. The results of the hurdle model with the lag of the equity ratio used as instrument is shown in Table 6, columns (1) to (4). As in the previous regressions without instruments, we find a positive and significant influence of the equity ratio on R&D activity for young but not for old companies. The size of the influence is again economically important. A one standard deviation increase in the equity ratio increases the probability of pursuing R&D as well as the R&D intensity by about 10%.

When using the credit rating as an instrument, we do not find a significant influence of the equity ratio in the probit regression any more. This can be either a sign that the instrument is too weak or that the previous regressions where influenced by reverse causality. In the Tobit regression for companies with R&D expenditures there is still a significant difference in the role of equity between young and old companies.

Table 6: Regression Results Equity Ratio Instrumented

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Hurdle model (IV lag equity ratio)				Hurdle model (IV credit rating)			
	Prob. of R&D		R&D intensity, R&D > 0		Prob. of R&D		R&D intensity, R&D > 0	
Equity ratio	0.002*	0.000	0.014	-0.017	-0.003	-0.003	-0.096	-0.090
	(0.001)	(0.001)	(0.018)	(0.016)	(0.012)	(0.012)	(0.148)	(0.151)
Equity ratio * Dummy young		0.003**		0.082***		0.001		0.123***
		(0.002)		(0.030)		(0.003)		(0.043)
No of employees	0.004***	0.004***	-0.027***	-0.025***	0.004***	0.004***	-0.022***	-0.022***
	(0.001)	(0.001)	(0.005)	(0.005)	(0.001)	(0.001)	(0.006)	(0.006)
Square no of employees	-0.000***	-0.000***	0.000***	0.000***	-0.000***	-0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Age	-0.003***	-0.002**	-0.074***	-0.048***	-0.004**	-0.003*	-0.053***	-0.025
	(0.001)	(0.001)	(0.014)	(0.013)	(0.002)	(0.002)	(0.020)	(0.018)
Square age	0.000	0.000	0.000***	0.000***	0.000	0.000	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dummy support programme	0.044	0.044	-1.199**	-1.190**	0.019	0.022	-1.612*	-1.502
	(0.042)	(0.042)	(0.599)	(0.597)	(0.074)	(0.073)	(0.908)	(1.017)
Dummy limited liability	0.321***	0.324***	0.722	0.741	0.313***	0.315***	1.136	1.353
	(0.051)	(0.051)	(0.792)	(0.788)	(0.070)	(0.066)	(1.088)	(0.943)
Dummy Eastern Germany	-0.048	-0.045	-0.032	-0.030	-0.081	-0.082	-0.217	-0.312
	(0.042)	(0.042)	(0.576)	(0.574)	(0.051)	(0.050)	(0.659)	(0.679)
No of observations	5,743	5,743	1,493	1,493	4,456	4,456	1,164	1,164
Log pseudolikelihood	-2,694	-2,692	-5,618	-5,612	-2,069	-2,069	-4,342	-4,336
Marginal Effect (ME) equity ratio	0.0005	0.0001	0.008	-0.009	-0.0009	-0.001	-0.055	-0.052
ME interaction young		0.001		0.047		0.0003		0.071
ME * sd equity ratio	0.011	0.003	0.166	-0.192	-0.020	-0.021	-1.13	-1.08
ME interaction young * sd equity ratio		0.021		0.952		0.007		1.47
Mean dep. variable	0.26	0.26	8.34	8.34	0.26	0.26	8.27	8.27

Note: Equity ratio is instrumented with its lag in regressions (1) to (4). Equity ratio is instrumented with the credit rating in regressions (5) to (8). Dummy young equals one for companies up and including the age of 10 years. Dummy support programme equals one for companies that participated in government programmes to support financing. Dummy Eastern Germany equals one for companies located in the Eastern part of Germany. All regressions contain industry dummies comparable to the 3-digit SIC level. Robust standard errors are in parentheses. *, **, *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively.

5 Conclusions

The literature on R&D activity has so far mainly concentrated on the influence of the size of the company. However, size is not the only interesting factor. We focus on the financial situation of the company, especially on the influence of the equity ratio.

We find a positive relationship between equity financing and R&D activity for young companies in regressions without controls for reverse causality. This relationship can have two explanations: Either companies are forced to finance with equity because they have no access to bank loans or they prefer to finance with equity since it is the relatively cheaper means in their situation. Using instrumental variables we can confirm that a higher equity ratio leads to more R&D activity.

The use of instrumental variables clarifies the direction of causality but does not show whether owners fail to obtain bank finance or do not want to use bank finance. Our analysis of loan applications suggests that difficulties with loan supply are at least partially responsible. With the given data it is more difficult to make a statement about the demand for loans. There is no influence of R&D activity on demand but it is not clear whether owners do not apply because they expect to be unsuccessful with their application.

Finally, the paper needs to leave the question open of whether owners are constrained in their R&D activity because they are limited in the personal resources they can invest in the company. In principle, it is always possible to admit an additional owner in order to increase the resources available to the company. However, this has also costs. It is often not easy to find an appropriate person and some owners do not want to share their control over the company.

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