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Dirk Engel and Torge Middendorf*

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Abstract

Previous studies argued that low investment-cash flow sensitivities of German firms may be caused by dominance of public banking. The paper addresses this topic and applies a unique accounting dataset of German firms. Results from a dynamic panel data approach show that the dependence of investment spending on internal funds does not significantly differ between firms attached to savings banks, cooperative banks or commercial banks. Thus, the importance of the public banking sector in Germany may not explain the rather low dependence of firms on internal funds and public ownership of borrowers seems not essential to reduce financing constraints.

JEL Classification: G32, D92, L21, C23

Keywords: Investment, Relationship Banking, Panel Data, GMM

May 2007

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1 Introduction

Research on firms' investment spending suggests that there exists a gap between the costs of external and internal financing and thus, the Modigliani-Miller theorem (Modigliani and Miller 1958) does not hold.¹ Cross-country studies clearly point out that German or Japanese firms show lower investment-cash flow sensitivities than Anglo-Saxon firms (Harhoff 1998; Bond et al. 1999, 2003; Hall et al. 1999). Thereby it appears that intermediated financial systems, characterized by the prominence of relationship lending, are more able to channel financial resources to firms than the Anglo-Saxon market-based system at arm's length.²

Studies about the competition in Germany's banking sector (Audretsch and Elston 1997; Deeg 1998; Vitols 1998; Audretsch and Elston 2002) shed light on the question whether the dominance of public sector banks (savings banks, state banks) and cooperative banks may be an additional factor explaining cross-country differences in investment-cash flow sensitivities. Both pillars have an explicit mandate to promote small and medium-sized enterprises (SMEs). Furthermore, due to the higher degree of local embedding there may exist an informational advantage compared to commercial banks. One may expect that firms with relationship banking to savings banks and cooperative banks show significant lower financing constraints. Related to this issue, there is an extensive debate at the European Commission and German authorities about the liberalization of savings banks and its impact on SMEs' finance.³ Empirical evidence, how-

¹ Schiantarelli (1996) and Hubbard (1998) give an overview to relevant empirical studies.

² For a description of Germany's financial system see Edwards and Fischer (1994). Allen and Gale (1995) compare the financial system of Germany and the US in detail. Schmidt et al. (1999) point out that German banks are more engaged in long term funding of small firms in particular whereas British have been specialized in short term funding and thus, arm's length funding.

³ See e.g. Brunner et al. (2004), Weber (2005), Fischer (2005), Wenger (2005), Moeschel (2005) und Paul (2006).

ever, is rather scarce (see Caletti et al. 2005: 48), but is a prerequisite for structural changes of the banking system (Sachverständigenrat 2004).

This study explicitly addresses the differences in the dependence of firms on internal funds with respect to the type of house bank of a firm using accounting data from 1,451 German firms. The data is provided by Creditreform and Bureau van Dijk through the Dafne database and covers the period from 1998 to 2004. The contribution of the paper is threefold: We test the hypothesis that public sector banks and cooperative banks are more likely to reduce the funding gap of SMEs than commercial banks. Based on this finding, we evaluate the role of the public sector banks pillar to explain cross-country differences in investment-cash flow sensitivities. Finally, we highlight the differences between firms attached to public sector banks compared to those attached to cooperative banks in order to ask for the needs and alternatives of public ownership of banks.

Following Bond et. al (2003), we subsequently estimate an Autoregressive Distributed Lag Model (ADL) via Generalized Methods of Moments (GMM) to test for differences in investment-cash flow sensitivities regarding the type of bank attachment. Whereas the model allows a flexible specification of short-run investment dynamics, the GMM method controls for unobserved firm-specific effects and allows for endogenous explanatory variables.

The remainder of the paper is organized as follows. Section 2 provides a description of Germany's financial system. We explicate the empirical approach as well as the database in section 3. Section 4 presents the empirical results. Section 5 concludes.

2 An overview of Germany's credit institutions

German business finance is characterized by a comparatively high degree of debt finance. Audretsch and Elston (1997: 102) report a debt-to-equity ratio of 4 in Germany compared to a ratio of 1.3 in the U.S. Especially small- and medium-sized firms draw

heavily upon debt finance with an equity-to-total assets ratio of 7.5 % in 2003 and 10 % in 2004 (Sparkassen-Finanzgruppe 2006a: 4). The supply of funds is covered by three main groups of financial intermediaries: (i) commercial banks like Deutsche Bank, Dresdner Bank, Commerzbank, Hypo-Vereinsbank and smaller private sector banks, (ii) public sector banks, namely savings banks (*Sparkassen*) and state banks (*Landesbanken*) owned by municipalities and the government of the federal states, respectively and (iii) cooperative banks (*Genossenschaftsbanken*).

As reported by the Sparkassen-Finanzgruppe (2006b: 25), three fourth of the German *Mittelstand* are financed by savings banks. Aggregate data of the Deutsche Bundesbank shows that around 61 % of the stock of long-term loans to firms was provided by public sector banks in 2005, whereas 27.4 % stemmed from commercial banks and 11.6 % from cooperative banks. In 1990, the share of long-term loans provided by the public sector banks marked at 42 % and thus, was remarkably lower than in 2005. The increasing dominance of public sector banks is also evident concerning the transfer of publicly assisted loans: In 2002, public sector banks transferred about 52 % of publicly assisted loan volume in Federal SME programmes; commercial banks had a market share of around 12 % (see Prantl et al. 2006).⁴ Twelve years before, commercial banks transferred 25 % percent of publicly assisted loan volume.

The strategic withdrawal of commercial banks from credit business seems to be mostly driven by the worsening of financial results. The interest rate spread (= interest earnings minus interest paid related to total assets) in credit business declined from 2.3 % to 1.0 % for commercial banks between 1994 and 2000. The reduction about 58 % is remarkably higher compared with those of savings banks (26 %) and cooperative banks

⁴ Publicly assisted credits are transferred to firms via the house bank principle. A bank has to take over outstanding publicly assisted debt for distressed borrowers partially or even completely.

(22 %), respectively (Deutsche Bundesbank 2001: 37). Furthermore, the return on equity is lower in Germany than in other European countries (Brunner et al. 2004). Commercial banks are confronted with the consequences of the liberalization of financial markets in the 1990s to a higher extent than public sector banks or cooperative banks. As one consequence, commercial banks shift to investment banking and asset management in order to increase the overall profit margin and thus, to fulfill the expectations of investors at stock markets. For example, Deutsche Banks have remarkably increased its return on equity since 2002. German firms in general and SMEs in particular may suffer negatively from the stronger profit orientation of commercial banks.

In contrast, public sector banks pursue a so-called “regional principle”: They are owned by the local or federal government and their activities are limited to the local area of its owner. Savings banks are owned by one or more municipalities and operate in the field of responsibility of the local government. In contrast, state banks can operate across the entire country and are mostly engaged in international business. *Sparkassen laws* of Federal States explicitly define a mandate to supply loans for SMEs and individuals as well as to promote the surrounding area of the savings bank as a whole. Based on this mandate, public sector banks need not to maximize their profit although a certain amount of profits is important. The *Sparkassen-Finanzgruppe*, the head of the savings banks, aims at a return on equity of 15 % (Sparkassen-Finanzgruppe 2006b: 39).⁵ Following from public mandate, savings banks are locally embedded and closely located to firms and individuals. According to the Deutsche Bundesbank 14,800 branches of savings banks, 13,000 branches of cooperatives banks, and 5,000 branches of commercial banks were active in Germany at the end of 2004. On-site presence offers informational

⁵ Currently, return on equity lies below this ratio (7.8 % in 2002 and 10.7 % in 2003).

advantages to evaluate the creditworthiness of local borrowers and may foster long-term relationships.

Cooperative banks are very similar to savings banks with respect to the mandate of SME promotion and local embeddedness. The cooperative banks are historically founded in the 19th century to reduce the funding gap of small scale firms during the process of industrialization. Based on §51 Cooperative Law (*Genossenschaftsgesetz*), the main purpose is the promotion of their owners and members, the small scale firms.

Regional orientation of both savings banks and cooperative banks correlates with a lower size of these banks compared to commercial banks which in turn may limit the possibilities of risk pooling remarkably. This, however is compensated for by the involvement in the Sparkassen-Finanzgruppe and the VR.net (network of cooperative banks), respectively.

The mandate to promote SMEs and informational advantages as well as advantages to establish long-term relationships favor both savings banks and cooperative banks to supply adequate conditions to SMEs (see Cole et al. 2004, Berger et al. 2005). Hence, we expect that firms attached to one of these two pillars are confronted with lower financing constraints than firms attached to commercial banks. The departure of commercial banks from SME finance may strengthen the hypothesis additionally.

Yet, savings banks and cooperative banks differ in the business objectives of the bank. Public ownership of the former speaks in favor of a special interest of municipalities to promote the regional economy. Owners of savings banks are likely to demonstrate the successful promotion of the regional economy to increase the probability of re-election (Eisinger 1993, La Porta et al. 2002). Therefore, in some cases, distressed borrowers are likely to receive credits again and politicians thus hope to secure jobs within the region.

Probably, public sector banks can offer adequate conditions to SMEs due to the so-called *Anstaltslast* and *Gewährträgerhaftung*. The former refers to the liability of the public sector for the debt of a corporation incorporated under public law, which applies to the savings and states banks. The latter denotes that municipalities, as the owner of the bank, settle the claims of all creditors in the case of bankruptcy. Brunner et al. (2004: 24) point out that the phase-out of the guarantees significantly affects the business operations of state banks, whereas the savings banks should be affected to a minor degree. Due to an intervention of the European Commission, the *Anstaltslast* and *Gewährträgerhaftung* have been remarkably reduced for obligations accepted after July 18, 2005.

Public sector banks play an important role for SME finance and thus, the intended liberalization of the German banking system could affect the supply of loans to SMEs substantially. Based on the foregone reasoning, there are arguments that the public ownership of savings banks implies a lower dependence on internal funds of firms attached to savings banks compared to firms attached to cooperative banks.

Recent empirical evidence by Nehls and Schmidt (2004) and Prantl et al. (2006) contributes to these presumptions. The latter observed that young firms attached to savings banks or cooperative banks exhibit a higher probability to get access to loans of the federal government. While these loans are cheaper, firms are more likely to reduce their funding gap. Nehls and Schmidt (2004) point out that there have been some signs of a *credit crunch* in Germany in 2002. Applying a disequilibrium-model, they show that a shortening of loans by commercial banks is mostly responsible for their results (Nehls and Schmidt 2004). This speaks in favor of a higher dependence on internal funds of firms with a commercial house bank.

3 Empirical approach

3.1 Empirical Investment Equation

We start with a rather parsimonious error-correction model (see Bond et al. 2003) in which investment is dependent on production and the user cost of capital (see Jorgensen 1963), whose variation can presumably be approximated by firm- and time-fixed effects. As the time dimension in our panel is short, the influence of initial conditions on subsequent investment behavior needs to be taken into account. Moreover, in the case of adjustment costs, the desired capital stock only reacts sluggishly and gives rise to short-term dynamics:

$$k_{it} = \alpha_1 k_{i,t-1} + \alpha_2 k_{i,t-2} + \beta_0 y_{it} + \beta_1 y_{i,t-1} + \beta_2 y_{i,t-2} + D_i + Z_t + \varepsilon_{it}$$

In this ADL (2,2) model k_{it} denotes the log of the desired capital stock of firm i in period t , y_{it} the log of output of firm i in period t , D_i the firm-fixed effects, Z_t time-fixed effects and ε_{it} an error term. Under the assumption that there is a long-run unit elasticity of capital to output and those two series are cointegrated, which is tested in our empirical analysis, the reparameterized ADL model can be extended by an error correction term. The coefficient on the term $(k_{i,t-2} - y_{i,t-2})$ then has to be negative to ensure error-correcting behavior. If the firm specific depreciation rate is captured by the firm-specific effects and Δk_{it} is approximated by $I_{it} / K_{i,t-1} - \delta_i$ with I_{it} denoting gross investment, K_{it} denoting the capital stock and δ_i the firm-specific depreciation rate, the equation takes the form

$$\frac{I_{it}}{K_{i,t-1}} = \chi \frac{I_{i,t-1}}{K_{i,t-2}} + \phi \Delta y_{it} + \varphi \Delta y_{i,t-1} + \eta (k_{i,t-2} - y_{i,t-2}) + D_i + Z_t + \varepsilon_{it}.$$

As a measure of the firms' financial power we add the contemporary and lagged cash flow (C_{it}) to the equation. Thus the equation takes the form:

$$\frac{I_{it}}{K_{i,t-1}} = \chi \frac{I_{i,t-1}}{K_{i,t-2}} + \phi \Delta y_{it} + \varphi \Delta y_{i,t-1} + \eta (k_{i,t-2} - y_{i,t-2}) + \lambda \frac{C_{it}}{K_{i,t-1}} + \mu \frac{C_{i,t-1}}{K_{i,t-2}} + D_i + Z_t + \varepsilon_{it}.$$

To discriminate between the firm's choice of bank attachment we implement four interaction terms, two for the contemporary and two for the lagged cash flow, respectively:

$D_{it}^{Coop} \cdot C_{it} / K_{i,t-1}$ measures the contemporary cash flow for firms attached to a cooperative bank and $D_{it}^{Sav} \cdot C_{it} / K_{i,t-1}$ the cash flow for firms attached to a savings bank only.

As the individual effects in the investment equation are stochastic, they are necessarily correlated with the lagged dependent variable, which causes the Ordinary Least Squares (OLS) estimator to be inconsistent. Therefore we apply the Generalized Method of Moments (GMM) estimator proposed by Arellano and Bond (1991) with suitable tests of serial correlation and over-identifying restrictions. Admittedly, one further point needs consideration. Within the estimator it is possible to treat the explaining variables as strictly exogenous, predetermined or endogenous. This means that, under the assumption of second order serially uncorrelated errors, the explanatory variable is uncorrelated with all realizations of the error term, only correlated with past realizations of the error term or in addition correlated with present shocks, respectively. Hence Bond (2002) proposes a Sargan Test to test the assumption of strict exogeneity. In the following we will treat contemporary values of the sales growth and the cash flow as well as lagged values of the investment ratios as predetermined variables, because the Sargan Test supported this procedure.

3.2 Data description

Accounting data is gathered from the Dafne database as of June 2004, June 2005 and September 2006. The database is updated monthly and offered by Creditreform, the largest German credit rating agency, and Bureau van Dijk (BvD), a leading company in

electronic publishing of business information. Dafne contains current and historical accounting data (at a maximum for the last ten years) for over 54,000 German firms. Accounting data are collected centrally at Creditreform's headquarter. These data are used for Creditreform rating, for example. Their major sources are firm's inquiry (80.5 % percent of all registered firms), followed by the *Bundesanzeiger* (8.4 %), published annual reports (10.1 %), and the *Trade Register* (1 %).⁶

However, because each Dafne update provides only information about the current bank relationship, we use historical annual data for the relationship banking from the ZEW-Firm Panel, which is also based on Creditreform data.

The accounting data was initially checked for logical errors, missing data, and outliers (see Appendix A for details). We consider all firms with unconsolidated accounts, an annual turnover of 100,000 Euro and more and with a main activity in the private sector (the agricultural sector, utility companies, banks, insurance and other financial companies are excluded). The observation period is limited to the years 1998 to 2004 as data on the firms' bank relationships is only available for these years.

The identification of primary relationship banking is difficult for companies with multiple relations to banks of different pillars. Therefore only firms with bank relationships to one or multiple savings banks, one or more multiple cooperative banks or one or more private banks have been included in the sample. Despite this restriction, we still detect a significant number of firms attached to one of the three banking groups only. Firms attached to cooperative banks only form the smallest group with 201 observations, followed by firms attached to savings banks, and those attached to commercial banks (see Table 1).

⁶ Accounting data from Informa, S.A., a provider of electronic business information similar to Creditreform, has been recently used by Sogorb-Mira (2005), who tests empirically the predictions of the Pecking Order Theory.

Because of the requirement for lagged values and instruments, at least three observations for each firm have to be available. As a consequence, the sample is remarkably reduced and consists of 1,455 firms. The total number of observations in the GMM first difference estimations is 2,234 (Table 1).

Table 1: Summary statistics (whole sample)

Variable	Mean	Std. dev.	Obs.
$I_{it} / K_{i,t-1}$	0.251	0.354	2,234
Δy_{it}	0.019	0.197	2,234
$C_{it} / K_{i,t-1}$	0.406	0.507	2,234
$D_{it}^{Coop} \cdot C_{it} / K_{i,t-1}$ for $D_{it}^{Coop} = 1$	0.468	0.475	201
$D_{it}^{Sav} \cdot C_{it} / K_{i,t-1}$ for $D_{it}^{Sav} = 1$	0.322	0.483	554
$D_{it}^{Com} \cdot C_{it} / K_{i,t-1}$ for $D_{it}^{Com} = 1$	0.429	0.517	1,479
y_{it}	261,272	1,517,649	2,234
age_{it}	24.684	33.223	2,234
PD_{it}	1.124	2.052	1,366

Comparing the means of the variables to those of the variables used in Bond et al. (2003: 158) it becomes apparent that the investment ratio as well as the cash flow ratio are noticeably larger in our sample. Firms attached to savings banks show the lowest cash flow although it does not differ significantly from the mean of the other firms.

Total sales (y_{it} , in thousand Euro), the age of the firm (age_{it} , in years) and the probability of default (PD_{it} , in %) inform about some major characteristics of the sample. The PD measure has been received via online-access of Moody's KMV (see Falkenstein et al. 2000). The mean value lies something below the average probability of default of 1.3 % for all German firms in 2002.⁷ This is due to a significant share of large firms (494 of

⁷ 37,600 cases of bankruptcy related to 2,926 million firms (based on the tax on sales statistics of the Federal Statistical Office).

1,455), and their very low probability of default. Firms are on average about 25 years old and realize annual sales of 261 million Euro.

4 Empirical results and discussion

4.1 Estimations results

We start with an analysis of the time series properties of our variables. This is done first of all, to check if our capital and sales series are cointegrated so that our ADL model can be extended to an error correction model. Secondly, we have to examine whether the use of lagged levels as instruments in our dynamic panel estimator causes a large finite-sample bias (Blundell and Bond 1998). Therefore, at first we applied a panel unit root test to the log capital and log real sales series. Maddala and Wu (1999) propose a Fisher test which combines individual Phillips-Peron (PP) and Augmented Dicky Fuller tests, respectively. They show that it has a greater power than the Im-Pesaran-Shin (IPS) panel data unit root test⁸, at least in samples with a large time dimension. Yet both tests reject the null of a unit root at the 1%-significance level for both series.⁹ Accordingly, we confine ourselves to estimating the rather parsimonious ADL model.

For the remaining variables of our model, the investment rate, the sales growth, the creditworthiness and the cash flow rate, we estimated AR(1) models by OLS, Difference-GMM and the fixed-effects estimator, respectively (see Table B.1 in Appendix B). The series do not exhibit any strong persistence and the Difference-GMM estimate lies in between the OLS and fixed-effects estimates. The OLS estimates are biased upwards and the fixed-effects estimates are biased downwards. Thus, there seems to be no prob-

⁸ The Fisher test combines significance levels of the different tests rather than the test statistics as the IPS does. Both tests, however, do not rely on a common unit root process as for example the Levin-Lin test.

⁹ The tests were carried out including fixed effects with the maximum number of lags based on the Schwarz Information Criteria.

lem of weak instruments and the use of lagged levels as instruments is sufficient to identify the parameters.

Table 2: ADL investment model: GMM first differences

Variable	All firms	SMEs	Large firms
$I_{i,t-1} / K_{i,t-2}$	0.176 ^a (0.042)	0.121 ^b (0.051)	0.239 ^a (0.063)
$C_{it} / K_{i,t-1}$	0.247 ^a (0.066)	0.319 ^a (0.088)	0.157 ^b (0.072)
$C_{i,t-1} / K_{i,t-2}$	0.004 (0.034)	0.038 (0.045)	-0.027 (0.039)
Δy_{it}	0.076 (0.06)	0.087 (0.063)	0.169 (0.107)
$\Delta y_{i,t-1}$	0.006 (0.042)	0.015 (0.053)	0.008 (0.032)
# obs. (firms)	2,234 (1,451)	1,435 (961)	799 (494)
Wald χ^2 (10)	57.59 ^a (0.000)	47.09 ^a (0.000)	28.39 ^a (0.002)
Hansen χ^2 (50)	38.80 (0.874)	43.21 (0.740)	48.11 (0.549)
m1	-4.39 ^a (0.000)	-3.71 ^a (0.000)	-2.41 ^a (0.016)
m2	-1.35 (0.178)	-1.41 (0.160)	-0.62 (0.534)

Notes: Two-step results with Windmeijer (2005) finite sample correction. Heteroscedasticity-robust standard errors are in parentheses. Estimations were carried out including time dummies. Wald χ^2 : Wald-test that all coefficients are jointly insignificant. Hansen χ^2 : Hansen-test of over identifying restrictions. m1: Arellano-Bond test of first order autocorrelation in the differenced residuals. m2: Arellano-Bond test of second order autocorrelation in the differenced residuals. Probability values in parentheses of the test statistics. ^a significant at 1%-level, ^b significant at 5%-level, ^c significant at 10%-level. SMEs are firms with annual sales below 50 million Euro.

There are concerns that the cash flow might just be a proxy for future sales growth without indicating any financing constraints. Indeed, recent results by Cummins et al. (2006) show that, once controlling explicitly for expected earnings by use of analysts' forecasts, the cash flow is no longer significantly related to investment spending. However, professional earnings forecasts are only available for listed companies hence we follow previous work and test whether the cash flow is a predictor of sales growth. Yet, carrying out a Granger-Causality test we can reject this hypothesis at conventional significance levels.¹⁰⁻¹¹

¹⁰ Results are available from the authors upon request.

Thereupon, we estimate a basic specification to evaluate the suitability of our data and to allow a comparative analysis with other studies. The results for the sample of all firms, SMEs, and large firms are reported in Table 2. Overall the test statistics support our parsimonious model. The Hansen test of over-identifying restrictions indicates that the validity of the instruments cannot be rejected. Furthermore there are no signs of second-order autocorrelation in the differenced residuals.

Previous investment activity shows up significantly positive in all samples. As the coefficient is higher for large than for small firms this suggests a higher degree of inertia of business investment for the former group. The main variable of interest, the cash flow, is also significant and shows the expected sign. The contemporaneous impact of the cash flow on investment for large firms is close to estimates by Bond et al. (2003: 160), who report a coefficient estimate of 0.180 for their sample of large German firms. Yet, the coefficient is smaller than the one estimated for small firms, which confirms previous findings that small firms are more financially constrained than large ones. This also becomes evident when looking at the probability of default: The median probability of default is 0.73 for large firms whereas it is 2.18 for small firms. In a further regression we find that firms with a higher probability of default (=more constrained firms) show higher investment-cash flow sensitivities than firms with a lower probability of default (see Table B.2 in the Appendix B). These results are contrary to Cleary (1999) who reports a negative relationship between the financial status, measured by a multivariate classification index, similar to Altman's Z factor (see e.g. Falkenstein et al. 2000 for details), and firm's investment. Furthermore our findings contradict Kaplan and Zingales (1997) and Rajan and Zingales (2001) who argue that a lower dependence on in-

¹¹ Furthermore, it is worth to note that the investment-cash flow sensitivities in the extended model are not affected as we take the probability of default explicitly into account (see Table B.4 in the Appendix B).

ternal funds does not necessarily indicate a lower level of financing constraints. In line with Harhoff (1998), we conclude that the higher investment-cash flow sensitivities of small firms indicate a higher level of financing constraints compared to large firms in our sample.

Table 3: ADL investment models: Dependence on internal funds by type of house bank - GMM first differences

Variable	All firms	SMEs
$I_{i,t-1} / K_{i,t-2}$	0.182 ^a (0.046)	0.093 (0.059)
Δy_{it}	0.05 (0.063)	0.058 (0.074)
$\Delta y_{i,t-1}$	-0.007 (0.042)	-0.008 (0.056)
$C_{it} / K_{i,t-1}$	0.248 ^a (0.056)	0.234 ^a (0.076)
$C_{i,t-1} / K_{i,t-2}$	-0.069 ^b (0.034)	-0.027 (0.057)
$D_{it}^{Coop} \cdot C_{it} / K_{i,t-1}$	0.186 (0.256)	0.345 (0.254)
$D_{i,t-1}^{Coop} \cdot C_{i,t-1} / K_{i,t-2}$	0.184 (0.144)	0.172 (0.149)
$D_{it}^{Sav} \cdot C_{it} / K_{i,t-1}$	-0.17 (0.147)	-0.062 (0.173)
$D_{i,t-1}^{Sav} \cdot C_{i,t-1} / K_{i,t-2}$	0.067 (0.08)	0.052 (0.078)
# obs. (firms)	2,234 (1,455)	1,435 (961)
Wald χ^2 (14)	58.19 ^a (0.000)	58.41 ^a (0.000)
Hansen χ^2 (86)	95.98 (0.216)	98.66 (0.166)
m1	-4.26 ^a (0.000)	-3.44 ^a (0.001)
m2	-1.46 (0.143)	-1.65 (0.098)

Notes: see Table 2.

Subsequently, we split the cash flow variable according to the firms' bank relationship. We extend the investment equation with four interaction terms on the firms' cash flow (two for firms attached to cooperative banks and two for firms attached to savings banks). Firms attached to commercial banks form the base group. The estimation results are depicted in Table 3. Due to the small number of large firms attached to cooperative banks (33 observations) and to savings banks (62 observations), results are only presented for all firms and the sample of SMEs.

Again, the validity of lagged levels dated $t-2$ as instruments cannot be rejected by the Hansen test of over-identifying restrictions and there are no signs of second order autocorrelation in the differenced residuals. Although the coefficients on the cash flow variable show the expected negative sign for firms attached to savings banks, they are in all cases insignificant. The cash flow variables for firms attached to cooperative banks are insignificant, too. Thus we do not find any evidence that firms attached to one of these two pillars are neither more nor less financially constrained than firms attached to commercial banks. Additional empirical tests show that the investment-cash flow sensitivity of firms attached to savings banks does not differ from those of firms with relations to cooperative banks at conventional significance levels.¹² The $\chi^2(2)$ statistic for the test on equal coefficients in the current cash flow is 1.48 with a p-value of 0.2234 in the sample for all firms. The corresponding values are $\chi^2(2)=1.93$ with $p\text{-value}=0.1645$ in the sample of SMEs.

4.2 Robustness of results

One may argue that firms' choice of bank attachment, however, may complicate the empirical test of our hypothesis. As firms might know about the role of savings banks and cooperative banks, more financially constrained firms might pre-select one of both. In this case, bank attachment is not randomly distributed and depends on the observable and unobservable financial constraints of firms before they enter a firm-bank-relationship. We investigate this point in detail and compare estimates of OLS with estimates of Within- and GMM-models in Table B.3 in the Appendix B. Estimation results show that point estimates of the cash-flow coefficients for firms attached to savings- or cooperative banks are lower when applying the Within- or GMM-estimator.

¹² Testing for equal coefficients on the current cash flow the $\chi^2(2)$ statistic is 1.48 (1.93) with a p-value of 0.2234 (0.1645) in the sample for small firms (SMEs).

This is due to the fact that the latter two already control for time-invariant heterogeneity and thus for a huge part of a possible selection problem.

Finally, we test the robustness of our results. Restricting the sample to firms with at least four observations, the sample has been reduced to 1,252 observations, 100 of whom are affiliated with cooperative banks and 273 of whom are attached to savings banks. Again, the results provide no evidence that the type of bank relationship affects the dependence on internal funds. Furthermore we further restricted our sample to firms with relationship banking to only one bank instead of having one or more business connections to banks of the same pillar. Yet, results were once again robust to this modification.

We also investigate indirectly whether duration of relationship biases our results. Berger and Udell (1995) report for the U.S. that interest rate on lines of credit decreases with the duration of the lending relationship. By contrast, Petersen and Rajan (1994) found a positive but insignificant effect on the price of loans based on the same data source.¹³ Harhoff and Körting (1998) also did not find a direct impact on the interest rate for Germany, they show, however, that the probability of banks to demand collateral decreases with the duration of the lending relationship. Since we restrict our sample on ten year old SMEs, we try to reduce potential biases due to unobservable durations of the firm-bank-relationship. In this unreported regression we do not detect any significant changes in the investment-cash flow sensitivities.¹⁴ Recapitulating unobservable differences in the duration of the lending relationship seem not to imply differences in the investment-cash flow sensitivities of German firms shown in Table 3.

¹³ Berger and Udell (1995) argue that the inclusion of transaction driven loans in the study of Petersen and Rajan (1994) primarily explains the different results.

¹⁴ Results of all mentioned robustness checks are available upon author's request.

4.3 Discussion

Based on our empirical findings we conclude that the availability of internal funds seems not to be a more important factor for firms attached to commercial banks than for firms with relations to savings banks or cooperative banks. The historical mandate for promoting SMEs as well as the expected informational advantages of public sector banks and cooperative banks does not cause a lower dependence of their borrowers on internal funds.

In contrast to our study, Prantl et al. (2006) detect that the probability to receive a public assisted loan is sensitive to the firm's attachment to one of the three pillars of Germany's banking system. While Prantl et al. (2006) focused only on start-ups, we addressed the segment of small and medium sized enterprises as a whole. Information asymmetries may be very high for young firms in Prantl's study and thus, bank heterogeneity may matter to a higher extent. Restricting the sample to up to ten year old SMEs, our results do not change, however. On the one hand the generalization of our results for young firms may be hampered due to the small sample size and the expectation that young firms providing accounting data are a selective group of all young firms. On the other hand, the interest rate of public assisted loan is expected to be marginal lower compared to the interest rate offered by the lender. Probably financing constraints are reduced to a minor extent due to the interest rate spread. Until now, an explicit test on the relationship between receiving a public assisted loan and the level of financing constraints is missing, however.

How can we explain that bank heterogeneity does not matter? In our point of view, rent-seeking behavior may explain our findings. Degryse and Ongena (2005) found empirical support for spatial price discrimination. Lenders located close to their borrowers offer an interest rate to borrowers above the marginal cost of lending and thus, exploit

some rents. In our sample, the distance between firms and banks is lower for firms attached to savings banks or cooperative banks compared to firms attached to commercial banks. As savings banks and cooperative banks might as well make use of spatial price discrimination, this would imply a higher price on the loans as well as limited availability of loans. As consequence, spatial price discrimination may imply a higher dependence on internal funds.

Yet, credit cooperatives and savings banks seem to have a similar impact on the funding behavior of their borrowers. This result is in line with findings of Prantl et al. (2006), who do not find any significant differences with respect to the probability to raise public assisted loans. Thus, the characteristic of public ownership and the explicit mandate to promote SMEs might not matter. Cooperative banks changed their on-site presence remarkably in the last ten years, however. At this stage, it is very difficult to evaluate how a specific change of the corporate form of savings banks may affect SMEs access to loans.

There are two main findings from our analysis: First, contrary to our expectations and the presumptions in the literature, the huge market share of public owned savings banks seems not to explain the overall low dependence of investments on internal funds in Germany. Second, public ownership seems not to imply lower financing constraints of German SMEs.

5 Conclusions

The paper addressed the question whether public banking, namely the large market share of savings banks and credit cooperatives in Germany, can explain the rather weak dependence of German firms on internal funds. Both bank groups have the mandate to promote the German *Mittelstand*, and are characterized by strong on-site presence,

which implies advantages to monitor the borrower. Thus, one could presume that firms attached to one of these two bank groups show a lower dependence of investment on internal funds than firms attached to commercial banks. Using accounting data on 1,455 German firms for the time period 1998-2004 and combining it with information on the firms' bank relationships we tested this hypothesis empirically. Following Bond et. al (1999), we applied an Autoregressive Distributed Lag Model (ADL) of firm investment. For the whole sample of firms, the supply of internal funds has a positive impact on investment and this effect is similar in size compared to previous studies. Yet, estimation results reveal that there are no statistically significant differences in the dependence of investments on internal funds between firms attached to a commercial bank, firms attached to a cooperative bank, and those attached to a savings bank. Therefore, the prominence of public banking seems not to be responsible for the internationally low overall dependence of investments on internal funds in Germany. Furthermore, we do not detect any significant difference in the investment-cash flow sensitivity between firms attached to savings banks and those attached to cooperative banks. Concerning the currently ongoing debate about the privatization of savings banks, public ownership seems not to be essential for reducing financing constraints of German SMEs.

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Appendix A: Calculation of variables and definition of outliers

Tangible fixed assets ($K_{i,t}$): land, property, plant and equipment deflated by the industrial sector price index of the gross capital stock

Investments in tangible fixed assets ($I_{i,t}$): first difference of tangible fixed assets plus depreciation on tangible fixed assets deflated by the industrial sector price index of investments in tangible fixed assets. As there is a high number of missing observations on the depreciation on fixed capital assets, we impute values for all observations. These are based on the following formula: depreciation on total assets multiplied with the ratio of tangible fixed capital assets to total assets.

Cash flow ($C_{i,t}$): depreciation plus profit (after taxes and interest) deflated by the price index of gross value added

Sales ($y_{i,t}$): sales deflated by the price index of gross value added

After preparing the variables, we checked the variables for outliers. Firms are excluded if there are negative values for sales or for tangible fixed capital assets, or if the ratio of either investment, profit or cash flow to the tangible fixed capital assets exceeded 3, or if sales increased or decreased more than factor 3, or if firms' ratio of either investment, sales, profit or cash flow to the tangible fixed capital lays above the 95th percentile or below the 5th percentile of the empirical distribution.

Appendix B: Further estimation results

Table B.1: Estimation results of AR(1) models

	$I_{it}/K_{i,t-1}$	Δy_{it}	$C_{it}/K_{i,t-1}$	$C_{it}^{coop}/K_{i,t-1}$	$C_{it}^{sav}/K_{i,t-1}$
OLS	0.378 ^a (0.022)	0.048 ^b (0.020)	0.676 ^a (0.023)	0.715 ^a (0.049)	0.716 ^a (0.039)
Within	-0.123 ^a (0.031)	-0.216 ^a (0.031)	0.009 (0.045)	0.128 (0.109)	-0.126 (0.092)
GMM-FD	0.261 ^a (0.050)	0.010 (0.034)	0.355 ^a (0.083)	0.227 ^c (0.121)	0.261 (0.162)
m1	-4.93	-6.47	-3.18	0.52	-1.14
m2	-0.83	0.73	-0.73	-0.72	-1.26
Hansen	0.12	0.28	0.09	0.64	0.11

Notes: Heteroscedasticity-robust standard errors in parentheses. All models were estimated including time-dummies. GMM-FD: first-differenced GMM-estimator. ^a significant at 1%-level, ^b significant at 5%-level, ^c significant at 10%-level.

Table B.2: ADL investment models: Dependence on internal funds with consideration of the probability of default) - GMM first differences

Variable	Basic model with interaction terms
$I_{i,t-1}/K_{i,t-2}$	0.093 ^b (0.037)
$C_{it}/K_{i,t-1}$	0.064 (0.086)
$C_{i,t-1}/K_{i,t-2}$	0.059 (0.059)
$PD_Yellow_{i,t} \cdot C_{it}/K_{i,t-1}$	0.221 ^c (0.116)
$PD_Yellow_{i,t-1} \cdot C_{i,t-1}/K_{i,t-2}$	-0.034 (0.071)
$PD_Red_{i,t} \cdot C_{it}/K_{i,t-1}$	0.561 ^a (0.146)
$PD_Red_{i,t-1} \cdot C_{i,t-1}/K_{i,t-2}$	0.059 (0.128)
Δy_{it}	0.117 ^c (0.061)
$\Delta y_{i,t-1}$	0.033 (0.035)
# obs. (firms)	861 (595)
Wald χ^2 (14)	148.55 ^a
Hansen χ^2 (73)	70.76 (0.555)
m1	-3.13 ^a (0.002)
m2	-1.00 (0.316)

Notes: see Table 2. PD_Yellow: probability of default is between 1.0 and 2.6; PD_Red: probability of default is 2.6 or higher.

Table B.3: Estimation results of OLS-, Within- and System-GMM-estimators

Variable	OLS	Within	System-GMM
$I_{i,t-1} / K_{i,t-2}$	0.253 ^a (0.017)	-0.143 ^a (0.04)	0.202 ^a (0.045)
Δy_{it}	0.143 ^a (0.024)	0.093 ^b (0.043)	0.088 (0.055)
$\Delta y_{i,t-1}$	0.063 ^a (0.023)	0.026 (0.04)	0.01 (0.037)
$C_{it} / K_{i,t-1}$	0.133 ^a (0.018)	0.184 ^a (0.049)	0.173 ^a (0.047)
$C_{i,t-1} / K_{i,t-2}$	0.007 (0.016)	0.086 ^b (0.042)	-0.007 (0.037)
$D_{it}^{Coop} \cdot C_{it} / K_{i,t-1}$	0.081 ^b (0.041)	0.029 (0.129)	0.121 (0.141)
$D_{i,t-1}^{Coop} \cdot C_{i,t-1} / K_{i,t-2}$	-0.014 (0.033)	0.133 (0.087)	-0.008 (0.063)
$D_{it}^{Sav} \cdot C_{it} / K_{i,t-1}$	0.081 ^b (0.041)	0.051 (0.109)	-0.061 (0.121)
$D_{i,t-1}^{Sav} \cdot C_{i,t-1} / K_{i,t-2}$	-0.027 (0.034)	-0.019 (0.098)	-0.044 (0.05)
# obs. (firms)	6,498 (4,091)	6,498 (4,091)	3,778 (1,455)
R ²	0.218	0.099	/
F-Test/Wald χ^2 (14)	56.99 ^a	5.47 ^a	74.76 ^a
Hansen χ^2 (115)	/	/	130.98 (0.146)
m1	/	/	-4.44 ^a (0.000)
m2	/	/	-1.25 (0.213)

Notes: Heteroscedasticity-robust standard errors in parentheses. All models were estimated including time-dummies. ^a significant at 1%-level, ^b significant at 5%-level.

Table B.4: ADL investment models: Extended model with consideration of the probability of default - GMM first differences –

Variable	
$I_{i,t-1} / K_{i,t-2}$	0.181 ^a (0.047)
Δy_{it}	0.049 (0.064)
$\Delta y_{i,t-1}$	-0.017 (0.043)
PD_Yellow	-0.048 ^c (0.025)
PD_Red	-0.057 (0.035)
$PD_MissingValue$	0.053 ^b (0.024)
$C_{it} / K_{i,t-1}$	0.254 ^a (0.055)
$C_{i,t-1} / K_{i,t-2}$	-0.074 ^b (0.036)
$D_{it}^{Coop} \cdot C_{it} / K_{i,t-1}$	0.201 (0.263)
$D_{i,t-1}^{Coop} \cdot C_{i,t-1} / K_{i,t-2}$	0.198 (0.136)
$D_{it}^{Sav} \cdot C_{it} / K_{i,t-1}$	-0.146 (0.15)
$D_{i,t-1}^{Sav} \cdot C_{i,t-1} / K_{i,t-2}$	0.076 (0.084)
# obs. (firms)	2,234 (1,455)
Wald χ^2 (17)	84.25 ^a
Hansen χ^2 (86)	95.87 (0.219)
m1	-4.19 ^a (0.000)
m2	-1.49 (0.137)