Identifying "Problem Banks" in the German Co-operative and Savings Bank Sector: An Econometric Analysis

Klaus Schaeck*

Simon Wolfe

† School of Management, Centre for Risk Research, University of Southampton, Highfield, Southampton, SO17 1BJ, United Kingdom. The authors would like to thank Anastasios Plataniotis, George McKenzie and Heinz-Rudi Förster for helpful suggestions and assistance for this research.

* Contact details: ++ 44 (0) 23 8059 3118; Fax ++ 44 (0) 23 8059 3844; E-mail: kschaeck@soton.ac.uk.

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Abstract

This paper provides the first econometric analysis of *problem banks* in Germany. Drawing on an original dataset of distressed co-operative and savings banks, we develop early warning indicators for banking difficulties using a parametric approach. Taking the idiosyncratic characteristics of the German banking sector into account and controlling for microeconomic variables, we evaluate as to whether bank type and location matter. Findings indicate that banks in West Germany are less risky than credit institutions in the Neue Länder and that co-operatives are more prone to experience financial difficulties than savings banks. We conclude that a model that combines both savings and co-operative banks is sufficient to identify *problem institutions* up to three years prior to the surfacing of distress.

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1. Introduction

The identification of *problem bank*s using econometric models has been a key subject of research over the past few decades. The need for such models, also termed early warning systems or off-site surveillance systems, stems from the fact that the information content of bank ratings obtained in on-site examinations can be rendered insignificant in a short time span (Cole and Gunther, 1988). Bank supervisors therefore supplement their on-site examinations with off-site surveillance systems for the identification of *problem banks*. These models are developed to discriminate between sound and unsound institutions such that bank supervisors can allocate scarce resources in an efficient manner. Moreover, early warning systems help to mitigate the cost imposed on society by bank failures and restrain supervisory forbearance as they enable prompt corrective action where financial difficulties are detected.

The seminal paper by Meyer and Pifer (1970) on impaired U.S. banks utilises a qualitative response model. Subsequent work by Sinkey (1975), Santomero and Visno (1977) and Altman (1977) also focuses on the U.S. banking market and draws mainly on discriminant analysis for the classification of banks. Martin (1977) and West (1985) employ logit regression analysis for the identification of unsound institutions whereas Lane et al. (1986) pioneered the field by using duration analysis. Further econometric studies of early warning systems for the U.S. based on logit regression analysis, duration analysis and trait recognition can be found in Espahbodi (1991), Thomsen (1991), Whalen (1991), Cole et al., (1995), Estrella et al., (2000), Kolari et

al., (2002), Gunther and Moore (2003) and Collier et al., (2003). Demirgüç-Kunt (1989) provides an in-depth assessment of the early studies. Research on other banking markets' experiences with *problem banks* is less widespread. Episodes of banking turmoil in Spain in the late 1970s and 1980s sparked off the development of early warning models by Laffarga Briones et al. (1988) and Rodriguez (1989). Leading indicators for *problem banks* in Norway are developed by Berg and Hexeberg (1994). Laviola et al. (1999) examine the period of banking difficulties in Italy in the 1990s and Logan (2000) provides an overview on leading indicators for the U.K. small banks crisis in the early 1990s. *Problem institutions* in South East Asia in the late 1990s are investigated by Bongini et al. (2001). However, in spite of the fact that the German banking sector has been experiencing severe strain recently, to our best knowledge no empirical analysis exists to date due to severe sampling limitations.

Three out of four large German private commercial banks suffered major losses in 2002 and a number of small and medium sized institutions had to be merged, closed by the regulator or had to be rescued by lifeboat operations over the past six years due to serious difficulties (IMF, 2003; Bundesaufsichtsamt für das Kreditwesen[1] (BAKred), 2001, 2000, 1999). Savings banks and co-operative banks increasingly engage in merger activities attributable to economic problems and due to excess concentration within the same municipality. Figures by the Deutsche Bundesbank (2000, 2004a) indicate that the total number of savings banks decreased by 17 percent between 1998 and 2003 and that the number of co-operative banks fell by 38 percent respectively. Finally, the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin), (2004, 2003, 2002) and the BAKred (2001, 1998) repeatedly report that a rising number of co-operative banks have received indemnities and cash injections by the

institution protection scheme operated by the Federal Association of Co-operative Banks over the past few years, thereby stretching the resources of the protection scheme significantly.

[TABLE 1]

Table 1 provides an overview on the composition of the German banking sector by pillar. The German banking system with its approximately 2,300 financial institutions is highly idiosyncratic in six distinct ways. First, the universal banking system consists of the three pillars of private commercial, savings and co-operative banks which are all different in terms of objectives and ownership structure (Brunner et al., 2004). Second, Schmidt and Tyrell (2004) point out that banks in Germany play a more significant role in the intermediation of funds than in Anglo-Saxon economies. Third, Hackethal (2004) exposits that more than 80 percent of licensed institutions are either savings or co-operative banks. These banks are therefore not strictly profit maximising enterprises as they serve the public interests of their region and their members respectively. Fourth, savings and co-operative banks operate on a regional basis that constrains business activities to their municipality or district. This precludes competition within the respective pillar (Hackethal, 2004). Fifth, the level of deposit insurance coverage is unusually high by international standards. For co-operatives and savings banks, not only deposits but also the institutions themselves are protected by institution protection schemes operated by the Federal Association of Co-operative Banks and by the German Savings Bank Association (Brunner et al., 2004; IMF, 2003). Finally, the German financial system is perceived to be a prime example for particularly close ties and extensive relations between corporate borrowers and their banks. This information-sensitive and long term-relationship is commonly referred to as the Hausbank Financing Principle (Elsas and Krahnen, 2004).

The urgent need to devise an off-site surveillance system for banking problems in Germany as identified by the IMF (2003) and the current absence of studies focusing on financial difficulties in co-operative credit institutions and savings banks provide the key rationale for investigating *problem institutions* in these two pillars. These groups of institutions together account for more than 48 percent of total assets in the German banking industry.[2] Moreover, the savings bank sector is expected to experience further strain in the future because of the phasing out of public guarantees of its liabilities in 2005 (Brunner et al., 2004). As savings banks are currently perceived to gain competitive advantages from these guarantees in terms of lower funding costs, the phasing out is likely to decrease these banks' profitability because of the anticipated rise in funding costs.

The idiosyncratic structure of the banking system provides an appropriate setting to advance the literature on leading indicators of bank fragility in a variety of ways. First, drawing on an original database of *problem institutions* across savings and co-operative banks over the period 1999 - 2002, we explore the question as to whether the classification as a *problem bank* is related to the type of institution. Second, we investigate whether the Hausbank Financing Principle impacts upon the importance of credit risk as leading indicator. Third, the observation that many German institutions are unusually small in size by international standards (Brunner et al., 2004), suggests testing whether or not bank size impacts upon the probability of being classified as a *problem institution*. Finally, the fact that there still exist marked differences in the economic environment between West Germany and the Neue Länder lends itself to an analysis of the question as to whether bank location matters.

In contrast to a widely held view that German accounting principles are fairly "uninformative" (Leuz and Wüstemann, 2004), our findings indicate that publicly

available financial statement data and institutional variables can effectively help classify *problem bank*s across the two types of institutions. The incorporation of variables that capture bank type and location is found to significantly augment the explanatory power of our model. Despite the close relationships between banks and borrowers, poor asset quality is discovered to be a main contributor to German banking problems. Based on our validation exercise, we conclude that leading indicators of banking problems in Germany can be effectively developed using publicly available financial statement data and institutional variables.

This paper proceeds as follows. Section 2 elaborates on the definition of *problem banks* and provides an overview on the parametric approach, the dataset and the independent variables. Section 3 reports the empirical results. Section 4 exposits the findings from the validation exercise and Section 5 concludes and offers avenues for future research.

2. Parametric Model, Sample Composition and Independent Variables

2.1 Definition of the Term "Problem Bank"

Our definition takes into account the idiosyncratic structure of the German banking sector. The German Savings Bank Association and the Federal Association of Co-operative Banks pursue a "quiet" approach such that problems rarely surface in the public domain (IMF, 2003). Ailing savings banks often receive indemnities to remain in business rather than exit the market. In addition, they may be merged with a stronger savings bank. The costs of restructuring the impaired institution are frequently shared between the owner of the troubled bank, the maintenance obligator (Anstaltsträger), and the institution protection scheme. Impaired co-operative credit institutions similarly receive indemnities and cash injections from the institution

protection scheme operated by the Federal Association of Co-operative Banks to remain in business independently. Likewise, they may be merged with a stronger co-operative bank. This approach of treating ailing savings and co-operative institutions is however highly debatable. Kane (1989) refers to those institutions that remain in business independently as "zombie" institutions as these banks can still provide banking services to the public even though they are no longer viable from an economic point of view. The fact that the bank resolution strategies adopted by the German Savings Bank Association and by the Federal Association of Co-operative Banks are closely aligned with each other suggests developing a leading indicator model of bank fragility that embraces the two pillars. Moreover, the Deutsche Bundesbank (2004b) comments that the private commercial banks are too heterogeneous a group to be included in an early warning system for the identification of *problem banks*. We therefore concentrate on co-operative and savings banks in this study. A savings or co-operative bank is classified as a *problem institution* at that point in time when it first seeks assistance from its protection scheme. This is an unambiguous definition and is similar to definitions employed in previous studies (Berg and Hexeberg, 1994).

2.2 Sample Composition

Sampling limitations have thus far impeded the analysis of *problem banks* in Germany as neither the Deutsche Bundesbank nor the BaFin provide details on *problem banks* or grant public access to their proprietary databases. We draw on an original database for *problem banks* compiled by the German Auditor's Chamber that contains information on qualified and amended certification annotations in annual reports. German auditors have to certify company accounts on an annual basis to assess as to whether the accounts provide a true and fair view of the financial

condition of the institution. Whereas the auditors certify sound institutions' accounts with an unqualified certification notation, a qualified or amended certification notation is applied for *problem institutions*.[3] A certification notation has to be qualified or amended whenever a bank receives external support from the respective institution protection scheme. The certification notation explicitly spells out the form of assistance provided to the banks. For example, indemnities, cash injections or other types of capital restoration measures received by the *problem bank* result in a qualified or amended certification notation of the bank's annual report.

We focus on the period between 1999 and 2002 as a large number of financial institutions across the savings and the co-operative banking sector sought support from the respective institution protection scheme. Our sample consists of 615 co-operative credit institutions and savings banks of which 96 banks received support from their institution protection scheme. Whilst this sample size is still small in comparison to studies focussing on the U.S. banking market, it is large by international standards. Furthermore, the number of *problem institutions* exceeds that of *problem banks* reported in many of the empirical studies on other jurisdictions reviewed in Section 1 of this paper. In terms of the number of institutions, our dataset covers more than 31 percent of licensed co-operative and savings banks in Germany and more than 44 percent of total assets held by these groups of institutions.

A small number of co-operative credit institutions received multiple indemnities over consecutive years that backtrack before our observation period. Additionally, some of the impaired co-operatives were merged with healthy institutions, and subsequently became a *problem institution* and were merged yet again. One savings bank received an indemnity, was merged with a sound savings bank and the merged entity received additional indemnities afterwards. As it is not possible to determine a problem date

for these nine banks, they had to be dropped from the original sample. Moreover, no data on independent variables could be obtained for a further six *problem institutions* such that overall 15 institutions had to be deleted from the dataset. The final sample therefore contains 81 *problem banks*.

We have carefully selected 519 sound banks as a control group. These institutions are a random drawing that represents savings and co-operative banks. As it is a common approach to merge *problem banks* with healthy ones, the condition was imposed that the sound institutions did not engage in any merger activity over the observation period in order to prevent sampling distortions.

Robustness tests are carried out by holding back 100 banks of which 17 are *problem institutions*. *Table 2* provides an overview of sample composition by pillar.

[TABLE 2]

2.3 Parametric Model

We use a cross-sectional model in this study to identify the key risk drivers that underlie an institution being classified as a *problem bank*. Consequently, we draw upon financial statement data and institutional variables as at year end 1998 to predict impairment in the succeeding three years in our training sample. As we decide against estimating a model for panel data, we rule out the possibility that our estimates are influenced by exogenous factors. Bongini et al. (2001) highlight that aspects such as changing supervisory behaviour over the years in the classification of *problem banks* or macroeconomic fluctuations could impact the inferences drawn.

We employ a parametric approach using logistic distribution as it enables the modelling of binary outcomes. This methodological approach is considered to be superior to other techniques such as multiple discriminant analysis as it establishes a

causal relationship between bank characteristics and subsequent problem status (Demirgüç-Kunt, 1989). Moreover, it does not require multivariate normality among the predictor variables (Kolari et al., 2002). The model underlies a latent variable model of the form

$$P\{y_i = 1|x_i\} = G(x_i, \beta). \tag{1}$$

The function $G(.)$ implies that the probability for observing a *problem bank* $y_i = 1$ is described by a vector of independent variables x_i. In order to obtain a binary outcome, the function $G(.)$ has to lie in the interval $[0,1]$ only. This can be achieved by using a distribution function such as the standard logistic function which gives rise to the logit model

$$L(w) = \frac{e^w}{1+e^w} \tag{2}$$

where w is an index that combines the independent variables of the form

$$w = \alpha + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_k X_k \tag{3}$$

where α is the intercept and $\beta_1, \beta_2, ..., \beta_k$ are the regression coefficients for the independent variables $X_1, X_2, ..., X_k$. The parameters of the model can be estimated using maximum likelihood estimation technique.

2.4 Independent Variables

Previous studies draw upon commonly employed CAMEL[4]-type variables as predictors for the identification of *problem institutions*. In addition, market data are incorporated as well into these studies to augment the explanatory power of these models. As neither equity nor debt securities of co-operatives and savings banks are publicly traded, this kind of information cannot be utilised in a study on Germany.

However, the German banking sector with its idiosyncratic characteristics provides an appropriate setting to test for numerous other hypotheses. Thus, rather than applying proxies for the CAMEL categories or including market data, we use a different set of independent variables. The structure of the banking system with different types of institutions that are characterised by different exposures to risk in the presence of information asymmetries and agency conflicts between debtholders, depositors, shareholders, managers and banking associations that wield an influential role in the bank resolution process, lends itself to testing the hypothesis as to whether the potential of being a *problem bank* is related to the bank type. We therefore fit a dummy variable (X_{12}) that captures bank type. Controlling for capital holdings (X_1), loan growth (X_2) and loan loss provisions (X_3), we also fit a dummy variable (X_{11}) that proxies bank location as the economic setting between East and West Germany still differs markedly. Poor management is considered a particular problem in co-operative banks. The BaFin (2003) reports that 88 percent of all formal actions taken by the supervisory agency against senior executives are aimed at co-operative institutions. This necessitates a proxy for management quality (X_4). We assume that management quality is reflected in asset quality, proxied by loan loss provisioning, and excessive loan growth. An interaction term of these two variables is therefore employed. Even if an institution experiences strong loan growth, we expect prudent bank managers to consequently increase provisions for bad debt. Financial performance of the institutions is captured by a proxy for operating profits. The recurring earning power (X_5) is a measure of profit before tax prior to deducting loan loss provisions. Cost-efficiency is reflected in the cost-income ratio (X_6). Liquidity is proxied by a variable expressing liquid assets as proportion of customer and short term funding (X_7). In order to gauge the exposure to sudden deposit withdrawals by institutional depositors,

we include a predictor for deposits held by banks (X_8). Brunner et al. (2004) contend that German institutions insufficiently diversify their revenue streams. We test revenue diversification by fitting a variable that captures interest income to total income (X_9). Finally, we empirically assess whether bank size matters (X_{10}). Contrary to previous studies, this is not to be understood as an examination of the adaptation of the "too big to fail" doctrine (Kaufman, 2002) in Germany as large private commercial banks, Landesbanken and the large apex institutions of the co-operative banks that would be deemed "too big to fail" are excluded from our study. The BaFin (2003), and the BAKred (2001) repeatedly state that management quality, particularly in small co-operative banks, is subject to close scrutiny as a number of the proposed mergers experience serious delays due to the absence of adequately qualified senior executives that meet the requirements laid out for senior bank managers by the German Bank Act (2004). It can be inferred therefore that small institutions may be more prone to experience difficulties due to the absence of sophisticated management procedures and principles. An overview of the independent variables and the expected sign of the respective coefficient is given in *Table 5*. Annual data for the independent variables are obtained from Bankscope, a commercial database for financial institutions maintained by Bureau van Dijk.

3. Empirical Results

3.1 Univariate Tests

There is a strong case for specifying one model that identifies *problem banks* in both the co-operative and savings bank sectors. First, the institutions in these two pillars are unusually small in size by international standards (Brunner et al., 2004). Second, their banking activities are locally constraint to the immediate municipality or district.

Third, the bank resolution strategies adopted by the respective institution protection schemes of the two groups are widely comparable. Whilst the two groups of institutions are markedly different in terms of their ownership structure, their lines of business are practically indistinguishable. Nonetheless, we perform an econometric analysis where we test against the null hypothesis of equal means of our independent variables between the two groups of banks.

Table 3 presents the results of our univariate test. In order to permit comparison of the full set of *problem banks* with sound institutions, data for 1998 are exploited for this univariate analysis. Contrary to the previously outlined commonalities of co-operatives and savings banks, all our independent variables exhibit statistically significant differences between the two types of institutions. Whilst the covariates for loan loss provisions (X_3) and management quality (X_4) only border on the 90 percent confidence level, all the other variables are significantly different between co-operatives and savings banks at the 95 or 99 percent confidence levels. We find that credit co-operatives are higher capitalised (X_1), experience stronger loan growth (X_2), provision more for non-performing loans (X_3), exhibit weaker recurring earning power (X_5), are less cost-efficient (X_6), show lower liquidity levels (X_7), receive less deposits from other institutions (X_8) and have a lower dependency on interest income (X_9). They are also smaller in size (X_{10}). Thus, contrary to the qualitative comparison of savings banks and co-operatives, our econometric examination of the dataset suggests marked differences between these types of institutions. Consequently, we estimated parametric models for each pillar individually to evaluate leading indicators for *problem banks*. However, the findings of these tests did not satisfactorily approximate the dataset for savings banks. This can be explained by the considerably lower frequency of distressed savings banks. In light of this, we do not report these results

here and conclude that a model that embraces the two groups of institutions simultaneously is superior for the identification of leading indicators of *problem bank*s.[5] The subsequent exposition concentrates on a model based on our full dataset.

[TABLE 3]

We run a further univariate test and evaluate whether the means of the independent variables between sound banks and institutions that became *problem banks* in the period between 1999 and 2001 are significantly different from each other. This analysis is also based on independent variables for the year 1998 for both groups of institutions. The data for 2002 are held back for the validation exercise (see Section 4). As depicted in *Table 4*, mean values of six variables for the sound versus *problem institutions* are significantly different at the 95 and 99 percent confidence levels respectively. Sound banks provision less for impaired loans (X_3), exhibit higher operating profitability (X_5), are significantly more cost efficient (X_6) and are more liquid (X_7) than *problem banks*. Interest income in *problem institutions* is more important than in healthy banks (X_9) and these institutions are also discovered to be significantly smaller than sound banks (X_{10}).

[TABLE 4]

3.2 Multivariate Tests

In order to assess leading indicators for *problem banks*, we estimate parametric models for the dataset comprising savings and co-operative banks based on independent variables for 1998. *Table 5* illustrates the results for two different specifications. In Specification I, we estimate a canonical model that contains exclusively financial statement data. We force all independent variables to enter the equation in Specification II to analyse as to whether the incorporation of dummy

variables that capture bank location and bank type augment the explanatory power of the model.

[TABLE 5]

The results presented in *Table 5* for Specification I illustrate that six out of the ten independent variables are significantly different from zero. Loan growth (X_2), loan loss provisions (X_3), management quality (X_4), cost-income ratio (X_6) and the proxy for liquidity mismatch (X_7) are significant at the 5 and 1 percent levels and show the expected sign for the respective coefficient. Accelerating loan growth and increased loan loss provisioning as well as cost inefficiencies in the period up to three years prior to being classified as *problem bank* increase the probability of distress. By contrast, high quality management and high levels of liquidity significantly contribute to decreasing the probability of future problems. The variable that captures bank size (X_{10}) is also correctly signed and borders on statistical significance at the 10 percent level. This confirms our hypothesis that larger banks are less risky than smaller institutions. The covariates that proxy capital holdings (X_1) and recurring earning power (X_5) exhibit counterintuitive signs and are not statistically significant. The proxy for revenue diversification (X_9) is insignificant and shows a negative sign, indicating that increasing dependency on interest income decreases the probability for future distress. The measure for the exposure to sudden deposit withdrawals (X_8) is correctly signed but insignificant. This finding underlines the influence that the institution protection schemes have on lowering the propensity for bank runs by institutions in Germany.

Closer examination of Specification II suggests that the incorporation of additional variables that proxy bank location and bank type considerably augments the explanatory power of the model. The higher McFadden R^2 indicates a better fit of

Specification II for our dataset. The superiority of Specification II is reinforced by the lower value of the Akaike Information Criterion, reported in *Table 5*. Eight of the twelve covariates exhibit statistical significance and all these variables show the anticipated sign. Loan loss provisions (X_3), management quality (X_4), operating profitability (X_5) and the cost-income ratio (X_6) are highly statistically significant at the 99 percent confidence level. The proxy for liquidity (X_7) is significantly different from zero as well, albeit at the 95 percent confidence level whereas the significance level for loan growth (X_2) declines to 90 percent in Specification II. Our analysis also presents evidence at the 99 percent confidence level that banks in West Germany are less likely to run into difficulties than credit institutions in the Neue Länder (X_{11}). This does not come as a surprise. Banks in East Germany operate in an adverse economic environment with considerably higher rates of unemployment than in West Germany. Whilst major improvements in managerial skills have been taking place in the Neue Länder over the past 15 years, the risk associated with credit institutions in East Germany is still considerably greater than in West Germany. The variable that captures bank type (X_{12}) is negatively signed at the 99 percent confidence level. This suggests that savings banks are less risky than co-operatives. Our empirical evidence is corroborated by repeated statements by German banking supervisors regarding the serious difficulties experienced in the co-operative banking sector. This is also substantiated by the higher frequency of observed distresses as illustrated in *Table 2*. The predictors that capture capital holdings (X_1) and deposits held by banks (X_8) are correctly signed but remain insignificant. Increases in interest income decrease the probability for future problems whereas the size variable (X_{10}) is now positively signed; suggesting increasing bank size increases the probability for impairment.

4. Robustness Tests

The validation exercise utilises financial statement data for 100 co-operative and savings banks of which 17 sought support from the respective institution protection scheme in 2002. *Table 2* provides an overview of the composition of the holdout sample. In light of our finding that the incorporation of dummy variables that capture bank type and location substantially augments the explanatory power of the model, we re-estimate Specification II employing only the eight statistically significant variables. The equation for the robustness test is reported in the *Notes* to *Table 6*. We perform three robustness tests in this section. In order to assess the actual classification accuracy of the proposed set of leading indicators for the identification of *problem banks*, the analyses are based on independent variables as at year end 1999, 2000 and 2001 to identify *problem institutions* in 2002. This approach assumes stable characteristics of *problem banks* over time. Deterioration in the model's predictive power over a number of years would suggest an unstable relationship between bank characteristics and subsequent impairment.

The evaluation of the predictive power of the model should not concentrate on the overall classification accuracy. Previous studies widely neglect the finding by Korobow and Stuhr (1985) that substantial differences in the sampling size of the groups of *problem banks* and sound institutions could give rise to misleading inferences when focussing on the overall classification accuracy. Whilst overall classification accuracy close to 100 percent can be obtained in such a case, only a small proportion of the crucial group of *problem banks* is identified in this setting. A more informative approach to gauge the predictive power was initially proposed by Lloyd-Ellis et al. (1990) and subsequently reiterated by authors at the Federal Deposit Insurance Corporation (FDIC) in the U.S. (Collier et al., 2003). Observing the trade

off between Type I and Type II Errors at different critical levels helps to assess the model's predictive power. Furthermore, the opportunity costs associated with each type of error have to be taken into consideration. A Type I Error is observed when a *problem institution* is flagged up as sound, whereas a Type II Error denotes the misclassification of a sound institution as a *problem bank*. Ignoring the opportunity costs associated with each type of error and simply maximising total classification accuracy has wide ranging ramifications for society. For instance, the misclassification of *problem institutions* can, in the worst case, impose negative externalities on society. If large institutions experience severe difficulties, it may happen, that the institution protection schemes have insufficient resources to recapitalise the banks and ultimately tax payer's money would have to be utilised. On the contrary, the opportunity costs associated with Type II Errors are far less substantial. Misclassifying sound banks suggests that the institutions are put under close scrutiny by the supervisory agency and subject to on-site audits. The supervisory agency thus bears the opportunity cost for Type II Errors. The opportunity costs of making a Type I Error undoubtedly outweigh the opportunity costs of Type II Errors. Therefore, the results for the robustness test in *Table 6* shows the respective Type I and Type II Errors in light of a range of different critical levels based on independent variables as at year end 1999, 2000 and 2001. These cut-off points constitute the level of making a Type I Error. For instance, a critical level of 10 percent underlies a confidence level of 90 percent not to make a Type I Error.

[TABLE 6]

Table 6 illustrates the results for the three robustness tests in light of different critical levels. As outlined previously, it is essential to reduce Type I Errors to mitigate the risk of missing a *problem bank*. Therefore, we set a confidence level of at least 90

percent to avoid making a Type I Error. Utilising independent variables as at 1999, that is three years prior to seeking support from the institution protection schemes, the risk for making a Type I Error approaches 56 percent, whilst the level for Type II Error is fairly low at 16 percent. However, increasing the confidence level to 95 percent reveals that the risk of misclassifying a distressed institution declines sharply to 31 percent whereas the level of Type II Error remains acceptably low at 32 percent. Allowing for this higher confidence level, and assuming the proposition that stable relationships between bank characteristics and subsequent distress hold, the reported predictive power for three years prior to becoming a *problem institution* compares favourably with previous studies of banking distress. For example, our classification accuracy in the validation exercise outperforms Logan's (2000) model that aims to identify problems in small institutions in the U.K.

The potential of failing to correctly identify a *problem bank* based on the independent variables for the year 2000 moves towards 29 percent at a critical level of 10 percent whereas the risk for misclassifying a healthy co-operative or savings bank increases to 42 percent.

At a critical level of 10 percent, the risk for misclassifying a *problem bank* declines to 25 percent in 2001 (the year immediately prior to distress). By contrast, the level of Type II Error rises to 48 percent, suggesting that nearly one half of the sound banks in our holdout sample are classified as *problem institutions*. This may be due to a substantial rise in the mean of the probabilities of being classified as *problem institution* over the period 1999 to 2001 as portrayed in *Table 6*. The mean for the probability of distress rises from less than 12 percent in 1999 to more than 26 percent in 2001 in the holdout sample. This figure does not necessarily imply that 26 percent of the institutions under consideration will eventually experience difficulties. Instead,

it strongly suggests the presence of exogenous factors that affect the entire banking system in a similar manner and spotlights a deteriorating soundness of the banking system. The observation of increased fragility in the German banking system is confirmed, at least partially, by the IMF's (2003) statement that numerous institutions, even large banks, reported sizeable losses in 2002. Likewise, the German supervisory agency reports that a rising number of bank insolvencies figured in the public domain in 2001 and that the institution protection scheme administered by the Federal Association of Co-operative Banks decided upon increasing the premiums for its member institutions from 2003 onwards in order to shore up resources due to the increased number of *problem* credit co-operatives (BaFin, 2002, 2003). Moreover, under the proposition that the relationship between bank characteristics and subsequent impairment is stable, the reported rise in the mean of the probabilities of being classified as *problem bank* in 2001 and 2002 suggests increased potential for exposure to systemic risk in Germany. This is of major concern as Upper and Worms (2002) present evidence that the collapse of a single institution can lead to the depletion of 15 percent of total assets of the German banking system due to contagious effects in the interbank market. However, it currently cannot be observed if the soundness has been deteriorating further as data for *problem institutions* for 2003 and 2004 is as yet not available from the Auditor's Chamber. Most recently, the Deutsche Bundesbank (2004b) reports that the condition of the co-operative and savings bank sector has improved.

[FIGURE 1]

Our inference based on *Table 6* is confirmed by the plot for the trade off between Type I and Type II Errors over various critical levels presented in *Figure 1*. Classification results not better than chance would be represented by a diagonal line

from 100 percent Type I Error on the Y-axis to 100 percent Type II Error on the X-axis. Thus, the concave shape of the three curves illustrates that the proposed model is of benefit for the early identification of ailing co-operatives and savings banks. While it could be expected that shortening the time span between the independent variables and the year 2002 increases the predictive power of our model, the plot suggests that this is not generally the case. Rather, the prediction based on variables for the year 2000 (two years prior to the intervention by the protection schemes) performs at critical levels of up to 15 percent better than the forecast based on data for 2001. Overall, the three lines are closely aligned with each other. We therefore conclude that the model is very stable over the sampling period. As a consequence, authorities involved in the bank resolution and restructuring processes would benefit from taking advantage of this model as it effectively helps identify ailing institutions at an early stage and requires little maintenance over time.

In summary, our model for the identification of *problem banks* in the German co-operative and savings bank sector is based on a combined dataset that consists of both types of institutions. The findings from our validation exercise, in particular the results based on independent variables for the year 1999, compare favourably with previous studies of *problem bank*s. The sharp decline of the potential for misclassifying impaired banks over time at the critical level of 10 percent is not surprising. The closer we get to the point of intervention by the protection schemes, the lower is the risk of making a Type I Error. Thus, this observation reflects deterioration in these institutions' financial condition in the lead up to distress. The close movement of the trade offs between Type I and Type II Errors in the classification plot suggests a fairly stable relationship between characteristics of banks and subsequent distress over time. We moreover detect an increase in the mean of the

probabilities for being classified as a *problem bank* based on independent variables for the years 2000 and 2001. This suggests the presence of exogenous effects that adversely impact upon the business environment of financial institutions in Germany and increased exposure to systemic risk. However, the cross-sectional model setup deterred us from testing effects of such factors. In view of this, and given that the utilised dataset does not embrace the whole population of German financial institutions, we finally conclude that our results may still understate the actual condition of the financial system in Germany. The ability to track structural changes across the banking industry is an additional benefit of the proposed model as it provides initial information for macroprudential analysis.

The findings for Germany confirm results of previous studies on other jurisdictions in that we also present evidence for the importance of excessive loan growth (X_2), earnings strength (X_5) and cost-efficiency (X_6) for the identification of impaired institutions. The significant bearing of a variable that proxies liquidity (X_7) on the classification of *problem banks* is a finding that has rarely surfaced in the literature. Albeit the Hausbank Financing Principle implies close ties between bank and borrower with close monitoring of the borrower's creditworthiness, poor asset quality, reflected by the significance of loan loss provisions as proportion of total assets (X_3), is found to have significant bearing on the probability for the identification as a *problem institution*. Our interaction term for management quality (X_4) is also found to significantly improve the predictive power of the model. Interestingly, five of the statistically significant covariates bear strong resemblance to the CAMEL components (capital adequacy, asset quality, management quality, earnings performance and liquidity) frequently employed in previous studies of *problem banks*. This underscores the applicability of these indicators for the German banking system. Our observation

that banks in West Germany (X_{11}) are less prone to experience difficulties has not yet been reported elsewhere. Likewise, the finding that the bank type matters (X_{12}) is also new in the literature. The empirical evidence for the higher risk associated with co-operative credit institutions is of significant bearing for bank managers and supervisors in Germany. Finally, we do not find that a high dependency on interest income increases the probability of future distress.

5. Conclusion

This study empirically investigates the efficiency of leading indicators for the identification of distressed German co-operative and savings banks. Severe data limitations on German *problem institutions* have prevented analysis in the past. Drawing on an original database of 96 co-operative and savings banks that received support from the respective institution protection schemes during the period from 1999 to 2002 and 519 sound institutions, we develop a parametric model that helps identify *problem institutions* up to three years prior to the surfacing of the difficulties. Our research suggests that the incorporation of variables that proxy bank type and location significantly augments the explanatory power of the proposed model.

We present empirical evidence that a logit model using a dataset of publicly available financial statement information and institutional variables for co-operatives and savings banks is sufficient for predicting impairment. Based on our robustness test, a degree of classification accuracy is achieved that compares favourably with previous studies in the literature. These findings are important for the institution protection schemes operated by the Federal Association of Co-operative banks and by the German Savings Bank Association. Faced with a growing number of impaired institutions that pose challenges for regulators and supervisors alike, the respective

bodies are currently working towards developing early warning systems for the identification of *problem banks*. Whilst bank size is not discovered to be of significance for future distress, we report that loan growth, operating profit, cost efficiency and liquidity play a significant role in the identification of *problem banks* in Germany. Moreover, an interaction term as a proxy for management quality is important for the early identification of *problem institutions*. Despite the close relationships between banks and their borrowers, deteriorating asset quality is discovered to be a chief factor for subsequent banking problems. We also find that banks in West Germany are less likely to experience difficulties than financial institutions in the Neue Länder. Finally, we observe that savings banks are more resilient to financial difficulties than co-operative banks. In summary, the proposed leading indicators can help discriminate between sound and impaired financial institutions and thereby complement on-site inspections by bank auditors.

The reliance on publicly available financial statement data makes our model dependent on the accuracy of the reported financial information by the institutions. As ailing banks' propensity to disclose accurate financial information declines and due to the fact that our dataset does not embrace the whole population of financial institutions, we conclude that the reported results may underestimate the actual condition of the German financial system. Future research is therefore required to analyse the remaining pillar of private commercial banks and the potential for the exposure to systemic risk in Germany. In addition, a formal off-site surveillance framework that takes account of the macroeconomic setting appears necessary. Furthermore, the current practice of restructuring impaired institutions calls for extended research as to whether improved guidelines for prompt corrective action can be established.

Notes

[1] The Bundesaufsichtsamt für das Kreditwesen, BAKred, (Federal Banking Supervisory Office), was the prime regulator for the banking industry until 2002. The BAKred was merged with the respective regulators for the securities and insurance industry in May 2002 to form the Bundesanstalt für Finanzdienstleistungsaufsicht, BaFin, (Federal Financial Services Supervisory Agency), the prime regulator for the three areas of banking, securities and insurance supervision.

[2] This figure includes Landesbanken and the apex institutions of the co-operative credit institutions.

[3] Auditors are required by law to state the result of their annual review of accounts in a certification notation as laid out by Article 322 Section 1 of the German Commercial Code (2004). There exists no straightforward English equivalent for the German expressions “eingeschränkter Bestätigungsvermerk” or “ergänzter Bestätigungsvermerk”. We translate these terms as qualified or amended certification notation. The guidelines for the application of certification notations are laid out in Article 322 Section 2 of the German Commercial Code (2004).

[4] CAMEL stands for Capital Adequacy, Asset Quality, Management Quality, Earnings Performance and Liquidity. It is a commonly used tool by regulators to assess the financial condition of a financial institution during on-site examinations. The CAMEL score ranges from 1 (best) to 5 (worst), where banks with a score of 1 or 2 are deemed satisfactory. A score between 3 and 5 implies the necessity of increased supervision where scores of 3 and 4 point at close

monitoring by the regulator, whereas a composite score of 5 indicates a high probability of failure (Heffernan, 1996).

[5] The results for the analyses for each pillar can be obtained from the authors upon request.

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Table 1
Number of banks in Germany

Bank Type	1998	%	2003	%	Δ %
Savings Banks[a]	607	19.1	502	22.3	-17.3
Co-operative Banks	2,253	70.7	1,396	61.9	-38.0
Private Commercial Banks	323	10.2	356	15.8	10.2
Total	**3,183**	**100**	**2,254**	**100**	**-29.2**

Notes: [a] includes 13 Landesbanken Source: Deutsche Bundesbank (2000, 2004a)

Table 2
Sample composition by pillar

	Savings Banks	Co-operative Banks	Total Number of Banks
Initial Sample			
Sound	286	233	519
Problem	15	81	96
Number of Banks	301	314	615
Training Sample[a]			
Sound	242	194	436
Problem	8	56	64
Number of Banks	250	250	500
Holdout Sample			
Sound	44	39	83
Problem	6	11	17
Number of Banks	50	50	100

Notes: [a] We run the estimation procedures for the training sample with 500 institutions as 15 *problem banks* had to be deleted from the initial sample due to data availability constraints regarding independent variables of six institutions and due to the fact that no problem date could be assigned to nine institutions. The 17 institutions that became *problem banks* in 2002 are held back for the holdout sample.

Table 3
Univariate test for the equality of means between savings and co-operative banks

Univariate test includes 250 co-operative and 250 savings banks. Calculations are based on variables as at year end 1998. The third and the fourth column report the means for the variables $X_1 - X_{10}$ for the respective group of institutions. The fifth column presents the *t*-ratios associated with the null hypothesis that the means for the respective variables $X_1 - X_{10}$ are equal between the two types of banks.

X_j	Variable Description	Univariate Test of Equality of Means by bank type		
		Co-operative Banks	Savings Banks	t-Ratio
X_1	Capital/total assets	4.9583	4.2998	7.5165***
X_2	Loan growth	0.0853	0.0576	2.75318***
X_3	Loan loss provisions/total assets	0.4101	0.3535	1.6786*
X_4	Management Quality: Interaction term of X_2 and X_3	0.0315	0.0182	1.8946*
X_5	Recurring Earning Power	1.0306	1.1033	-2.0373**
X_6	Cost-income ratio	71.9263	68.4508	3.9701***
X_7	Liquid Assets/Customer and Short Term Funding	23.9303	30.9664	-6.8574***
X_8	Due to banks/total assets	13.2945	19.9450	-10.8321***
X_9	Interest income/total income	1224.0710	1481.1291	-2.1860**
X_{10}	*Log* of total assets	12.4464	13.9112	-18.5401***

Notes: The asterisks indicate whether the means of the variables of co-operatives and savings banks are statistically different from each other at the 90 (*), 95(**) or 99 (***) percent confidence levels.

Table 4
Univariate test for the equality of means between sound and problem banks

Univariate test includes 436 sound and 64 *problem banks*. Calculations are based on variables as at year end 1998. The third and the fourth column report the means for the variables $X_1 - X_{10}$ for the sound and the *problem institutions*. The fifth column presents the *t*-ratios associated with the null hypothesis that the means for the respective variables $X_1 - X_{10}$ are equal between the two groups of institutions.

X_j	Variable Description	Univariate Test of Equality of Means by bank condition		
		Sound Banks	**Problem Banks**	**t-Ratio**
X_1	Capital/total assets	4.5520	4.6081	-0.4075
X_2	Loan growth	0.0682	0.0822	-0.5498
X_3	Loan loss provisions/total assets	0.3412	0.6603	-3.8307***
X_4	Management Quality: Interaction term of X_2 and X_3	0.0201	0.0570	-1.5150
X_5	Recurring Earning Power	1.1150	0.7313	5.3667***
X_6	Cost-income ratio	68.8469	79.0767	-8.2329***
X_7	Liquid Assets/Customer and Short Term Funding	28.1054	23.6147	2.8069***
X_8	Due to banks/total assets	16.7640	16.2726	0.5541
X_9	Interest income/total income	1279.3798	1907.1114	-2.5642**
X_{10}	*Log* of total assets	13.2564	12.7879	4.1226***

Notes: The asterisks indicate whether the means of the variables of sound and *problem banks* are statistically significant from each other at the 95 (**) or 99 (***) percent confidence levels.

Table 5
Empirical results for the parametric models

Maximum likelihood estimation procedures for 500 institutions of which 64 received support from the respective institution protection schemes during the period 1999 – 2001. The results are based on independent variables as at 1998. Specification I utilises financial statement information ($X_1 - X_{10}$) only whereas Specification II additionally includes dummy variables that capture bank location (X_{11}) and bank type (X_{12}). Standard errors are in parentheses.

X_j		Variable Description and Expected Sign of Coefficient	Specification I	Specification II
		Constant	-10.9097 (2.6898)	-10.6698 (2.2107)
X_1	(-)	Capital/total assets	0.0609 (0.1927)	-0.0454 (0.1406)
X_2	(+)	Loan growth	0.0017** (0.0007)	0.0012* (0.0007)
X_3	(+)	Loan loss provisions/total assets	3.7887*** (0.7035)	3.0592*** (0.7220)
X_4	(-)	Management Quality: Interaction term of X_2 and X_3	-3.7895*** (0.7037)	-3.0599*** (0.7222)
X_5	(-)	Recurring Earning Power	0.1332 (0.2861)	-0.1442*** (0.0304)
X_6	(+)	Cost-income ratio	0.1719*** (0.0246)	0.1367*** (0.0245)
X_7	(-)	Liquid Assets/Customer and Short Term Funding	-0.0405** (0.0184)	-0.0530** (0.0206)
X_8	(+)	Due to banks/total assets	0.0111 (0.0266)	0.0295 (0.0305)
X_9	(+)	Interest income/total income	-0.0008 (0.0001)	-0.0003 (0.0001)
X_{10}	(-)	*Log* of total assets	-0.03467* (0.1898)	0.0650 (0.1474)
X_{11}	(-)	Location dummy: Unity if bank is located in West Germany or zero otherwise	n/a	-1.6892*** (0.5572)
X_{12}	(-)	Bank type dummy: Unity if bank is a savings bank or zero otherwise	n/a	-2.0044*** (0.5813)
		McFadden R^2	0.3225	0.3818
		Akaike Information Criterion (AIC)	0.5624	0.5250

Notes: The asterisks indicate statistical significance at the 90 (*), 95 (**), or 99 (***) percent confidence levels. The McFadden R^2 is defined as follows: 1 – (unrestricted log likelihood function/restricted log likelihood function). The Akaike Information Criterion (AIC) is a model selection statistic whereby the model with the lowest value of the AIC is preferred.

Table 6
Robustness test

Holdout-sample results based on independent variables as at year end 1999, 2000 and 2001. The holdout sample comprises 100 co-operatives and savings banks of which 17 received support from the respective institution protection scheme in 2002. A Type I Error denotes incorrect classification of a *problem bank* as sound institution whereas a Type II Error constitutes the classification of a sound institution as *problem bank*. The figures reported in the very last row constitute the mean probability in the holdout sample for being classified as problem institution in 2002 based on independent variables as at 1999, 2000, and 2001.

	Robustness Test based on 1999 data		**Robustness Test based on 2000 data**		**Robustness Test based on 2001 data**	
Critical Level	**Type I Error in %**	**Type II Error in %**	**Type I Error in %**	**Type II Error in %**	**Type I Error in %**	**Type II Error in %**
0.950	94	0	94	0	100	0
0.900	94	0	94	1	100	0
0.850	88	0	76	1	94	1
0.800	81	1	71	1	94	5
0.750	81	1	71	4	94	9
0.700	81	1	71	5	75	11
0.650	81	2	65	6	69	11
0.600	81	2	65	6	69	12
0.550	81	4	65	9	69	15
0.500	81	7	65	12	63	18
0.450	81	7	59	14	56	21
0.400	81	7	53	17	56	21
0.350	75	7	53	17	56	24
0.300	75	10	47	21	44	28
0.250	69	12	47	25	44	32
0.200	63	14	29	27	38	37
0.150	63	16	29	32	31	43
0.100	56	16	29	42	25	48
0.050	31	32	24	53	13	67
0.010	13	64	12	91	13	93
0.005	13	73	6	96	13	100
0.001	6	94	6	100	n/a	n/a
< 0.001	0	100	n/a	n/a	n/a	n/a
	Mean Probability for Classification as Problem Bank based on 1999 data		Mean Probability for Classification as Problem Bank based on 2000 data		Mean Probability for Classification as Problem Bank based on 2001 data	
	0.1144		0.2135		0.2610	

Notes: Equation for robustness tests:
$P(y=1) = -9.67832118 + 0.00129029\ X_2 + 3.07915620\ X_3 - 3.07983265\ X_4 - 0.09154643\ X_5 + 0.13680952\ X_6 - 0.05564967\ X_7 - 1.69428003\ X_{11} - 1.76224111 X_{12}$

Figure 1
Trade off between Type I and Type II Errors over different critical levels

The plot illustrates the achieved trade off between Type I and Type II Errors using the results of our validation exercise based on 100 institutions of which 17 received support from the institution protection schemes in 2002. A diagonal line in the plot from 100 percent Type I Error on the Y-axis to 100 percent Type II Error on the X-axis would represent results that are not better than chance. The arrows indicate the trade off for the years 1999, 2000 and 2001 for the critical levels of 10 and 5 percent respectively.